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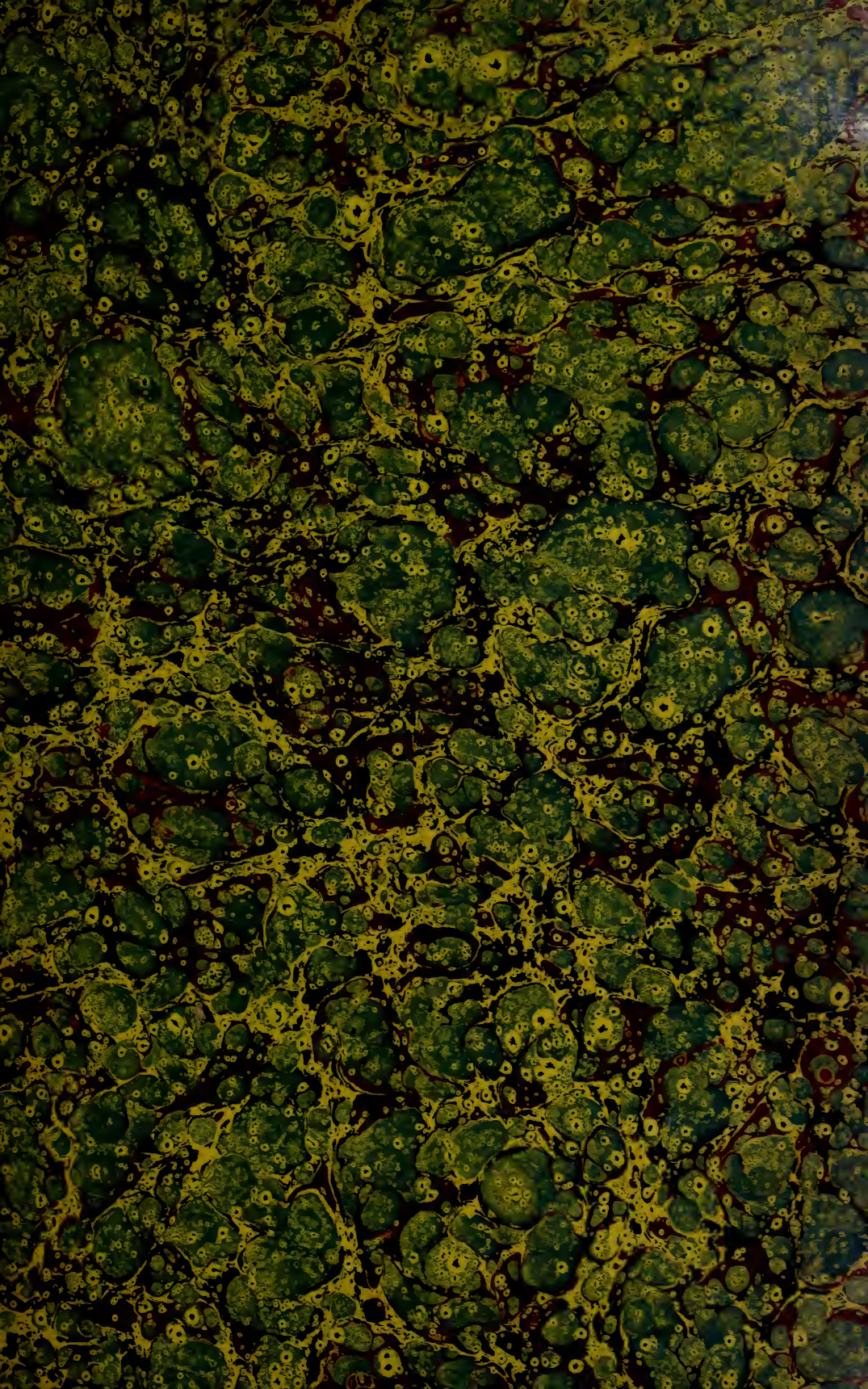
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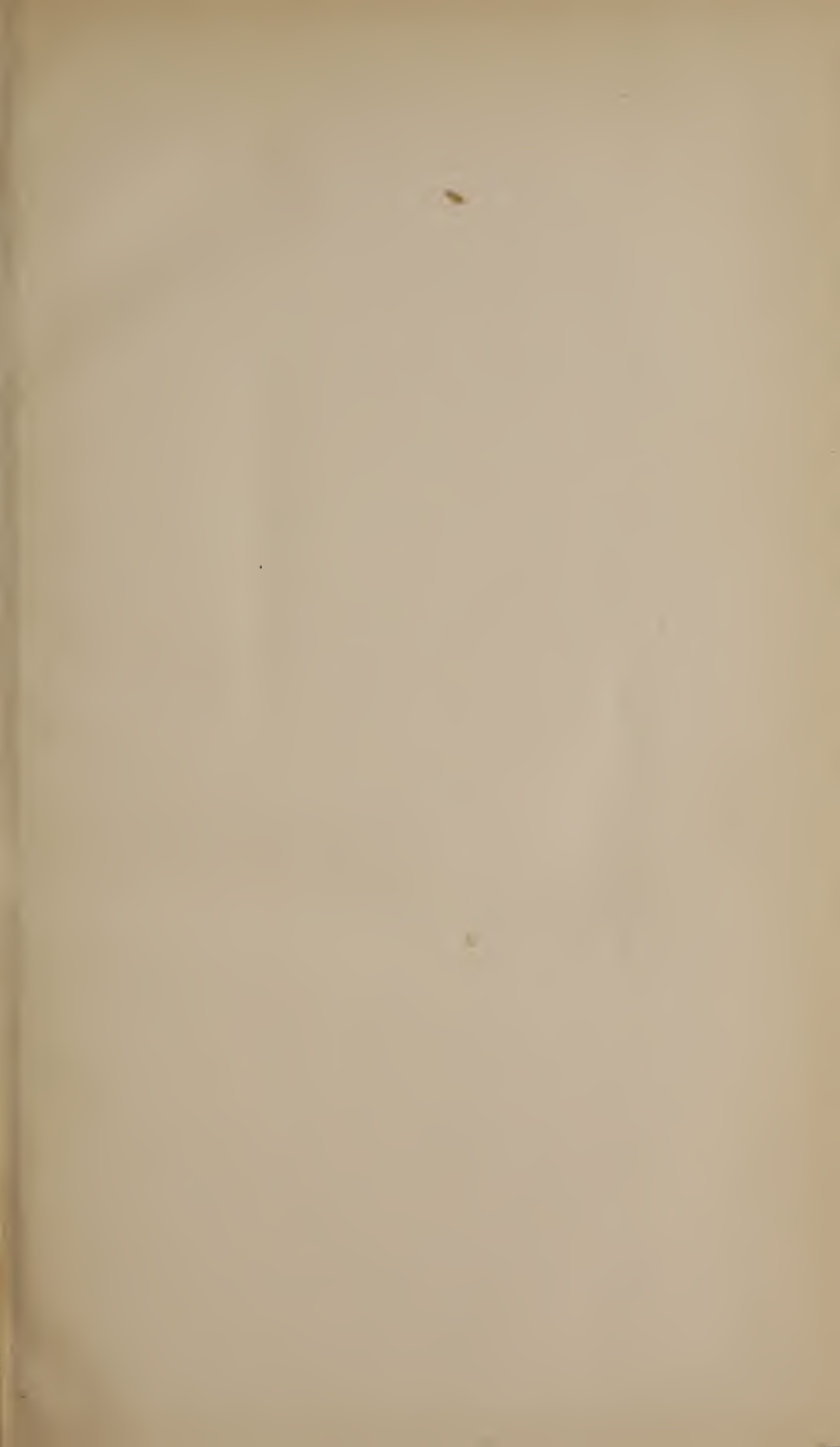
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BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

New Series. Vol. III.

KINGSTON, JAMAICA :
GOVERNMENT PRINTING OFFICE, 79, DUKE STREET.

1896.

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CONTENTS:

Rum Aroma : III.	-	- PAGE 1
Notes on the Orange	-	7
Coccidæ or Scale Insects : VIII.	-	8
Insecticides	-	10
Grants for Agricultural Education	-	13
Notes on curing Cocoa	-	15
Notes on Kola	-	16
Orris Root	-	18
Wild Lime	-	18
Ornamental Plants	-	19
Eucalyptus Oil in Yellow Fever	-	19
Ferns : Synoptical List.—XXXII	-	20
Castleton Gardens	-	22
Contributions to the Department	-	23

P R I C E—Threepence.

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

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JAMAICA.

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BOTANICAL DEPARTMENT.

New Series.]

JANUARY, 1896.

Vol. III.
Part I.

CONTRIBUTION TO THE STUDY OF THE PRO-
DUCTION OF THE AROMA IN RUM.

By PERCIVAL H. GREG.

III.

THE OIL OF RUM AND THE ORGANIC BASES.

Every Distiller knows that rum made from pure fresh cane juice is devoid of any pronounced flavour, as compared with rum made from skimmings, molasses and dunder. It is also generally asserted that rum can only be made from juice, or the residue of juice, which has gone through the process of sugar boiling; though what particular part of that process it is which constitutes the deciding influence is not known.

My experiments lead me to conclude that it is *the heating of the juice with lime* which is the essential part of that process.

I have already shewn in the Bulletin for September, the part which I believe the treatment of the juice with lime to play in the production of the fruity acid in rum; though it is probable that the nature of the influence is different to that which I suggested in article No. 2 of this series. Experiments which are not yet completed, seem to indicate that the fruity acid is an oxidation product of the essential oil; at any rate observations extended over a considerable period, shew that the fruity acid in samples of cane juice which have been treated with alkali and then sterilised increases considerably on standing exposed to sterilised air. This change whatever may be the nature of it, takes place in alkaline as well as in acid solutions, though in the former case the change is of course not discernible, until the liquid has been acidified. The influence of the lime in that case is antecedent, partial, and indirect, but lime also exercises a direct and complete influence on the aroma, in setting free the essential oil of Rum.

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The way to prove this, when once this has been discovered, is very simple; since if we take and extract by a suitable solvent for this oil, and chloroform answers this purpose the best, a sample of cane juice which has been divided into three parts, of which No. I, is extracted without any previous treatment, No. II, after it has been boiled *without* lime, and No. III after it has been boiled *with* lime; and if we find on the evaporation of the chloroform solutions from these portions, that fractions I and II, leave no aromatic residue, but that fraction III *does*, we have proof positive that the action of lime, or caustic alkali, is necessary for the production of these aromatic residues. This has been the method employed in these investigations.

The considerations which led to this discovery were:—

1. The use of alkali in enabling No. 18 yeast to produce its characteristic aroma.
2. The failure to extract any aromatic oils from untreated cane juice, or from rum made entirely from such cane juice.
3. The discovery of this essential oil in Rum made in the ordinary manner.
4. That the treatment of the juice with lime, is the only strictly chemical treatment, to which the juice on the majority of estates in this country is subjected.

The odour of this essential oil may be best described by calling it *the* essential oil of Rum, since it has a peculiar and indescribable smell of rum, and, without doubt, it is to the presence in it of this oil, that rum owes its characteristic aroma; an aroma which is so utterly different to that of any other spirit. It is of an oily nature, and a small quantity will remain for a considerable time in a glass exposed to the air without entirely losing its strength; and I should say therefore that it is to this property that rum owes its oiliness, “body” and *permanency* of aroma which distinguishes genuine rum from any artificial imitation. After having been set free by caustic alkali from its combination in a natural state, it does not appear to be further acted upon by alkalis or dilute H_2SO_4 ; but strong H_2SO_4 seems to dissolve it with formation of a faint pink colour, which may be due to carbonization. It is readily soluble in chloroform, alcohol, and water. If a portion of cane juice, containing this oil, be filtered absolutely brilliant, the quantity of oil which can be extracted does not appear to have been lessened by filtration. Of course, this does not dispose of the objection that it might be found floating at the top, or forming a layer at the bottom of the liquid, in the form of an oil insoluble and lighter or heavier than the liquid with which it was associated; but, on carefully scrutinizing the filtrate, I have not been able to observe any such phenomenon. It is true that if we take a sample of cane juice, heat it with lime, and then let it settle and absorb air in some deep and narrow vessel, a Nessler’s reagent glass or test-tube for instance, that a band of darker colour may be observed at the top on cooling, but this is due to oxidation, probably of glucose compounds, and, on shaking the tube, the dark brown band at the top mixes easily with the lower portion of the liquid. It is also true that a waxy film may be observed floating on the top of such liquor, but it possesses merely a wax-like aroma, and is probably palmitic acid. That

there is a large amount of wax in cane juice has been known for a long time, and palmitic acid has been found in rum.* It would appear, therefore, that in the process of manufacture a considerable portion of this aromatic oil will be lost, since being soluble in water it cannot be separated by the preliminary clarification process in the cyphons, but must pass from thence into the coppers, where a good deal of it will be dissipated in the form of vapour. To a certain extent no doubt as the liquor gets concentrated by ebullition, and the essential oil has less water for its solution, and as the density of the liquor increases, it may rise to the top in an insoluble form, in which it can be skimmed off. But on these points further investigation is necessary.

Its boiling point appears to be comparatively high. It comes over from the still in the later runnings and can be extracted from dunder in considerable quantity, and I *have* succeeded in extracting in small quantity from molasses. The fact of its boiling point being high and that it can be extracted from dunder, shews us at once that we do not obtain by our distillation process, so much of this oil in our rum as we might do. It seems also to indicate that the use of patent continuous stills with high rectifying columns, would certainly be attended with a minimisation of the aroma of the rum in so far as this was due to the essential oil; and it suggests to us as to whether or no this may not be the reason as to why a low still head produces a better rum than a very high one—this seeming to be a pretty general opinion among Planters. If this should prove to be the case, it would seem as if the addition of an extra retort filled with cane juice, which had been properly treated for the production of the essential oil, through which the alcoholic vapours would have to pass, would be a distinct advantage: though certainly care would have to be taken that the lime was not present in excess, as this would lead to a decomposing of the “fruit ethers” which might come over with the alcoholic vapours. It is interesting to note that something of this sort appears to be done in some parts of the colony though instead of lime, common salt appears to be used.

What was said in a previous paper concerning the possibility of the existence of different “fruity acids” in different canes and in different soils, applies equally to this oil of rum. But here again a chemical examination of juice from different sources alone can decide. I am inclined to think however, after having examined rums from different estates and from different parishes, that, with the exception perhaps of the “new leather” smell, which may be caused by the presence in the rum of some single substance possessing that aroma, and which is not found in other rums, that variation is more to be sought for in the quantity in which this oil is present than that different soils each possess a characteristically different essential oil. Turning to the results obtained in the examination of samples of juice taken at different times from the mill from the *same* estate, I have been surprised by the marked differences exhibited in the quantity of this oil present. In very many cases it does not appear to be present at all. So far the samples have been taken at random from the mill without any attention having been paid as to the soil on which the canes yielding such juice were grown, or as to the nature of the cane whether plant or rat-

* Mulder. Jahresbericht für Chemie, 1858, p. 302.

toon. But having once established these two important facts, viz., the necessity of heating with temper lime or fixed caustic alkali to set this essential oil free, and that the amount in which it is present varies so widely, we are now in a position to carry on a systematic examination of cane juice from different soils with a view to ascertain what is the determining cause of such variations; while it is evident that until such variations had been proved to occur, that any investigation in this direction could not be undertaken. It may be a matter of surprise to some, that if such variations do occur, that a greater variation in the quality of the rum from the same estate is not noticed. But the truth is that from the nature of our manufacturing process such changes in the character of the juice and the rum manufactured from it, must to a great extent remain hidden from us. In the parish of Westmoreland at any rate, it is the custom to mix and grind the canes from different fields simultaneously, so that the liquor, which finds its way to the still-house, is in no sense a representative sample of any particular cane piece, and the same may be said of the molasses. Coming to the still-house, we not only use the liquor of a previous setting, *i.e.*, the dunder, but many estates preserve their dunder from crop to crop; and in so far as concerns the distillation, not only is a double still frequently used, but also a retort containing a charge from the previous distillation, while, finally, the liquor is stored in butts of large capacity before racking into the puncheons. Yet, in spite of all this, anyone who watches the rum carefully, cannot fail to notice variations, and it is notorious that a difference in the quality of the shipments, from the same estate, is often commented on in England.

THE ORGANIC BASES.

But the treatment of the juice with lime also finds expression in the aroma and taste of the rum, in a distinctly *unfavourable* manner. It is owing to this that the organic bases or bodies of an alkaloidal nature are set free and are found in that state in the rum. A sample of rum shaken up with chloroform left behind, in addition to the essential oil, a vile smelling residue, the smell of which completely hid that of the essential oil, and resembled almost exactly the smell and taste of the dark brown liquid which may be found in the stem of a foul tobacco pipe. There seems very little doubt that this must be due to the presence in the rum of some organic base of the pyridene group, and last crop I succeeded in producing the same smell in cane juice by heating it with excess of caustic lime. During this crop, curious to relate, I have not been able to detect it in the samples of cane juice which I have up to now examined, but it must be understood that no systematic search for it has been carried out. But I have never yet failed to detect the presence in large quantity of some kind of bases or alkaloidal bodies in cane juice which I have heated with excess of lime, and I have so far never yet failed to detect them in greater or less quantity in Jamaica rum. The influence of these bases on the rum is to make it dry and harsh, and I should say, judging from personal experience, that the action of rum on the human system containing these bases in any appreciable quantity is not beneficial. There seems very little reason to doubt, that it is the presence of these bodies which renders new rum almost undrinkable. Anyone who has had an opportunity of smelling

these vile compounds, when isolated from the more agreeable smelling constituents of rum, could hardly be in doubt as to the desirability of doing away with them if possible. But can this be done? There seems to me no doubt that it can.

If cane juice be tempered with gradually increasing quantities of alkali, starting say from an amount sufficient to produce neutrality, it will be found that these vile smelling substances can only be extracted when *a considerable excess of alkali* has been used, and that by using moderate quantities of alkali it is quite possible to set free the essential oil of rum, without setting free these vile smelling bases. It will thus be seen that the tempering of the liquor is of great importance, not only to the process of sugar boiling but also to the manufacture of rum. As a result of my experiments in this direction I am able to say, that whenever the liquor is tempered until it becomes of a deep fiery orange to a ruby red colour, that there is danger of these organic bases having been set free.

It would appear then that a moderation in tempering is an essential point in the preparation of a good *drinking* rum, inasmuch as it would tend to furnish a rum of a mild, soft character, devoid of that dryness and harshness due to the presence of these organic bases, and thus fitter for immediate consumption: though whether this would equally hold good in the case of German Rum, in which I believe as much "flavour" as possible is desired, may remain a disputed point. On the other hand, on estates with heavy badly drained clay soils, rather heavy liming is, I believe, found to be necessary, which probably stands in intimate connection with the destruction of the glucose, which would be found in larger quantity in canes grown on lands where all the conditions necessary to the thorough ripening of the cane were not present. Besides the effect on the flavour, these organic bases have a very disastrous effect on the fermentation. As the result of a large number of fermentation experiments, performed with No. 18 yeast, I have found this to be invariably the case, and this enables us to make a shrewd guess as to what would be the effect of such bases on the human system.

The yeast is in fact poisoned. The amount of lime then used in the tempering of the liquor may not only have an effect on the flavour of the rum, but also on the progress of the fermentation, and it does not seem at all improbable that some of the disasters of the Still House may be due to the treatment of the juice in the Boiling House. I hope, however, at some future time to be able to furnish some more definite and interesting information on this point.

Lime therefore exercises a potent influence both for good and evil. Thus *indirectly*, it sets free the fruity acid. While *directly* it sets free—

- (1). The essential oil of rum.
- (2). Various kinds of organic bases or alkaloidal bodies.

As regards the nature of the chemical reactions which take place, it seems to me that we can pretty well infer it from the nature of the reagent used, and of the substances set free. The only reactions which *can* take place, as far as I am aware are those of hydration and interchange of lime for the volatile organic bases or alkaloids combined with acids. In tempering cane juice, which for this experiment may be most con-

veniently performed by an easily soluble fixed alkali, such as caustic soda, it will be found, if the alkali, be used with caution, that a gradual disappearance of the fixed alkali takes place as the heating progresses. In this respect it is instructive to compare the behaviour of the two indicators phenol-phthalein and litmus; the former shewing us the gradual disappearance of the fixed alkali, while from the behaviour of the latter, we should imagine that the fixed alkali was still present in excess. That this is not so can also be proved by distilling the liquor, when the distillate will be found to behave exactly the same towards the two indicators, blueing litmus and having no effect on phenol-phthalein—due of course to the setting free of volatile organic bases; which have no effect on phenol-phthalein: it need hardly be said that this is not due to the liberation of ammonia. But whatever conclusions may be ultimately arrived at as to the exact nature of the chemical changes, and as to the nature of the products of such decompositions, it will not I think be denied by anyone who carefully goes into the matter that the tempering of the liquor in the Boiling House has a very decided influence on the aroma of the Rum. No one who examines the residues which result from the chloroform and ether extractions of cane juice, before and after the treatment with lime, can have a doubt of this while an examination of almost any rum, which has been manufactured in this country, using the aforementioned solvents, will enable him to discover the same smelling substances which can be extracted from treated cane juice. It is not of course contended that the whole of the aroma of Rum is due to this cause, but I do not hesitate to say that directly and indirectly a very considerable part of it is. And moreover in breaking fresh ground, as I believe I am in these researches, it was considered more important to attempt to localise the chief points of interest and to ascertain the *actual facts* of the case, rather than to dwell on the theoretical side of the question, which becomes of importance only in relation to facts. These researches too were commenced in the first instance with one object in view, viz to elucidate the nature of the action of No. 18 yeast in producing its characteristic aroma. I very soon found that I was working in the dark on this very interesting question, and it is only now on having learnt the nature and the result of the action of temper lime on cane juice, that I am encouraged to believe that I have found the solution of this previously difficult problem. But of this more anon. It is obvious however that even the practical side of the question is far from being exhausted, and an ever broadening field of investigation is opened up. If one may be allowed to theorize a little, there seems sufficient grounds for concluding, from the results which I have up to now attained, that though the aroma of rum is in the first instance derived from the soil, that this influence is chiefly potential not actual; that it is latent, dormant, and only brought into existence during the process of manufacture. If this should prove to be the case, it would seem to hold out a hope that much may be done to improve our rums both for the home trade in England and for export to Germany; and to imply a rebuke against manufacturing with folded hands—"it's the soil that does it."

NOTES ON THE ORANGE.

PRUNING.

The operation of pruning a full-grown Orange tree is best done as soon as the fruit is picked, and before the tree is in full blossom.

All dead and diseased wood should be cut out. The cut should be made, if possible, just into the living healthy wood, so that no canker be left. Branches which rub against each other should also be removed.

The head of the Orange tree should be encouraged to grow open, so as to allow light and air free access, otherwise moss, lichens, and other injurious growths accumulate on the stem and branches.

An open head also encourages the extension of the lower branches, so that the tree can produce more fruit. The small inner branches are of no use, as they produce no fruit, and steal away the sap from the fertile terminal branches.

"Gormandisers" should be cut off as soon as they appear, unless they are required to fill up vacant spaces, or to shelter the lower part of the stem. In these cases they require bending carefully into the proper positions, and tying down to stakes.

Any branches which actually touch the ground should be trimmed or removed.

It is well to commence pruning while the plants are still young, 2 or 3 years old, as it is much more easy to get the tree to grow into proper shape, and it is possible then, to shorten the branches without injury.

The tools necessary for pruning are a knife, a small saw, and a pair of shears—a cutlass should not be allowed under any pretence. The instruments should be kept very sharp, as a clean cut heals quickly, and a jagged one may only do harm by starting canker. The saw is used in removing large branches. The knife can then be applied to make the saw cut smooth; it is also used in removing small branches. The shears may be used for removing dead wood, thorns, and some of the smaller branches.

GREEN DRESSING.

Dr. Grabham writes as follows:—

"Now that Orange cultivation is so much to the front, I intended to have mentioned to you how useful the employment of a green dressing had proved in the plantations in the Azores and Madeira.

"The plants most commonly used are the Lupine which is allowed to grow under the trees, and then dug into the ground; and the Broom (*Sarothamnus scoparius*) branches of which cut off are buried in the ground."

Lupines grow remarkably well in Jamaica, and are a weed in some coffee estates in the Blue Mountains. The flowers are very ornamental, and it is doubtful whether any native plant would answer the purpose better.

The advantage of green dressing with lupines is that they will supply nitrogen from the air to the soil (see "Assimilation of Nitrogen by plants" in Bulletin for August, 1895); and will also serve the purpose of humus in the soil which not only also provides nitrogen, but assists in the preparation of the soil as plant food.

COCCIDÆ OR SCALE INSECTS.—VIII.

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

Genus *Asterolecanium*; the Fringed scales.

Small round, oval or elongated scales, with a microscopical fringe of fine threads. This includes the genus *Planchonia*, which does not sufficiently differ from *Asterolecanium*.

(43) *Asterolecanium pustulans*, Ckll. (The Akee Fringed-scale.)

Diagnosis.—Small round scales, about the size and shape of a pin's head, greenish yellow with a pink fringe. They look like little pustules, and are found, not on the leaves, but on the twigs and stems of plants infested. Sometimes they are on the leaf-stalks.

Distribution.—Common in Jamaica; also found in British Guiana, Montserrat, Grenada, Antigua, Anguilla, Brazil, Mexico, Florida and the Sandwich Is.

Food-plants.—In Kingston, Jamaica, any one may find it by searching on the akee trees. It also infests oleander, pigeon-peas, custard-apple, mango and other plants. Mr. Barber (*Insect Life*, vi., p. 51) reports it as on perillea—which is, I suppose, a misprint for *Fevillea*. In Grenada, Mr. W. E. Broadway has found it in the Botanic Gardens on *Leucæna glauca*.

Destructiveness.—It is quite a pernicious species, especially on oleander.
Enemies.—It has a Chalcidid parasite in Montserrat.

(44.) *Asterolecanium oncidii*, Ckll. (The orchid Fringed-scale.)

Diagnosis.—Like the last but a little smaller, and bright yellow. Found on leaves.

Distribution.—Common in Jamaica; also found in Trinidad, by Mr. Hart. In Europe, Targioni-Tozzetti has found it on hot-house orchids, and indentified it, I believe erroneously, with *A. aureum*.

Food-plants.—On orchids only, found on the leaves. Targioni-Tozzetti found it on *Oncidium*; Mr. Hart on *Epidendrum*. In Jamaica, Dr. Henderson found it on *Oncidium tetrapetalum* and *Angræcum sesquipedale*, while I found it on *Broughtonia sanguinea*.

Destructiveness.—Likely to be troublesome on choice orchids.

Remarks.—It is probable that the "*Lecanium*" *epidendri* of Bouché is identified with this, but Bouché's description is very short. If the identity be assumed, *epidendri* has long priority.

(45) *Asterolecanium aureum*, Boisd. (The golden Fringed-scale.)

Diagnosis.—Similar to the last but rather larger, the outline more oval also rather flatter. Fringe seeming to consist of comparatively few broad rays, but this is due to several of the minute threads adhering together. On leaves, not of orchid.

Distribution.—Found in a European hothouse. Mr. Hart sends me what I believe to be the same species from the Botanical Gardens, Trinidad.

Food-plants.—Originally on *Maranta vittata*, more correctly called *Calathea vittata*, Koern. a plant of which the native habitat appears to be

unknown. Mr. Hart's specimens are labelled as from *Zamia* but the leaves seem to me to belong to some Amaryllidaceous plant.

Destructiveness.—It occurs scattered on the leaves and is probably not very injurious.

(46.) *Asterolecanium bambusæ*, Boisd. (The Bamboo Fringed-scale.)

Diagnosis.—Larger than the other species, oval in outline, pale, greenish or greyish, with one end darkened by the body of the insect showing through the scale.

Distribution.—Found at Moneague and Kingston, Jamaica. Messrs. Urich and Lunt have found it in Trinidad. It is found on cultivated bamboo in Algeria, and Mr. E. E. Green has discovered it in Ceylon.

Food-plants.—Only on bamboos, on the stems of which it is often very abundant.

Destructiveness.—It must do some injury, but the bamboos are very vigorous growers.

(47.) *Asterolecanium miliaris*, Boisd. (The Flask-shaped Fringed-scale.)

Diagnosis.—Smaller and narrower than the last, with the hind end constricted like the neck of a flask.

Distribution.—I did not find it in Jamaica, but Mr. Campbell detected it at Castleton Gardens after I had left the Island. It appears to be quite abundant in Trinidad. It was originally found on cultivated bamboos in Algeria, like the last.

Food-plants.—Only on bamboos, on the stems and leaves.

Destructiveness.—Doubtless injurious when abundant. It sometimes covers the stems.

(48.) *Asterolecanium palmæ*, Ckll. (The Coco-nut Fringed-scale.)

Diagnosis.—Very small and narrow, lemon-yellow. It is approximately boat-shaped in outline.

Distribution.—Only known from near Montego Bay, Jamaica, where it was found by Dr. Sinclair.

Food-plants.—On leaves of coco-nut palm only.

Destructiveness.—Does no appreciable harm.

(49.) *Asterolecanium urichi*, Ckll. (Urich's Fringed-scale.)

Diagnosis.—Very small, elongate-oval, brownish, fringe reddish. Not so narrow as *palmæ*, and not narrowed posteriorly like *miliaris*.

Distribution.—Only known from Port-of-Spain, Trinidad, where it was discovered by Mr. Urich.

Food-plants.—On palms.

Destructiveness.—Not complained of as injurious.

Genus *Orthezia*; the Lamellated scales.

These look something like mealy-bugs, but possess curious lamellar formations of white secretion. Their ovisacs are white, and extend a considerable distance behind the bodies of the females, which retain the power of movement to the last. The males have a tuft of fine threads at the end of the abdomen.

(50.) *Orthezia insignis*, Douglas. (The semi-nude Lamellated scale.)

Diagnosis.—The back is dark-colored (greenish to black), and has down the middle two lines of white secretion, which diverge, leaving a space,

about the centre. The sides are fringed with white lamellæ, and the ovisac is longitudinally grooved.

Distribution.—Common in Jamaica. Found also in Trinidad, British Guiana, and Mexico; likewise in Ceylon, and on hothouse plants in England and the United States.

Food-plants.—Very various, *Strobilanthes*, potato, *Citrus* trees, verberna, mint, *Chrysanthemum*, violets, *Myosotis*, *Lantana*, *Eupatorium*, *Coleus*, &c.

Destructiveness.—A very pernicious species in hothouses both in England and the United States, especially upon *Coleus*. Out-of-doors in warm countries it is also quite a pest, notably on *Citrus*-trees in Trinidad (Hart) and Mexico (Townsend.)

Remarks.—A detailed account of this insect, by Mr. C. P. Lounsbury, will be found in the 32nd Annual Report of the Massachusetts's Agricultural College.

(51.) *Orthezia prælonga*, Douglas. (The Horned Lamellated scale.)

Diagnosis.—The back is almost entirely covered by white secretion, two thick processes of which project over the head, like horns. The ovisac is longitudinally ribbed or grooved.

Distribution.—British Guiana, Trinidad, and Jamaica.

Food-plants.—*Capsicum*, *Sanchezia*, and *Croton*.

Destructiveness.—Mr. Hart sends it from the Trinidad Botanic Gardens in enormous numbers on *Croton*; it must be very troublesome when so abundant.

INSECTICIDES.*

By J. E. DUERDEN, Curator of Museum, Jamaica Institute.

THE ARSENITES—PARIS GREEN AND LONDON PURPLE.

There is little difference in these two insecticides, the former being arsenite of copper and the latter arsenite of lime. The London purple is lighter in weight, mixes more easily with water, but burns the foliage more readily than Paris Green.

A. As a Dust.—The Arsenites are often used in the dry form with lime, plaster, or flour. The best rule as to the proportion in which to use them is to combine them so that only a very faint green or purple tint will be seen in the mixture. This makes a proportion of 1 part of arsenite to 100 or 150 of powder.

B. As a Spray.—Take one pound of Paris Green or London Purple to 200 gallons of water; or 3 ounces of either to every 40 gallon barrel, is not apt to burn the foliage and proves effectual on leaf-eating insects. Occasionally unaccountable injury will occur, and it is always safest to use a little milk of lime in the spraying mixture. A pound or two of the lime, freshly slaked, to each barrel of the mixture is sufficient. It should be considerably diluted and allowed to settle, or else strained into the barrel through some coarse cloth, before using, or the dirt and impurities will clog the pump and nozzle in spraying. This lime forms a chemical combination with the soluble arsenic and makes it insoluble. In this condition it kills insects as readily as the soluble arsenic, but does not prove harmful to plant life.

* For many of these notes and formulæ I am indebted to Bulletin 121, of the Michigan Agricultural Experiment Station.

WHITE ARSENIC.

A. As a Spray:—Boil for 20 minutes in two gallons of water one pound of white arsenic, and two pounds of lime which has been carefully slaked. Smaller but similar proportions may, of course, be used. A light white precipitate will gradually form. White arsenic dissolves slowly even in boiling water, but the lime unites with it as it dissolves and takes it out of solution, so that a small amount of water will answer for the purpose. The white precipitate formed is arsenite of lime, which is practically the same as London purple without the colouring matter. This is nearly insoluble, and as in the case of London purple and Paris green, the lime used with it prevents injury to the foliage. If desired the water can be poured off and the precipitate can be kept for future use. Before using the arsenic, dilute to 400 gallons. There will be no danger of burning the foliage if the boiling is kept up until all the arsenic is dissolved and rendered insoluble by the lime, but if this is not done it will be likely to do injury. Until one has had experience in making the solution it will be well to test the material upon a small scale.

B. As a Lime-Wash:—Mix the precipitate of arsenite of lime obtained as above, in the proportion of 1 part of arsenite of lime to 100 parts of lime-wash. This is becoming an important preparation as a means of protection against borers. After removing all the dead loose bark white-wash the trunks of the trees. It kills the young borer in attempting to eat through the outer bark.

White arsenic mixed with lime in the proportion of one part of arsenic to one hundred parts of lime can be used on the trunks of trees without boiling. The wash should be quite thick with lime, and wood ashes or some of the alkalies may be added.

A little pure arsenic added to the nests of ants is generally sufficient to lead to the death of the whole colony.

KEROSENE EMULSION.

This is a common and well-known remedy for soft-bodied insects that do not feed by chewing, but suck the sap instead. The emulsion is cheap, simple, and effectual. It is made of soap, kerosene, and water.

A. Soft Soap Formula:—Heat a gallon of soft soap until it becomes liquid, then take from the fire, add two quarts of kerosene and agitate for three or five minutes so thoroughly that the soap and oil will become permanently mixed; that is, until the oil will not separate from the soap either on standing or when diluted. A hand force pump should be used in making the emulsion. Slow pumping, or stirring with a stick or spoon, will not emulsify the soap and oil.

The emulsion as made is now one-third oil, and 1 for the plants, it should be only one fifteenth oil, so it will need four times its own bulk of water before using. In other words, the gallon of soap and two quarts of oil will make seven and one-half gallons of the dilute emulsion.

If the emulsion is to be made in the above or greater quantity, it should always be made with soft soap, if that is obtainable, as the emulsion is more difficult to make by the hard soap formula where more water is required.

B. Hard Soap Formula:—To two quarts of water add one-fourth pound of hard soap, cut into thin pieces heat to the boiling point, and

when the soap is dissolved, add the pint of kerosene, and proceed as in the soft soap formula. This is one-fifth oil, and should be diluted with twice its own bulk of water before using.

CRUDE CARBOLIC ACID.

Where diluted or emulsified, this preparation has some very good insecticidal properties, and is apparently superior to the kerosene emulsion, for certain insects, especially for ants. Always use the *crude* carbolic acid as it is cheaper and quite as effectual as that which is refined.

(A.) *Carbolic Acid Emulsion*.—Take one pound of hard soap, or one quart of soft soap, dissolve in one gallon of water, into which pour one pint of *crude* carbolic acid and agitate the whole mass into an emulsion, which will remain in this condition for a long time. In treating the plants, take one part of this standard emulsion and dilute it with 30 equal parts of water; it can probably be used stronger without injury to the plants. If the emulsion is cold and semi-solid, use several parts of warm water at first.

(B.) *Carbolic Acid mixed with Soft Soap*.—In the proportion of one part of acid to sixteen of the soap, this makes a wash which has been highly recommended for all kinds of borers and for scale insects. The acid may be made into an emulsion and used as a spray, if preferred, making the emulsion not weaker than one to ten when diluted.

(C.) *When mixed with Water* at the rate of a tablespoonful of acid to two gallons of water, or at the rate of a pint to a barrel of water, and sprinkled over the plants, carbolic acid has been found to be a temporary repellent for some insects. Mixed with water in the proportion of 1 of acid to 3 of water it has been found to be very effective in Jamaica against ants in trees and in houses. Jeyes' Fluid is often used for this purpose, as it mixes readily with water.

BITTER WOOD AS AN INSECTICIDE.

"The original Quassia wood was derived from *Quassia amara*, L., a small tree of Surinam. The supply, however, fell short, and the Quassia of commerce is now almost entirely derived from the tree known as Jamaica Quassia or Bitter Wood (*Picræna excelsa*, Lindl.)

"This is a large tree 40 to 60 feet high, with a trunk sometimes attaining a diameter of one to two feet. It has pinnate leaves not unlike an ash, hence one of its colonial names, bitter ash. The flowers are small, yellowish-green in colour, followed by small black berries. . . . The wood is of a pale yellowish colour, it has no odour, but is of an intensely bitter taste. Quassia chips are officinal in the Pharmacopœias of Britain, India and the United States. They possess tonic and stomachic properties, and are valuable in dyspepsia and debility. Bitter cups (in which water allowed to stand acquires a bitter flavor) are made from Quassia wood. The active principle is Quassia or Quassite, which appears in small white crystals, very bitter and inodorous. It is present in the proportions of about $\frac{1}{10}$ per cent. Although an infusion of Quassia is harmless to human beings, it is remarkable that the drug acts as a narcotic poison to animals. It is used in what is known as *papier mouri* to destroy flies, and fruit and hop growers also use large quantities at certain times of the year to destroy aphides and so called "blights." To prepare an extract of Quassia on a large scale it is recommended to use very fine chips and boil them in

water with soft soap. A simple infusion without soap, is, however, quite as effective, and for use in green-houses the latter is preferred. Quassia water is odourless and perfectly safe to use. In these respects it is preferable to both kerosine emulsions and to tobacco water. There is always a certain amount of risk in using kerosine emulsion even in the most careful hands, and besides, the smell is specially objectionable. If more widely known, it is probable that Quassia extract for delicate plants in houses, would almost entirely take the place of tobacco water and largely also of kerosine emulsion. If sprayed regularly over the plants, it would keep them entirely free from insect pests." (*Kew Bulletin*).

GRANTS FOR AGRICULTURAL EDUCATION.

Mr. P. G. Craigie has presented to the President of the Board of Agriculture his Report on the administration of the Parliamentary grant-in-aid of agricultural education in Great Britain, during the financial year ended 31st March, 1895. As a great deal of interest is being taken in the subject in Jamaica, it may not be out of place to insert a notice of what is included under the phrase "Agricultural Education" in England. Out of the total Vote of 8,000*l.* entrusted to the Board of Agriculture for educational purposes, a sum of 7,400*l.* has been distributed in specific grants to 17 institutions. The balance has been applied to making the necessary provision for the cost of inspecting the work of the collegiate bodies or societies applying for assistance, as well as for the inspection of the educational arrangements of various County Councils, undertaken at the request of those authorities. After recounting the history of the grant, Mr. Craigie says:—"Central institutions receiving aid from the Board of Agriculture, and of the special type which seven years' experience has shown to be of practical value, are, therefore, now available, or in process of equipment, for the counties lying in the centre, south-east, and south-west of Scotland, for all those in Wales, with the exception of Glamorganshire, for the three Ridings of Yorkshire, for the counties of the North of England, and for the counties of Berks, Oxford, and Hants, in the Valley of the Thames, as well as, in a less perfect form for the East Midland and Eastern Counties of England. Some extension of the areas directly benefited by several of these institutions may yet be looked for in several instances by including in their sphere of work other contiguous counties. Other counties which have not yet the same facilities within reach may eventually find it to their interest to co-operate for the establishment of centres, either of the type which Kent and Surrey are maintaining at Wye, or such as the county of Lancaster has provided for itself. The cases are, however, rare where establishments of this nature can be economically managed by single counties, and were the system of grouping, pursued elsewhere, to be adopted by the Western and West Midland Counties, this would suffice to provide, for England at all events, the two or three additional centres still lacking to complete the organization of a uniform system of graded agricultural teaching for the entire country. Some of the leading features in which it has been found that agricultural centres are likely to prove of special value to agricultural education in all its bear-

ings are as follows:—(1) The technical training of teachers, mostly engaged in elementary schools, who are capable of giving instruction to lads in evening schools and classes (2) The provision of experts for giving courses of instruction in particular branches of practice, such as dairying, horticulture, poultry-keeping, and the like, together with convenient arrangements for the necessary supervision of the instruction so given. (3) The provision of instruction to actual farmers in those matters of a semi-scientific, semi-practical character which are now usually classified under the head of extension lectures, and which comprise such subjects as the economic use of artificial fertilisers and feeding stuffs, the methods of preventing or mitigating the attacks of injurious insects and other pests affecting farm crops, the hygiene of the farm, and the treatment of stock in health or disease. (4) The conduct of stations of field demonstration and experiment, whereby farmers are shown on their own farms the action of different manures, and are taught by means of lectures how to discriminate between them, and to choose and purchase those which are calculated to give the best return to the crops for which they are intended. (5) The provision at the college centre of such continuous courses of scientific instruction as are likely to be of educational value to the sons of farmers in the district, at a cost within the reach of the class for which they are intended. (6) The provision of means for personal intercourse between the head of the agricultural department of the local college and his staff and the farmers in the neighbourhood, so that the college may become the place to which the agriculturist of the district will naturally turn for information and assistance in every matter of a scientific character bearing in any way upon their practical work. (7) The provision in each locality, for the benefit of the local authorities, of a body of scientific experts whose services may be available, either for instruction or for consultation, at a cost much below that which an individual Council would have to pay if it were to attempt to set up an institution of similar character in its own area. This broad statement of the proper work of a collegiate centre indicates generally the aims that may be kept in view in establishing or developing institutions of this class. Notwithstanding the concentration of a large portion of the State grant on the maintenance of the centres, it is fully recognised that some time must elapse before all of these, brought into existence through the action of the Board, can fully discharge the list of potential functions above described. Developments must in every case be more or less gradual and tentative, and the precise importance attached to each section of the work will to some extent necessarily vary with the local needs of each district. In contrast with the position of matters in 1888, it must be remembered that, according to the latest returns of local educational enterprise, dairying is now being taught, in some form or other, under the County Councils of all the counties of England and Wales, except London and Middlesex. Similar instruction is given in more than half of the administrative counties of Scotland. Separate fixed schools for the more systematic teaching of dairying in addition to the institutions aided by the Board have been established, or are being projected, by various County Councils. Lectures and demonstrations on horticulture, poultry-keeping, and farriery, are now being given in many counties as part of the regular scheme of technical education and manual instruc-

tion in various processes of agriculture in others. The training of elementary school teachers, where the demand for this form of instruction still exists, is being steadily pursued, while use is being made of evening classes, or continuation school and science classes, as well as occasionally of middle class schools, to make further local provision for elementary agricultural instruction. In at least twenty counties in England and Wales demonstrations by experimental work in field plots are now undertaken, and, except in cases where the experiments are of a special class, or are organised on a general scale and for much wider areas than those of counties, it has been found in a large degree practicable, in the past two years, to relegate to the local funds, now forthcoming, the responsibility for maintaining local object lessons of this type."

NOTES ON CURING COCOA FOR SMALL SETTLERS.

By W. CRADWICK, *Superintendent of Hope Garden.*

The first important point to be observed when about to cure Cocoa is that it must be quite ripe, but not over-ripe. The pods must have attained their full colour whatever it may be, but if the beans shake about easily then the pod is over-ripe. The reason is that if the beans are not ripe, the mucilaginous matter covering the beans is not properly developed into the stage when it will readily ferment. If left to get over-ripe, the mucilage commences to liquefy.

The best vessel in which a small cultivator can ferment Cocoa is an ordinary flour barrel. To prepare this for the reception of Cocoa beans, first bore about a dozen holes, each half an inch in diameter, in the bottom of the barrel, then place about ten inches of banana trash in the bottom of the barrel. Line the sides also thickly with trash, and have a sufficient quantity on hand to cover the beans when placed in the barrel. When the barrel is ready, break the whole of the pods and place the beans in the barrel, covering with the banana trash. The beans must be left to ferment for two days, then remove one-third of the beans and lay them in a heap on the floor and mix them thoroughly. Remove the balance of the beans and mix them also, but do not put the two heaps together. After placing fresh trash in the barrel, put the beans which were at the top back into the bottom of the barrel and those which were at the bottom, place at the top. Cover with trash in the same way as before and leave for two more days, when the beans should be treated in exactly the same way as before. They should then be left for two more days, when they are to be taken out and washed thoroughly. On the day the beans are finally removed from the barrel the work should be commenced very early in the morning, so as to get all the sun possible on the first day, for the beans mildew very quickly. They should be washed immediately they are taken out of the barrel as this helps to keep them plump.

The proper amount of Cocoa to ferment in one barrel is the quantity of beans obtained from 1,000 ordinary sized pods. If many more than this number are put into one barrel, the fermentation is too great and the beans turn black.

If a less quantity, say below 700 pods, are to be fermented, the green

trash and more of it must be used, and a weight not exceeding 28lbs. placed on the top which helps the fermentation.

When the Cocoa is being dried, it is not advisable to expose it after the first two days to the extreme heat of the mid-day sun, it is better to take it in about 9 o'clock, and then put it out again between three and four o'clock. Those who use evaporators are warned against an excessively high temperature.

Great care must be taken when removing the pods from the trees that they be cut off with a good sharp knife, not pulled off. If pulled off, the little knob at the base of the stem of the pod is injured, and the tree will not bear from the same spot the following year. If the pods are cut off carefully, the tree goes on bearing from the same spot year after year.

NOTES ON KOLA OR BISSY.

CULTIVATION.

Situation.—Wherever Bananas bear fruit, Kola may be planted.

Sowing Seed—Prepare by good digging a nursery bed under the shade of trees, and near water. The bed should not be more than 3 feet broad, so that it can easily be weeded while the seedling are growing. When the bed is prepared 3 feet broad, and as long as required, make a straight narrow trench 2 inches deep down along the centre, and others at 6 inches from each side. There will thus be 3 trenches in your seed-bed one foot apart. Put the seeds in at 9 inches apart in the trenches. Draw a little soil over the seeds to cover them. Water very gently and see that the soil is kept constantly moist, but not too wet. Keep the bed quite free from weed. Take only the largest and ripest seeds for planting and plant whilst they are quite fresh.

Planting—The seedlings or suckers may be permanently planted out when they are 2 or 3 feet high; but better results will be obtained by transplanting when a foot high into another nursery bed with not so much shade, and allowed to grow another 1 or 2 feet.

If a regular plantation is to be made, they can be put out at intervals from each other of not less than 25 feet. But if they are planted anywhere, they should not be put in nearer than 13 or 14 feet to any other tree.

Holes should be dug for them some time before planting, at least a foot wide, and 18 inches deep.

Spread out the roots very carefully when planting, and fill in the soil until level with the top. Then tread it down firmly, fill in more soil, and water.

Drive in a stout stake beside each plant so that in weeding they may not be missed and cut down.

Shade is necessary for the young plants for a little time, and Banana or Plantain suckers should be planted out a few months beforehand, if there is no shade already.

HOW TO PREPARE BISSY OR KOLA NUTS FOR THE MARKET WITHOUT DRYING.

In the Report of the Department for the year ended 31st March, 1894, it was stated in a note on Kola that "it is possible that the native

method in Africa of keeping the nuts as fresh as possible is the way to get most out of them."

Mr. F. B. Kilmer, the author of a most instructive article on Kola in the *Bulletin* for last May, has been for some time studying the nut, its chemical constituents, and the best way of sending it to the market, and has at length come to the conclusion that it is better not to dry the nuts at all, but send them, when quite ripe, as fresh as possible for export. He has kindly furnished the directions given below. As the method is so simple, the export ought in time to rival that of Bananas.

"The proper time to gather the nuts is when the pods begin to break open or when the fruit is full and beginning to ripen. The pods may be shaken or broken from the tree. They may then be prepared for the market in two ways: either *by taking pod and all just as it comes from the tree and carrying to the market without drying*, or the nuts may be removed from the pods and the yellow fibre husks or covering rubbed off with the hands or washed off with cold water. After washing, if they can be carried to the market at once, let this be done, as the sooner they reach the shipping port the better. If they cannot be carried at once to the market, a good way to keep them is to dig a hole in the ground under shelter where they will not become wet. Line the hole with any kind of large thick leaves dipped in water. Lay the Kola Nuts on the leaves and then cover leaves and all with dry earth. They will keep in this way for months. In carrying the Nuts into market for sale, line a basket or bag with any kind of thick leaves that have been dipped in water, lay on the Kola Nuts. The nuts may also be wetted with water, then cover all with plenty of fresh leaves, lay a piece of bagging over all. In this way the heat and sun cannot injure them.

"Bissy nuts or Kola nuts can be sold in the Jamaica markets either in the pod undried, or taken from the pod washed as above. In any case do not put them out in the sun to dry, keep them where the air and insects cannot get at them. If any of them begin to rot, mould or show specks, throw them away. In handling them be very careful not to cut, bruise or break the skin as this causes a change.

"Undried Bissy or Kola nuts are much more profitable than dried ones. For instance, a tree which would give 100 pounds of dried nuts per year will yield 250 pounds of the undried nuts. In other words, in drying one hundred pounds of nuts the planter loses from 60 to 75 pounds of moisture as every 100 pounds of dried nuts shrink to less than 40 pounds. Besides this, it takes from one to two weeks to spread them out and turn them over and dry them. In selling the undried nuts, if the planter gathers 100 pounds from the tree he takes 100 pounds into the market and gets paid for it. In other words, he will get paid for from 60 to 75 pounds more than he would if dried. He will have two or three times the crop to sell.

"Arrangements have been made with the leading merchants of Kingston, Montego Bay, and other points in Jamaica to purchase all the undried Kola that may be offered during the season. It may be shelled and washed as above, or taken in the pod without shelling. Planters will find a ready market and be given a fair price."

Further copies of these directions may be obtained by addressing Director of Public Gardens and Plantations, Gordon Town P. O.

ORRIS ROOT.

Orris Root is the dried root-stock (rhizome) of three species of *Iris* indiscriminately, viz. : *I germanica* with a blue flower, *I florentina* with a white flower, and *I pallida* with delicate blue flower.

Soil and climate.—They grow in Italy in poor soil, and are not manured. In that country they are generally planted in waste stony places near cultivated ground, and along the edges of terraces. In Jamaica it is recommended not to grow Orris at a lower elevation than about 2,000 feet. It is growing well in the Hill Garden.

Harvesting.—The root-stocks, or rhizomes, increase in size with every year's growth, which gives them a jointed appearance. They are not harvested for 3 years from planting, and then they are taken up in the autumn before commencing next year's growth. The root is cut off just below the base of the leaves. The leaves are cut off a few inches above the root, and the "head" is then replanted for another 3 year's growth.

Preparation.—The root is allowed to mature and dry in the sun ; it is then cleaned, trimmed and the "bark" pared off. The Orris Root appears in the markets in pieces from 2 to 4 inches long, and from $\frac{1}{2}$ to $1\frac{1}{4}$ inches wide. It was sold in London in Dec. 1895, at 64/6 per cwt.

The characteristic odour of violets is only gradually developed, and does not attain its maximum for at least 2 years from the time of harvesting and sale.

WILD LIME.

Under the name of "Wild Lime" a correspondent has lately sent fruits, asking for information about it.

The fruit is of a yellowish colour, about the size of a small hen's egg, and coming abruptly to a blunt point at the top. The rind is somewhat thick, and in the hollow enclosed by it are 3 or 4 seeds enveloped in a glistening white pulp. The pulp is of a pleasant acid taste, and a jelly made of it is very agreeable to convalescents.

The fruits succeed to small flowers with 4 whitish petals about a quarter of an inch long which appear in clusters just above the leaves. The leaves are about six inches long, thick and leathery, in pairs on opposite sides of the branches.

The tree is rather small, and exudes a yellowish resinous gum of an agreeable smell which burns readily, and is good for caulking.

It belongs to the family Guttiferæ, which includes the famous Mangosteen of the Malay Archipelago, the Gamboge tree of the East Indies now naturalised here, and the native Mammee, Santa Maria, and Hog Gum trees.

The Spanish name is "Ciruelo," while French West Indians call it "Cyroyer," and "Prunier d'Espagne."

The scientific name of the tree is *Rheedia lateriflora*. The genus was dedicated by Linnaeus to Van Rheede, a Governor of Malabar ; and author of "Hortus indicus malabaricus," a celebrated work published in folio, at his own expense, at Amsterdam between the years 1678 and 1703 A.D.

There are several species belonging to this genus, almost all natives of tropical America, but only one besides the Wild Lime is reported to have an edible fruit. This is *Rheedia edulis*, the "Sastra" of Panama, a tree about 50 feet high with a pleasant tasted fruit about the size of a hazel-nut.

ORNAMENTAL PLANTS IN THE GARDENS.

BEAUMONTIA GRANDIFLORA, *Wall.*, is a climber with large showy, white, fragrant, bell-shaped flowers, and covered with large dark green leaves. It is a native of the eastern Himalaya Mountains, being found even at as high an elevation as 4,000 feet. In its native country it is of vast extent, climbing over high trees. It was named by Dr. Wallich, the Indian Botanist, in honour of Mrs. Beaumont of Breton Hall, Yorkshire, in whose conservatory it flowered in England in 1832. But it had previously flowered in 1825 at Messrs. Whitleys to whom it had been sent in 1818 by Dr. Wallich. A fibre is prepared from the young twigs.

BIGNONIA VENUSTA, *Ker-Gawl*, is a high climber, and is covered with bunches of flowers of a vivid orange-vermillion colour. Trained on a trellis against a wall, or on a verandah, it is a most beautiful object. It is a native of Brazil, whence it was received in England by Lady Liverpool in 1816, and flowered in 1817. The species of the genus *Bignonia* are mostly natives of South America. The name was given by Tournefort in honour of the jurist, Bignon, librarian to Louis XIV.

BIGNONIA MAGNIFICA, *Bull.*, is another species of this genus. It has very large flowers of a delicate mauve colour. It is a native of Columbia, and was only introduced into English hot-houses in 1879.

BOUGAINVILLEA SPECTABILIS, *Willd.*, with rounded leaves covered with hairs on both sides, and *B. glabra*, Choisy, with lance-shaped longer leaves without any hairs, are the two species of *Bougainvillea* under cultivation. The large coloured bracts, surrounding small groups of flowers, constitute the beauty of these climbers. The colour is variable, but in *B. spectabilis* it is generally rosy-purple, and in *B. glabra* it is a rosy-mauve. There is a very beautiful variety of *B. spectabilis* at Hope, the colour being a crimson-brick-red. These plants are natives of Brazil. The genus is dedicated to De Bougainville, the first French circumnavigator, and the founder, at his own expense, of a colony on the Falkland Islands. He fought in the naval engagement near Martinique, when Rodney defeated the Count de Grasse, and succeeded in rallying and bringing safely away eight ships of his division. He died in 1814.

EUCALYPTUS OIL IN YELLOW FEVER.

Dr. Lacerda, says *El Restaurador Farmaceutico*, has discovered that eucalyptus oil has a distinctly germicidal action in the case of the yellow-fever germ, and a well-known Brazilian medical authority, Dr. Pinto Portella, has decided to employ this substance in the form of tincture, in cases of yellow fever, in doses of from 15 to 40 grammes. *Anorita* did not show itself except in moribund cases; in the others the ordinary secretion was simply diminished. Dr. Lacerda does not yet venture to draw too definite conclusions from his discovery, but in the meantime he notes the curious fact that *Anorita* rarely occurs in the patients treated with eucalyptus, and draws the attention of his Brazilian colleagues to his new remedy.—*Chemist & Druggist*.

FERNS SYNOPTICAL LIST—XXXII.

Synoptical List, with descriptions of the Ferns and Fern-Allies of Jamaica, by G. S. Jenman, Superintendent Botanical Gardens, Demerara, (continued from Bulletin II, 12.)

TRIBE IX. ASPIDEÆ.

1. *Nephrodium basiattenuatum*, Jenm., Stipites tufted, $\frac{1}{4}$ –1 in. l., very slender, channelled, clothed with a slight gray pubescence; fronds 3–6 in. l., 1–1 $\frac{1}{2}$ in. w., bipinnate, base gradually dwindling, the upper part tapered to the finally entire or semilobed point, green, clothed with a fine gray pubescence, the very slender channelled rachis and other vascular parts similarly clothed, texture barely firm, pinnæ numerous, spreading, contiguous, the greater part of each pinnatifid, fully pinnate only at the sessile base, the acute point entire, surface glossy above; $\frac{1}{2}$ –1 in. l., 3–4 li. w.; lobes blunt or round-pointed, the basal dimidiate ones free, the rest decurrently connected, $\frac{3}{4}$ –1 li. w., 1–2 li. l., entire or somewhat cremulate; veins free, pinnate, simple; sori minute, medial, copious; involucre as large, gray, with a stellate pubescence.—Gard. Chron. March 17th, 1894. *Aspidium*, Jenm. Gard. Chron. 2nd Feb. 1895.

Mount Moses, 2,000 ft. altitude, St. Andrew parish. Small and distinct, and only connected with the conterminum group by its free veins and dwindling base of the fronds, the dimidiate basal segments distinguishing it.

2. *N. sanctum*, Baker.—Stipites densely tufted, and tenaciously adherent to a fibrous, erect (often a few inches high) rootstock, slightly scaly and dark coloured at the base slender, 1–2 $\frac{1}{2}$ in. l., channelled; frond narrowly lanceolate, bipinnatifid, gradually reduced to the base, 4–10 in. l. 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ in b., clear light green, naked; texture chartaceous; rachis very slender, and with the costæ, channelled and very stramineous; pinnæ inequilateral, sessile, spreading, subdistant, the lower ones gradually dwindling to tiny, trifoliate, auricles central longest and $\frac{3}{4}$ –1 $\frac{1}{2}$ in. l., 1 $\frac{1}{2}$ –3 li. b., lobate, pinnatifid, or within fully pinnate, widest at the base, thence tapering to the subentire bluntish point; segments oblong, bluntish or rounded at the point, the larger narrowed to the base, the lowest pair of all usually the largest, most of all that on the superior side, $\frac{1}{2}$ – $\frac{3}{4}$ li. b. 1–3 li l. the inner ones apart: except usually the basal one, those on the inferior side of the pinnæ much reduced or nearly abortive; veins pinnate in the larger segments, with simple branches; sori dorsal, medial on nearer the edge than midrib, involucre minute, fugacious. Sl. t. 49 fig. 2, *Polypodium*, Sw. *Aspidium*, Mett.

A. var. hirtum.—Fronds small and compact, pinnæ only lobed, colour, dark, rachises brown, surfaces especially the rachises and ribs, freely pubescent.

B. var. magnum.—Fronds 10–15 in. l. 3–4 in. b. stipites 3–5 in. l. pinnæ contiguous or apart, 1 $\frac{1}{2}$ –2 in. l. 4–5 li. b. deeply pinnatifid above the fully pinnate base.

Common on wet rocks and banks up to 3,000 ft. altitude or higher. The fronds are adherent, and remain on the rootstock after they are dead till they decay away. In small states the pinnæ are merely cre-

nate with an enlarged lobe on the upperside at the base. In all conditions one or both of the pair of basal segments are enlarged, the upper most so, and they increase in relative proportion as the pinnæ dwindle to trifoliate segments at the base of the fronds *a* differs only in its relatively very compact habit, darker colour and pubescent surfaces.

3. *N. caribæum*, Jenm. Stipites densely tufted, slender, erect, light brown, slightly scaly at the base, 2-4 in. l. slightly channelled, puberulous; fronds erect, bipinnatifid, $1\frac{1}{4}$ - $1\frac{1}{2}$ ft. l. 3-4 in. w., gradually dwindling at the base to small trifid or trifoliate segments, firm in substance, pellucid, dark green above, paler beneath, slightly ciliate on the ribs above, beneath glabrous or puberulous; rachis light brown, slender, puberulous, faintly channelled; pinnæ spreading, sessile, contiguous or more or less apart, broadest at the base from whence they taper to the acuminate serrate-entire point, 2 in. l. 4-5 li. w., subequilateral, uniformly deeply pinnatifid, or the very base fully pinnate; segments linear-oblong, close, except the enlarged basal pair which are nearly or quite free, $\frac{3}{4}$ -1 li. w. 2 li. l. (the basal ones 3 li.); veins close, simple; sori medial, copious involucre evident, ciliate.—Journ. Bot. Sept. 1886, 270.

Infrequent, gathered on Mt. Diablo, St. Ann, 2,000 ft. altitude. This comes near the variety magnum of *N. sanctum* which it a good deal resembles, but is a still larger plant, and further marked from that by its puberulous surface, and the pinnæ which are generally from one to three times their own width apart being uniformly pinnatifid only, from the pair of enlarged basal segments outwards. A very slender plant.—Endemic.

4. *N. Nockianum*, Jenm.—Rootstock small, erect, stipites tufted, erect, very slender, brownish, 4-6 in. l. channelled, puberulous or becoming naked, a few small deciduous brown scales near the base; fronds erect, bipinnatifid, 1-2 ft. l., 3-4 in. w. lanceolate, or oblong-lanceolate, the base reduced gradually or abruptly, but usually not tapering; pinnæ spreading horizontally, oblong-lanceolate acuminate, sessile, close, or more or less distant, the reduced lower ones most distant, and usually rather deflexed; central $1\frac{1}{2}$ -2 in. l. 5-6 li. w., the acuminate point, which is not sharp, serrulate-entire, within this pinnatifid nearly to the costæ; segments close, nearly or quite straight, but rather oblique, rounded and even or faintly crenulate at the point, not wider at the base, 3 li l. $\frac{3}{4}$ -1 li. w.; rachis very slender, finely grayish or rusty pubescent, channelled, costæ similar, other surfaces glabrous, or the upper slightly ciliate, glandulose and pale beneath, above dark green; veins oblique, simple, or the posterior one of the segments on the inferior side of the pinnæ forked, about six to a side; sori nearer the margin, involucre developed, ciliate.—Journ. Bot. Dept. 1886. 270.

Infrequent in open places at 4,000-5,000 ft. altitude. Marked by its slender character, contiguous pinnæ, their translucent texture few veins thin and very pellucid substance and glandulose surface.—Endemic.

5. *N. negligens*, Jenm. n. sp.—Rootstock small, upright, fibrous, scurfy; stipites very slender, brown, naked, channelled, $\frac{1}{2}$ - $\frac{3}{4}$ in. l.; fronds bipinnatifid, a span or over long, 2-2 $\frac{1}{2}$ in. w. the apex tapering through diminishing lobes to the linear bluntish point, gradually reduced

in the lower half of the base, membranaceous, dull grayish-green, pellucid slightly ciliate, rachis channelled, slender, fragile, gray, ciliate or puberulous, midribs similar; pinnæ deeper on the upper side, free but quite sessile, the upper only adnate, $1-1\frac{1}{2}$ in. l. $\frac{3}{8}$ ths to $\frac{5}{8}$ ths in. w., deeply cut within to the open but subacute sinuses, passing outwards through diminishing lobes to the broad, entire point; margins even, basal lobes of the superior side $\frac{1}{4}-\frac{3}{8}$ ths in. l. $1-2$ li. br. oblique, rounded at the end, veins opens, pinnate, simple, forked in the smaller lobes, about 3-4 to a side, very oblique; sori small, intramarigal, involucre delicate, early fugacious.

Infrequent on open or partly shaded banks from 3,000 ft. altitude upwards. Among the smaller species it is well marked by its broad rounded parts and even uncrenulated margins.

6. *N. rigidulum*, Mett.—Root-stock slender, elongated, paleaceous; stipites tufted, 2-4 in. l. brown; fronds bipinnatifid, lanceolate, 12-15 or 18 in l. 3-4 in. w., gradually reduced both up and down, pellucid, chartaceous dark green, ciliate; rachis gray, puberulous on the costæ ribs and margins; pinnæ contiguous, spreading in the lower half horizontally, the lower ones reduced gradually to mere deltoid subentire segments central 2 in l. $\frac{1}{2}$ in. w., sessile, acuminate, pinnatifid to within $\frac{1}{2}$ a line of the costæ, segments linear oblong, oblique, slightly broader at the connected base, point obliquely rounded, 3-4 li. l. $1-1\frac{1}{2}$ li. w., entire, veins simple, oblique, 6-7 to a side; sori medial, involucre ciliate around the edge. *Aspidium*, Mett.

Infrequent in open situations above 3,000 ft. altitude. It is near *conterminum*, but much more compact, only the lower reduced and subentire pinnæ being separated, which however are not more from base to base than those above them, but being reduced and narrower they appear so. These are entire, with only a pair of patent lobes at the base, and their uncut character is a conspicuous feature of the fronds.—Cuba.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of January:—

IN FLOWER.	IN FRUIT
Amherstia nobilis	Attalea Cohune
Bauhinia variegata	Barringtonia Butonica
Cananga odorata	Caryocar nuciferum
Cinnamomum zeylanicum	Coffea liberica
Cocos botryophora	Dillenia indica
Coffea liberica	Diospyros discolor
Erythrina umbrosa	Dypsis madagascariensis
Hibiscus elatus	Hyophorbe Verschaffeltii
Hyophorbe amaricaulis	Lonchocarpus cyanescens
Hyophorbe Verschaffeltii	Myristica fragrans
Jacaranda filicifolia	Oreodoxa regia
Phoenix acaulis	Pachira aquatica
Tectona grandis	Pandanus utilis
	Semecarpus Anacardium

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of February:—

IN FLOWER.	IN FRUIT.
Amherstia nobilis	Araucaria Bidwillii
Arenga saccharifera	Areca Catechu
Aspasia variegata	Attalea Cohune
Bignonia magnifica	Barringtonia Butonica
Cananga odorata	Bauhinia variegata
Carludovica gracilis	Bignonia magnifica
Chrysobalanus Icaco	Cananga odorata
Cinnamomum zeylanicum	Caryota urens
Cocos australis	Chrysalidocarpus lutescens
Cocos botryophora	Cocos flexuosa
Coffea liberica	Coffea liberica
Cola acuminata	Colvillea racemosa
Dictyosperma album	Dictyosperma album
Ellettaria Cardamomum	Dillenia indica
Erythrina umbrosa	Diospyros discolor
Faradaya splendida	Diplothemium caudescens
Garcinia indica	Dipteryx odorata
Hibiscus elatus	Ellettaria Cardamomum
Jacaranda filicifolia	Entada scandens
Landolphia florida	Erythrina umbrosa
Latania Verschaffeltii	Eugenia caryophyllata
Mesua ferrea	Hibiscus elatus
Michelia Champaca	Livistona australis
Musa textilis	Livistona chinensis
Napoleona imperialis	Manihot Glaziovii
Nephelium Lit-chi	Musa textilis
Pachira aquatica	Myristica fragrans
Pterospermum acerifolium	Oreodoxa regia
Quassia amara	Pachira aquatica
Saraca indica	Pachyrhizus tuberosus
Spathodea campanulata	Pandanus utilis
Sterculia carthaginensis	Sapindus Saponaria
Strychnos Nux-vomica	Sarcœcephalus esculentus
Tectona grandis.	Semecarpus Anacardium
	Strychnos Nux-vomica
	Terminalia Arjuna.

CONTRIBUTIONS TO THE DEPARTMENT.

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PLANTS.

- From Botanic Gardens, Grenada.*
 Black Pepper.
From Mr. W. T. James, Bermuda.
 Lily Bulbs.
From Dr. H. A. Nicholls, through Botanical Station, Dominica.
 Durian.

SEEDS.

- From Botanic Gardens, Trinidad.*
 Livistona Jenkinsiana
 Oreodoxa regia
 Pritchardia pacifica.
From Botanic Gardens, Bangalore.
 Withania somnifera.
From Mr. C. W. Treleaven, Balaclava.
 Grape Fruit.
From Mrs. Corty, Chester Castle.
 La Reine Peas
 Beurre Peas.
From Mr. L. Tate, Bluefields.
 Lime.
From Mr. J. Shore, Little River.
 Shaddock.
From Messrs. Reasoner, Bros., Florida.
 Ipomæa sp.
 Melia Azedarach var umbraculiformis.

NOTE.

The Director will be at the JAMAICA INSTITUTE on the morning of the first Friday in every month between the hours of 10 and 12 o'clock for the purpose of giving information to those who may wish to consult him.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

Tropical Fodder Grasses	-	25
Notes on Laborie	-	41
Para Grass vs. Guinea Grass	-	42
The Vanilla Market	-	42
Ferns: Synoptical List.—XXXIII	-	45
Contributions to the Department	-	47
Castleton Gardens	-	48

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BULLETIN
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TROPICAL FODDER GRASSES.

Reprinted from the Kew Bulletin.

The selection of suitable grasses for cultivation in tropical countries is a matter of considerable importance. Few countries have completely solved the question. It is evident also that a good deal of time and energy is spent in the effort to introduce foreign grasses, when there are excellent indigenous grasses close at hand. It is proposed to draw attention to a few grasses that have attained to first rank for fodder purposes in the tropics, and to give particulars respecting the conditions under which they have been found to thrive. It is well known that the same kinds of grasses do not succeed equally well in all localities. There are certain conditions and peculiarities of climate and soil to be considered; but there is no reason to doubt that if careful experiment is made, suitable grasses can be found for cultivation in almost every tropical country. In some of our colonies it is well known that grass, even for valuable horses, is gathered day by day from waste places and jungles. Such fodder is not only poor in quality, but it is liable to be infected with disease from stray animals. Further, during seasons of drought, the fodder supply is likely to fail altogether. The selection and cultivation of grasses, with particular reference to their grazing qualities, or for the production of hay, should receive more attention, and it will doubtless become, before long, a regular branch of rural industry in the tropics, as it has been for so many years in temperate countries.

NATURAL HERBAGE.

In the tropics the difficulty in establishing grasses is caused by the usually rank growth of weeds and bushes. These soon overrun any cleared area, and they have to be continually eradicated, or the grass would be completely destroyed. The natural herbage in most tropical countries would, of itself, form excellent pasture for cattle and horses. There is hardly any part of the world entirely devoid of good grasses, and these should first of all receive attention. Where no suitable fodder grasses are available, then, under such exceptional circumstances, it would be well to introduce the useful "Guinea Grass" and "Para Grass" for cultivation on land suitable for the purpose. In countries like Ceylon and Jamaica, there are vast stretches of lands, known as

“patanas” and “savannahs,” where somewhat coarse grasses have established themselves almost to the exclusion of every thing else. Even these grasses, although in a fresh state they may be distasteful to cattle, become, after being cut and partially dried, very acceptable food to them. Such grasses might also be largely utilised for silage purposes. Under cultivation, good pastures can, as a rule, be established by clearing the land of weeds and bushes, and encouraging the spontaneous growth of local grasses from seed carried from neighbouring areas. This is regularly done in Jamaica in regard to Guinea grass. During the first year or two the land requires to be carefully weeded, and if the soil is poor it should also receive a dressing of manure. After the grass has become thoroughly established an annual clearing after the rains is all that is required. It should, however, be understood that continuous feeding is injurious to the permanency of good pastures. The best grasses are thus destroyed, and rank growing ones gradually take their place. Close feeding for a time is advantageous, but the pasture should have time to recover before the animals are again placed upon it. Further, it is better to keep cattle on a portion of the pasture at one time, and not allow them to wander at will over a large area.

TREES IN PASTURES.

Thwaites recommended that in Ceylon trees should always be planted upon land laid out for permanent pasture. The trees would afford grateful shade to the cattle, and they would prevent the grass from being entirely dried up during seasons of drought. Trees would also add to the beauty of the country. Most extensive pastures dotted over with shade trees exist in Jamaica. Many trees, such as the Saman (*Calliandra Saman*), not only give excellent shade, but the pods are a most wholesome food for cattle. The commoner and more hardy sorts of mango might be planted for the same purpose, as also the Ramoon (*Trophis americana*), the leaves of which afford a very nutritious food for cattle in tropical America; the bread nut (*Brosimum Alicastrum*); the Jack tree (*Artocarpus integrifolia*); and the bastard cedar (*Guzuma tomentosa*). The leaves as well as the fruits of the last are much liked by cattle. This brief list of useful pasture trees might be considerably enlarged. It would be noticed that many of the trees mentioned belong to the natural order, *Urticaceæ*. As the plants belonging to this order are so widely distributed over tropical regions, each country could make its own selection of suitable pasture trees. The best tree of all is, undoubtedly, the Saman. (*Kew Reports*, 1878, p. 18, *et. seq.*)

GRASSES FOR DRY REGIONS.

Where the climate is moist and humid the selection of suitable grasses presents little difficulty. In countries subject to periods of prolonged droughts the circumstances are wholly different. The great want in such regions is the introduction of grasses that will maintain growth and vigour during many months when no rain falls. Grasses of this kind are to be found in the Bahama grass (*Cynodon Dactylon*), the Kangaroo grass of Australia (*Anthistiria australis*), and the Mitchell grass of Australia (*Astrelba triticooides*). These will stand periods of prolonged drought, and, in the case of the last, cattle are said to fatten

on it, even when it is much dried up. In Jamaica, during severe droughts, cattle feed almost entirely on the underground stems of the Bahama grass. In dry soil impregnated with salt there are several grasses known in India affording a considerable amount of forage. A variety of *Sporobolus arabicus*, Boiss. (*S. pallidus*, Duth.) known as *Kalusra*, is mentioned by Duthie as constituting the greater part of the grass vegetation of the *usar* tracks in the north-western provinces, and is always a sure indication of the presence of *reh* salts. Other grasses mentioned as more or less characteristic of saline soils are *Aristida depressa*, Retz. (more sandy parts): *Cynodon Dactylon*, Pers. (on less infected parts); *Chloris barbata*, Sw. (more sandy parts); *Tetropogon villosus*, Desf.; and *Diplachne fusca*, Beauv. (in moister parts).

ANNUAL FODDER GRASSES.

In dry regions not suitable for permanent pastures the Abyssinian Teff (*Eragrostis abyssinica*) might be grown during the occasional rains and made into hay. This grass will produce a heavy crop of hay in six weeks from the time of sowing. It is very nourishing, and cattle are very fond of it. There are other annual grasses that might be grown during the rains for fodder purposes. In Northern India green wheat is used as fodder, and where a large yield is desired within a short season, green oats are also used, as in St. Helena, for fodder purposes. The maize (*Zea Mays*) is often given as a green fodder, or dried and mixed with other green fodder. On sugar estates in the West Indies and elsewhere "cane tops" are largely used during crop time as fodder for working cattle, mules, &c. The tops are cut small, and sometimes mixed with molasses. They are regarded as most nourishing. In Mysore *Sorghum saccharatum* is regarded as an excellent fodder, and if cut before seeding it is well suited for cattle, especially milch cows—"their milk being enriched to an extraordinary degree by its use in small quantities." The United States Agricultural Department has declared that "the value of sorghum for feeding stock cannot be surpassed by another crop, as a greater amount of nutritious fodder can be obtained from it in a shorter time, within a given space, and more cheaply." The common sorghum (*Sorghum vulgare*), the *Juár* of India, is largely used as fodder, green or dry. It is often specially grown as a fodder crop, in which case it is sown earlier and more thickly than when cultivated for the grain.

A very valuable fodder grass belonging to this group is the Teosinte (*Euchlaena luxurians*). This yields very large crops in good land, and is regarded as one of the most prolific of annual grasses. Four good cuttings can be made in four months.

Most of these annual grasses, as also many coarse-growing perennial grasses, might be largely utilised by being preserved in the green state in silos. In South Africa silos, consisting merely of pits dug in the ground, have been found very useful in preserving fodder that would otherwise be lost, until the dry season. The cost of making silos is comparatively trifling, but it should be borne in mind that fodder preserved as hay is often more generally useful, and especially if made in good weather. Silos, on the other hand, offer a very ready and convenient means for preserving fodder during wet seasons, when it is impossible to make it into hay.

GRASS GROWING IN INDIA.

Voelcker* records an instance of the greatest care in grass growing in India, at Nadiad, in Gujarát (Bombay), where the cultivators do not use the village common land for their cattle. "Every one of their fields," he says, "is enclosed with a hedge, and then comes a headland of grass from 15 to 20 feet wide all round the field, and producing capital grass. There is a double object in this practice, for, as the fields are hedged, and have trees round them for supplying firewood and wood for implements, the people know quite well that crops will not grow when thus shaded, but that grass will. They obtain four or five cuttings of grass in the year as food for their cattle, and when the fields are empty the cattle are let in to graze on them. . . . Dúb grass (*Cynodon Doctylon*) as a crop for irrigation gives a great yield, and is about the only grass that keeps green in the hot weather. At Belgaum, fields are grown with grass; two cuttings are obtained yearly, and 6 annas is the sum paid for 100 lbs. of green grass. No seed is ever sown, only the grass that comes up naturally being used."

To supply grass to military cantonments in India regular grass farms have recently been established. These were started by Sir Herbert Macpherson at Allahabad in 1882, and since then have been extended largely.

Previous to the introduction of the grass farm system, the practice had been to send out "grass-cutters," whose duty it was to cut and collect grass for the troops from wherever they could. Owing to a full supply of grass being now obtainable by the "grass-cutters" from Government grass lands great saving has been experienced, and the horses are believed to be healthier owing to the grass no longer coming from unprotected and suspicious sources. The amount of grass grown at military stations in India has been so increased that it is now possible to supply not only the British troops, but even the native cavalry with it. The saving at Allahabad alone for the seven years 1882-89 was estimated at Rs. 91,158. The extent of the Allahabad grass farm is 3,558 acres.

Ensilage, or the preserving of green fodder, has been carried out at many places in India. The cost as between haymaking and that of silage is, however, unfavourable to the latter. One advantage of cutting an early crop of grass for silage is that there are many grasses, such as numerous species of *Panicum*, which seed in the rains; these may be secured as silage if rain continues, whereas the other grasses, being kept back somewhat, yield a good hay crop about October, when the rains are over. It may further be said in favour of silage that by means of it some grass which would otherwise have been altogether lost owing to the heavy rains is saved by being put into the silo. Voelcker concludes: "I differ entirely from the opinion of one of my predecessors to the effect that India is the great field for the development of silage. That it is the field for haymaking I am much more ready to think. With a sun and climate such as exist over the greater part of India, I cannot see how it could well be otherwise. Hay requires no making, for it

* Report on the improvement of Indian Agriculture, London, 1893.

makes itself. Silage, I repeat, will only be useful when by means of it can be saved what would otherwise be lost."

The following tropical grasses are selected as possessing special merits for fodder purposes. Amongst them are plants suitable for almost every condition found in tropical countries. The list has had the advantage of the revision of Sir Joseph Hooker, who is now working out the grasses of British India and who has suggested some emendations of the commonly accepted nomenclature.

1.—*Anthistiria australis*, R. Br.—The well-known "Kangaroo grass" of Australia, but widely distributed throughout southern Asia and the whole of Africa. A perennial upright grass over 3 feet in height. It enjoys a wide reputation and is regarded as the most useful of the indigenous grasses of eastern Australia, stock of all descriptions being remarkably fond of it. The roots are strong, and penetrate the soil to a great depth, so the plant remains green during the greater part of the summer. In the autumn the foliage turns brown, when, however, its nutritive qualities are said to be at the highest. If cut as soon as the flower stem appears it can be made into excellent hay. The most reliable way to propagate this grass is by division of the roots. It perfects very little seed (Turner).

2.—*Anthistiria avenacea*, F. Muell.—"Tall oat-grass" of New South Wales. A nutritious perennial pasture grass, often rising to a height of 4 to 5 feet. It grows generally in tussocks, and prefers rich soils, where its roots can penetrate deeply into the ground. It thus can withstand long spells of dry weather with impunity. It yields a large amount of bottom fodder, and is regarded by Bailey as "one of the most productive grasses of Australia." It possesses the advantage of seeding freely. Turner remarks "it might be profitably cultivated for ensilage, especially if it were cut before the flower stems become hard and cane-like."

3.—*Astrebla pectinata*, F. Muell.—Widely distributed in dry regions inland in north and east Australia. Closely allied to "Mitchell grass," but usually not so tall. A perennial desert grass, resisting drought, and sought with avidity by sheep, and very fattening to them and other pasture animals. Seeding freely (Mueller).

4.—*Astrebla triticoides*, F. Muell. (*Danthonia triticoides*, Lindl.).—The "Mitchell grass" of Australia. A very valuable perennial grass with glaucous green leaves. On rich soils it produces a great amount of rich herbage, of which stock of all kinds are remarkably fond. Cattle are said to fatten on this grass even when it is much dried up during periods of drought. If cut when about to flower it makes excellent hay. Turner "thoroughly recommends it for permanent pastures." The land should, however, be well drained.

5.—*Cynodon Dactylon*, Pers.—A prostrate perennial grass with very narrow glaucous green leaves. It is widely distributed in all hot countries, and extends also into temperate regions. It passes under various names, such as "Bahama grass," "Bermuda grass," "Indian couch grass," "Doub," and "Doorva." It is an important grass for covering bare, barren land, and for making smooth, compact lawns. It resists extreme drought, and once established in cultivated land it is

very difficult to eradicate. It is easily established by planting small portions of the rooting stems about 8 inches apart. If done at the beginning of the rainy season the ground will be completely covered in six weeks. It may also be propagated by seeds, which are now readily obtained in commerce. It should, however, never be planted except in places [where it is required to remain permanently. When grown specially for fodder, in enclosed paddocks, it yields three or four crops in the year, and makes excellent hay. In very dry seasons in the East Indies animals exist almost entirely on the underground rhizomes of this grass.

The following note on the use of Bahama grass for making lawns in India is taken from Firminger's *Manual of Gardening for Benyal and Upper India* [Calcutta, 1874] p. 26 :—"The grass principally used for lawns in this country is that called Doob-grass (*Cynodon Dactylon*), a plant of trailing habit, not growing high, and when in vigorous growth of a soft dark green hue. It thrives where scarcely any other kind will, and delights in the edges of frequented highways. The spot it seems to like especially is where brick and lime rubbish has been thrown and trodden down hard. It will also grow in the poor soil beneath the shade of trees, where other grasses grow but scantily, if at all. When required for lawns a sufficient quantity can easily be collected from the roadside and waste places. The piece of ground intended for lawn should be well dug, and then made perfectly level and smooth. Drills should then be drawn over it a foot apart, in which little pieces of the roots should be planted out at the distance of half-a-foot from each other, and the ground afterwards watered occasionally, till the grass has become thoroughly established. In Bengal further watering will be unnecessary, but in the [upper provinces irrigation during the hot season is indispensable, as otherwise the grass would soon become scorched up and perish.

"A more expeditious and very successful plan of laying down a lawn sometimes adopted, is to pull up a quantity of grass by the roots, chop it tolerably fine, mix it well in a compost of mud of about the consistency of mortar, and spread this out thinly over the piece of ground where the lawn is required. In a few days the grass will spring up with great regularity over the plot."

6.—*Eragrostis abyssinica*, Link.—A slender annual grass, known in Abyssinia as "Teff," "Ttheff," or "Thaff." It is indigenous to the higher lands, and is cultivated for the sake of its grain all over Abyssinia. There are several varieties, some depending on the height of the plant, others on the colour. According to Richard, there are green, white, red, and purple Teffs. The grain crop requires four months to ripen. "In good years it returns 40 times the seed, and only 20 times in bad years." The flour of Teff is very white, and produces bread of excellent quality. Seed of Teff was obtained by Kew in 1886, and distributed to numerous establishments in India and the colonies (*Kew Bulletin*, 1887, January, pp. 2-6). The plant prefers light sandy soils, and adapts itself even to the most sandy; it then produces slender wiry stems, and supports a large weight of ear. The grain is reported to make "an excellent fine hay" in British Guiana, and to mature in six or eight weeks from the time of sowing. "For this purpose teff is well worth cultivating. It is cleaner and brighter looking than any other

grass, and is readily eaten by cattle and horses." The reports from Australia and India are equally favourable. The value of this plant for fodder purposes is exceptionally high. Its chief merits in this respect are the short time it takes to mature, and its suitability to thrive in dry, sandy regions, where few other grasses would flourish equally well.

In the Proceedings of the Agri.-Hort. Society of India, 1888, p. lxxii., the following note appeared:—"The seed of this new cereal was received from Kew, and was distributed as noted in the *Proceedings* of May last. Mr. C. C. Stevens, Commissioner of Chota Nagpore, now writes: "You will remember having given me a small packet of seed of "tcheff" for experiment. I gave it to the Rajah of Jashpore, who had it sown in two or three different localities. He has not given me very precise information, but I understand that the seed was treated exactly like the ordinary rainy weather crops. He tells me that he has saved some three or four seers of seed, and that the hill people have taken a fancy to the crop. The best thing he can do is to keep the seed and sow next season. He has sent me a bundle of plants, which I shall forward to you when a favourable opportunity occurs. The straw or grass is 4 feet or $4\frac{1}{2}$ feet in length, and smells sweet. "As only about 2 ounces of the seed was supplied to Mr. Stevens, the results obtained appear very satisfactory for the first season, and if the crop is found suitable there should be no difficulty in establishing it next season."

A very full account of teff is given by Mr J. F. Duthie, F.L.S., in the Report of the Saharunpur Gardens for the year 1888, p.p. 11-12. The following extracts are of interest:—

"Seeds of this grass were sent to us last year by the Director of the Royal Gardens, Kew, with the remark that it was an Abyssinian food-grain which might prove useful for India. I have a bad opinion of it as a food-grain, but think better of it as a fodder, and have therefore classed it under the head of 'fodder plants.'

"Teff consists of two varieties, one with white seeds and the other with red seeds. The white-seeded kind is said to be cultivated in Abyssinia during the dry season and the red during the rains. We tried the two kinds here during both seasons, and found, as stated, that the white answered best for the dry season and the red for the white.

"Three sowings were made of the two kinds—the first in March, the second in April, and the third in July. The March sowing of the white variety gave an out-turn of grain at the rate of 660 lbs. per acre, while the red variety, sown on the same date, only resulted in an out-turn of 17 lbs. per acre. The crop was cut in the beginning of May, but sprang up again into a second growth and yielded a cutting of green fodder early in the rains. The note made regarding the weight of this cutting has, unfortunately, been mislaid, and I am therefore unable to give its approximate weight per acre.

"The April sowing of the white variety produced no grain, and the sowing of the red variety made at the same time only returned 11 lbs. of grain per acre. Both kinds, however, gave a good crop of fodder in the middle of July, the red variety producing 11,022 and the white 7,436 lbs. per acre. The cutting was in a half-dried state when weighed, or the figures would have amounted to a greater total.

"The July sowing of the white variety gave an out-turn of 11 lbs.

of grain p r acre, and the sowing made on the same date of the red resulted in an out-turn of 82 lbs. per acre. These out-turns may be looked upon as failures, and conclusively prove that teff is of no great account for cultivation on the plains as a food grain. A cutting was made across a section of the two plots of this July sowing in the middle of August, and weighed collectively in its green state, and as a result gave an out-turn of 16,300 lbs. of green fodder per acre. The out-turns of 3,116 and 2,676 lbs. noted in the statement for part of this plot really mean the out-turn of dried hay, as the fodder was weighed in the beginning of October, and was then crisp and dry. A rainy season sowing of teff may, therefore, be looked upon as capable of producing 16,000 lbs. of green fodder and from 2,000 to 3,000 lbs. of dried hay per acre.

“A sowing of $\frac{1}{2}$ lb. of each kind was made at Arnigadh in the begin ing of the rains, and resulted in a collective out-turn of 40 lbs of grain This was a remarkably good yield for the small quantity of seed sown, and proves that in hill tracts teff may yet prove a prolific food grain.

“The hay made from the teff was of exceptional good quality and was greedily eaten by the garden bullocks. When it was offered to them they were being fed upon jowar or sorghum stalks, and, as is well known, these are remarkably sweet and cattle, when fed upon them, generally refuse other kinds of dry food until they find that sorghum is not forthcoming. Our garden cattle, however, seemed to prefer the teff hay to the sorghum, as they would not touch the latter until they had devoured the whole of the teff placed before them.

“The experience gained here in the cultivation of teff during the past year may therefore be summed up as follows:—

“When sown in the dry season it will yield a light crop of grain, and when sown in the rains it yields little or no grain, but produces abundance of green fodder which may be cured into very palatable hay where the latter is preferred. In my opinion, teff is destined to become the rye grass of India, and is well worthy of more extended trial on some of the Government fodder reserves.”

7 *Euchlana luxurians*, *Miers* (*Reana luxurians*, *Durieu*). “Teosinte.” An annual grass of large size from Guatemala allied to the maize. The first published illustration of the plant was given in the *Botanical Magazine*, tab. 6,414. It attracted a good deal of attention about 20 years ago as a fodder plant (see *Kew Reports*, 1878, 1879 and 1880). Seeds of it were widely distributed from Kew to the East and West Indies, Australia, and tropical Africa. It is a tall, densely-tufted grass, sometimes reaching 15 feet in height, the stems are as thick as the thumb at the base, and the leaves 3 to 4 feet long, by 2 or 3 inches broad. Dr. Schomburgk in 1880 wrote from the Adelaide Botanic Garden, S. Australia: “I have now cultivated Teosinte for three years, and it is one of the most prolific fodder plants.”

Mr. W. R. Robertson, Agricultural Reporter to the Government of Madras, wrote as follows in July 1833:—“A small plot was sown with this crop; the out-turn of green fodder was at the rate 38,400 lb. per acre, a very large out-turn; but, the cost of production was great, for it was necessary to irrigate the land nearly every other day, from sow-

ing until harvest. *Reana* is undoubtedly a very heavy producer, crops grown on the farm have given enormous yields, but further experience confirms the opinions expressed regarding the crop in the last report : 'On good soils, under liberal treatment, when it can obtain plenty of rain or irrigation water, the crop grows most rapidly and luxuriantly ; but it cannot withstand a drought. Indeed the experiments made showed that a drought, which scarcely affected the *Sorghum* crops, was sufficient to check the growth of the *Reana* to such an extent as to render it useless to keep the crop standing longer. As a fodder crop in a damp warm climate, or where irrigation can be secured, it is well worthy of attention. There is perhaps no other crop, sugar cane excepted, which will produce such an enormous quantity of green plant per acre, but the fodder is very watery, and does not appear to be very palatable to stock when offered for the first time. The watery juices of the stem seem to be destitute of saccharine matter during all stages of growth.' "

The following account of the grass was given in the Report of the Botanic Garden at Bangalore for the year 1888-9, p. 13 :—"Teosinte or buffalo grass. With rich cultivation this noble grass affords an inexhaustible supply of fodder for cattle. In special instances the stalks have been known to attain a height of 18 feet, but in ordinary cultivation they are usually 6 to 8 feet, with a small colony of offsets rising up from the base of each parent stalk. Seed was first received from Mr. Blechynden, Honorary Secretary to the Agri-Horticultural Society of India, and in the subsequent year (1878-79) the following particulars of cultivation appeared in the Annual Report of the Garden :

"The forage plant *Euchlæna luxurians* has been grown experimentally on a small scale. 16 square yards of highly manured land produced 288 lbs. of dry fodder and 19 lbs. of seed. The object in culture was chiefly to obtain seed to meet the demands of correspondents, and to enable me to sow a larger piece of ground if Government should wish to extend the experiment. Cattle and horses are fond of the green grass and I think it will be a good addition to the green forage crops of the monsoon season. At any other time the crop would require irrigation and I have a small field now under this method of culture, which will be reported on when the results are fully known."

Subsequent cultivation confirmed the truth of the above remarks, and the great value of Teosinte as a food plant has been established in many parts of India. It should be grown on all land holdings where there are horses, cows, and bullocks to be fed. If, during the dry season, small plots are raised along the channels, and in spare nooks and corners, the condition of live stock would be better maintained than we usually see it.

The latest reports of Teosinte are as follows :—

In a report on *Agricultural Work at British Guiana* for the years 1891-2, p. 68, Messrs. Harrison and Jenman give interesting particulars as under :—*Teosinte* is an annual, but readily reproduces itself on good land from the seed shed. It soon dies out, however, on impoverished land. Though an annual, in the season of growth, if reaped young but not too short, the stubble quickly springs again, and a second and third crop can be thus taken in favourable weather. It should be sown *in situ*, and the plants thinned out as much as is necessary to give each

one 9 to 12 or 16 square feet of superficial space, as it does not bear transplanting, under which the yield is poor. The following is an analysis of the seed:—

Water	...	12·75
Fats	...	3·94
*Albuminoids	...	9·94
†Amides, &c.	...	1·00
Pectose, gum, &c.	...	8·22
Starch	...	37·38
Digestible fibre	...	16·46
Woody fibre	...	9·67
Mineral matters	...	2·44
		<hr/>
		101·80
		<hr/>

The grain of this grass, from its composition, possesses a fair value, although the proportions of fibre present are somewhat high.

In the *Journal of the Agri.-Hort. Society of India*, 1894, p. 78, it is stated:—"A very good crop was raised this season. After the stalks had reached a height of about 5 feet, they were cut down to within 1 foot of the ground; three weeks later a second crop was ready for cutting, varying in height from 18 inches to 3 feet; a third crop was cut a month later, and yielded stalks about 2 feet high; in this manner three good cuttings were made in four months. It was found that from 4½ to 5 lbs. of seed were sufficient to sow an acre. The fodder is greatly relished by cattle."

At Lagos, on the West Coast of Africa, Mr. Millen has successfully introduced "Teosinte" as a fodder plant and in June 1894 wrote: "I have planted a quantity of plants of *Euchlana luxurians*; it is the only fodder plant of those introduced which appears to be growing with good results."

At Saharunpur, in the *Report* for 1893 just issued, Teosinte is mentioned as having suddenly grown into demand as an annual forage grass, and seed has been harvested to meet all possible demands.

8. *Leersia hexandra*, Sw. "Rice-grass." A widely distributed perennial swamp grass found in the warm regions of both hemispheres. It has a somewhat slender stem, 2 to 3 feet long, with narrow leaves and paniced spikes. In the Philippine Islands this grass is regularly cultivated, under the name of *Zacate*, for the purpose of supplying food for domestic animals. It is treated like rice, being transplanted to wet and previously ploughed meadows. Bailey found it to be one of the most relished by cattle amongst the aquatic grasses of east Australia. In Singapore it is regularly gathered in waste places as a green fodder for cattle and horses.

9. *Panicum Colonum*, Linn.—An annual grass widely distributed throughout tropical countries. It prefers a rich soil, and is often found as a weed of cultivation. In some parts of India it is cultivated for its grain. The straw is much used in the Madras Presidency and in

* Containing nitrogen	.	1·59
† " "	.	·61

Mysore as cattle fodder. Duthie gives the following account of this grass (*Fodder Grasses of Northern India*, p. 5):—

“It is generally considered to be one of the best kinds of fodder grass. It is abundant all over the plains, and ascends to some few thousand feet on the Himalaya. It is greedily eaten by all kinds of cattle both before and after it has flowered, the abundant crop of grain yielded by it adding materially to its nutritive value. It extends to Australia, where, it is reported, its very succulent stems grow from 2 to 8 feet in height.”

10. *Panicum maximum*, Jacq. (*P. jumentorum*, Pers.):—“Guinea grass.” Native of tropical Africa. Widely cultivated in most countries. In Brazil it is known as “Capim de Colonia.” This grass was accidentally introduced to Jamaica from the Coast of Guinea as bird food about 1740. In 1794 Bryan Edwards wrote: “Most of the grazing and breeding pens were originally created and are still supported by means of this invaluable herbage, and perhaps the settlement of the ‘north side’ is wholly owing to the introduction of this excellent grass.” In 1879 taxes were paid in Jamaica on 115,576 acres under guinea grass. It was described as “growing freely from sea-level up to nearly 5,000 feet, and when once established, except for an occasional weeding, it receives very little attention. It answers in every respect the requirements of a good fodder plant in being perennial, nutritious, and thoroughly suitable to the soil and climate.” The late Dr. Inray, quoted in the Kew Report, 1879, p. 17, says, “Guinea grass may be cut down crop after crop for many years. I have had a guinea grass piece (with the weeds cut down and an occasional manuring) kept in good order for full 20 years.” Guinea grass grows to the height of 2 to 6 feet. The leaves are broad and flat, with the sheathes and nodes softly hairy. The panicle is large and loose, with numerous branches. Although it usually seeds freely, it is generally propagated by root cuttings. It requires to be weeded at regular intervals, and to be manured in poor soils. When it grows rank and tall it should be cut frequently to prevent it becoming too hard and coarse. Analysis shows it to be very rich in nutritive qualities, and where this grass can be fully established it is probably the best fodder plant known for permanent cultivation. It is a favourite grass for stall-fodder, but it is sometimes necessary to guard against over-feeding with this grass alone in a rank state. It would form an excellent material for preserving in silos.

The following particulars have been published respecting the cultivation of Guinea grass in India (*Dict. Econ. Prod. India*, VI., Part 1, p. 11):—

“It is best propagated by root cuttings. It should be planted about 2 feet apart, in parallel ridges, at the commencement of the rains. The rows of plants should form lines at right angles to the ridges. This arrangement will facilitate ploughing and weeding between the plants. In Madras this grass is known to resist the effects of severe droughts. In old-established fields it is advisable to pass a plough or cultivator occasionally through and across the crop, and to manure the land thoroughly. Where the plants have formed large tussocks these should eq reduced by simple chopping with a spade or hoe at right angles, thus

dividing each one into four parts. Of these three may be removed for planting elsewhere, or they will form excellent bedding for cattle stalls. During the cold weather of northern India the plants dry up and remain dormant until the approach of spring. In places where frosts appear manure should be applied to the roots at the commencement of the cold season. It is particularly enjoined that Guinea grass should not be grazed too closely."

The "St. Mary's Grass," in Jamaica may be a robust variety of *P. maximum* or another species. It grows in large tufts to the height of 6 to 8 feet, with the stems hard and indurated in old specimens.

11. *Panicum bulbosum*, H. B. K. (regarded by Munro as a variety of *P. maximum*, and found in the Southern United States) is mentioned by Vasey as likely to be of great agricultural value. "Its bulbous root-stocks contain a store of moisture which enables it to endure a protracted drought, and as the plant grows to a large size it would produce a great amount of fodder."

12. *Panicum molle*, Sw. This is somewhat similar to the following *P. muticum*, with which it was confused by Grisebach in his Flora of the British West Indian Islands. According to Swartz it is a native of Surinam, and is commonly called "Dutch grass" in Jamaica. He describes it as having thick succulent stems which are readily eaten by cattle.

13. *Panicum muticum*, Forsk. (*P. numidianum*, Lam.; *P. barbinode*, Trin.; *P. molle*, Griseb. non Sw.)—It has various names, such as "Para grass," "Mauritius grass," "Scotch grass," and "Water grass." A coarse and very vigorous grass, spreading rapidly in damp places. It has succulent stems and leaves, with the nodes distinctly hairy. It roots readily at the joints, and these are even said to grow after passing through animals. Hence, this grass is regarded as unsuitable to grow in the neighbourhood of cultivated land. Its use is also discouraged as fodder for animals specially kept for manure. For general pasture purposes it is, however, one of the best of tropical grasses. In Barbados, 40 acres of this grass, well manured and irrigated, are said to yield in good years cut-grass of the annual value of £600. It is largely cultivated elsewhere in the West Indies. in Florida (where it is said to make heavy growth on high pine-ridges,) in Curacao (where it is regarded as capable of resisting drought), and also in Ceylon, Mauritius, and in the plains of Bengal. It is readily propagated by seed and by cuttings of the root and stem.

Seeds and plants of Para grass were first introduced from Caracas to Barbados by Colonel Reid, Governor of the Windward Islands, in 1847. Later a supply was received in this country, and forwarded to Kew, with the following letter from Earl Grey, Secretary of State for the Colonial and War Department, addressed to Sir William Hooker, dated 30 June, 1849:—

"I am directed by Earl Grey to transmit to you a copy of a despatch from the Lieutenant-Governor of St. Lucia, stating that he had transmitted a few roots of the Para grass, and proposed to send some seeds when he should have been able to collect a sufficient quantity.

"The roots and seeds having arrived, they are also now forwarded to

you, together with a copy of the despatch from Colonel Reid, late Governor-in-Chief of the Windward Islands, in which the valuable qualities of this grass are described. Lord Grey requests that you will have the goodness to take charge of these roots and seeds, and to cause them to be prepared for transmission to the different Australian Colonies, to the Cape of Good Hope, and to the Mauritius.

“I am also to transmit to you a case containing some slips of this grass, which has been forwarded to Lord Grey from the Caracas. His Lordship would be glad to be furnished with any suggestions which may occur to you as to the best mode of proceeding in order to introduce these seeds and plants into those colonies for which they are best fitted.—I have, &c., (Signed) B. HAWES ”

The correspondence in regard to the introduction of Para grass to Barbados is given by Dr. Lindley in the *Journ. Roy. Hort. Soc.*, iv. (1847) p. 148. Adapting the name given to the grass in Curacoa, Dr. Lindley called it *Panicum jumentorum*, thus confusing it with Guinea grass.

Further supplies of Para grass were received at Kew in six Wardian cases, shipped from Caracas by Her Majesty's Consul, Mr. J. Riddel. From these plants distribution was made (with full directions for cultivation) to various colonies in the eastern hemisphere, including New South Wales, Western Australia, Ascension, &c. In the first reports it was stated that Para grass was capable of resisting drought. This was shown by Mr. Riddel to be an error. It evidently prefers and, indeed, will only flourish in localities where it has abundant moisture. It is interesting to note that this distribution of Para grass from Kew by Sir William Hooker was one of the early operations undertaken by him to assist industries in the colonies. Such operations, since that time, have been consistently carried on for nearly 50 years.

The following extract from the report of the Government Experimental Farm, Poona, for the year ending March 31, 1894 (p. 5), gives the results of the experimental cultivation in India :—

“Mauritius Water Grass or Buffalo Grass.—This is the chief fodder grass of Ceylon. There it remains green all the year round, and is employed largely for feeding milk cattle. A few roots were obtained from the School of Agriculture Farm, Colombo. The plant can be propagated either from the roots or from the stoloniferous stems which grow out laterally along the ground, and root at every node. From these rooted nodes straight shoots spring up. When ready to cut, the grass is very thick, and stands about 18 inches high. Cattle like it, but it grows slower than Guinea grass, and does not give the same out-turn. It has this advantage, it thrives well in a damp, even a wet, situation. The best method of propagating is to cut the long lateral stems into short lengths. Broadcast these sparingly over the surface, and cover lightly with soil. The plot on the farm since it has become fully established has been cut twice, at an interval of 87 days. The yields of green fodder were :—

		Yields per Acre.
1st cutting	...	10,700lbs.
2nd cutting	...	18,020 “

14. *Panicum spectabile*, Nees,—A valuable fodder plant long established

in Brazil and other parts of tropical America. It is known as "Capim de Angola." According to Spruce it is also called "Canna Rana." The stem is stout, 5 to 6 feet high, with the nodes softly bearded. The leaves are 3 feet long and about an inch broad. The spikes are numerous, with the spikelets arranged in 4-6 series. It belongs to the same section of *Panicum* as the "Cockspur grass" (*P. Crus-galli*). By some it is regarded as only a robust variety of that species. The Brazilian specimens in the Kew Herbarium are, however, well marked. This grass was introduced, according to Martius, *Fl. Bras.*, ii., pt. 2, p. 143, from the south-west coast of Africa. It prefers moist situations, and spreads rapidly everywhere. On the Niger, Barter described it as an "aquatic grass 6 feet high." In East Africa Kirk speaks of it as supplying "the richest fodder for cattle." It is very widely spread in tropical America, in Cuba (Wright), Jamaica (MacFadyen), various parts of Brazil, and south as far as Paraguay. It is a very desirable grass to introduce into the East Indies. Seeds of "Capim de Angola" sent to Kew by Glaziou (*Kew Reports*, 1880, p. 16) proved to be "Para grass" (*Panicum muticum*, Forsk.).

15. *Panicum texanum*, Buckley.—"Blue-grass," "Colorado grass," "Buffalo grass," or "Austin grass." An annual grass little known outside Texas. The plant is furnished with an abundance of rather short, broad leaves, and the stems, which are rather weak, are often produced in considerable number from a single root. It grows usually from 2 to 4 feet high. It prefers rich, alluvial soils, but stands drought well, though on dry uplands the yield is much reduced. It is especially valuable for hay.

16. *Paspalum conjugatum*, Berg.—"Sour grass" of Jamaica. "Green grass" of Singapore. A low grass rooting at the nodes, seldom more than 1 to 2 feet high, leaves bright green, flat, and ciliate. The flowers arranged in two divergent spikes at the top of the stem. Widely distributed throughout tropical America and Africa. Introduced to Ceylon and East Indies. In Jamaica this grass forms the excellent "low-bite" pastures in the warmer parts of the island. It spreads rapidly, and covers the ground to the exclusion of everything else. In Ceylon this grass was described by Dr. Thwaites as growing well in shade and in places exposed to the sun, and it retained its fresh green appearance even during the dry season. It is a somewhat coarse grass, but when cut and slightly dried it has been found a very acceptable food to cattle and horses. In Singapore this grass is equally valued, and it deserved to be more widely known in the East.

17. *Paspalum distichum*, Linn (*P. vaginatum*, Sw.)—"Silt grass" or "Water couch." A coarse, somewhat tall grass, with creeping rhizomes and convolute, rarely flat, leaves. The flowers are arranged in two spikes. It is a common grass in pastures and wet places in tropical America, and extending also into temperate countries. It is said to be naturalised in south-western France. Probably indigenous to Australia, where it endures some frost, and is temporarily inundated. Will grow half emerging in shallow pools or wet meadows, and proves quickly fattening to cattle. It keeps beautifully green throughout the year, affords a sufficiently tender blade for feed, and is excellently adapted to cover silt or bare slopes on banks of ponds or rivers (Mueller).

18. *Paspalum sanguinale*, Lam. (*Panicum sanguinale*, Linn.)—A widely diffused annual grass, found in all warm regions of the globe. The stems usually rise to the height of 2 to 3 feet, and at the summit have from three to six slender flower spikes, each from 4 to 6 inches long. In cultivated areas this grass is a troublesome weed, as it spreads with amazing rapidity. Known in the United States as "Crab grass," where it is recognised as the most useful of all pasture grasses, it makes a sweet hay, and horses are exceedingly fond of it. Cotton and corn-fields in the south are often so overrun with it that the hay which might be secured would be more valuable than the original crop. In Fiji, Singapore, and Ceylon it is widely diffused near gardens and plantations. In the former country it is "the best pasture grass," while at Singapore Ridley says it makes an excellent "turf grass." *Panicum pabulare*, Aitch. & Hensl. (*P. ciliare*, D.C.) is a variety of *P. Sanguinale* described by Aitchison as the best fodder grass for cattle in the Kuram Valley of Afghanistan.

19. *Paspalum scrobiculatum*, Linn.—"Kodo" or "Koda" Millet of India. An erect growing annual grass, with stems about 2 feet in height. It is widely dispersed through the tropics of the eastern hemisphere, generally regarded as a valuable pasture grass, and as an ingredient for hay. It sometimes attains a height of 6 to 8 feet. The grain is largely used as food by the natives of India, but it is by no means a wholesome article of diet. Unless special precautions are taken, it is liable to act as a narcotic poison. Cattle, and especially buffaloes, eat the grass readily when it is young. The straw is occasionally used as a fodder. Animals are, however, carefully excluded from the fields when the crop is ripening, as they appear to suffer even more than men from the ill-effects of *Kodra* poisoning. It is the "Ditch-millet" of New South Wales and the *Herbe à épée* of Mauritius.

20. *Stenotaphrum americanum*, Kunth. (*S. dimidiatum*, Trin.)—"Pimento grass." (Jamaica), "Buffalo grass" (Australia). A perennial creeping grass, with wide-spreading rhizomes, seldom more than a foot high. Each joint of the rhizome bears a tuft of smooth, pale-green leaves. The panicle is 3 to 4 inches long, with a flat jointed rachis. This is an excellent grass for binding sea sand and loose soil of river banks. It flourishes on dry limestone soils in Jamaica, and affords nourishing food for animals pastured under the pimento trees. Hence its name. There seems to be a diversity of opinion as to its merits as a fodder plant in other countries. It keeps alive in the hottest and driest region of central Australia, where it was introduced by Sir F. von Mueller. It was successfully established also as Ascension, and it flourishes on the singularly arid volcanic rocks of that island. The plant has been grown for many years in pots and under the stage in the cool Economic House at Kew.

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INDEX TO COMMON NAMES.

The figures refer to the numbers at head of descriptions.

Austin Grass, 15
 Bahama Grass, 5
 Bermuda Grass, 5
 Blue Grass, 15
 Buffalo Grass, 15, 20
 Capim de Angola, 14
 Capim de Colonia, 10
 Colorado Grass, 15
 Crab Grass, 18
 Ditch Millet, 19
 Doorva, 5
 Doub, 5
 Dutch Grass, 12
 Green Grass, 16
 Guinea Grass, 10
 Indian Couch Grass, 5
 Kangaroo Grass, 1
 Kodo Millet, 19
 Mauritius Grass, 13
 Mitchell Grass, 4
 Oat Grass, 2
 Para Grass, 13
 Pimento Grass, 20
 Rice Grass, 8
 St. Mary's Grass, 10
 Scotch Grass, 13
 Silt Grass, 17
 Sour Grass, 16
 Teff, 6
 Teosinte, 7
 Water Couch, 17
 Water Grass, 13.

NOTES ON "NOTES ON COFFEE FROM LABORIE'S COFFEE PLANTER "

By J. A. STEPHENS.

Climate.—Probably 2,500 ft. to 3,500 ft. is the most paying altitude. He is a bold man who plants much above that.

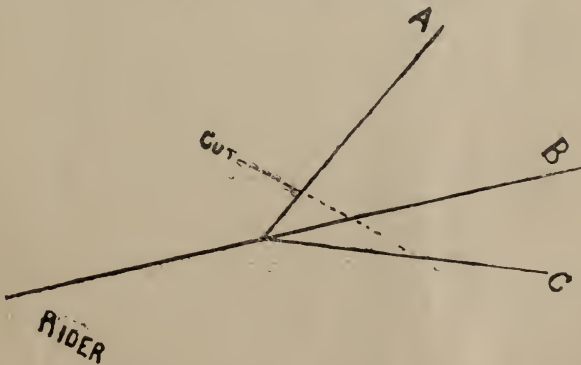
Soil.—Most hard woods, such as "Bully" and "Iron" wood, grow best on the *best* land, about here. [Radnor]

Laborie meant that plenty of running water would be required for the works, for driving wheels, pulp ng, washing, etc, he did not mean that it is good to have running water near coffee fields, (as the "notes" might lead some to suppose); for at a higher altitude than 2,000 feet. coffee should never be planted near running water, for if so planted the spray that arises from even small water-falls is wafted over the fields by the wind, and together with the cold currents of air that running water itself creates, keeps the coffee wood green and soft, prevents it maturing, and often causes the trees to drop their leaves altogether.

Planting out.—The method of planting out should vary with the nature of the land, for instance, in light land "firm" with the two *feet*, and then throw a little more earth round the plant; in heavy land, only just "settle" the plant. If coffee is planted in stiff land so deep that the "lower branches are below the level of the ground," the plant *may* live, but certainly they will not grow as they ought.

Shade during 1st year.—When Laborie wrote, he *had to feed* his labourers. Boiled green corn and beans (locally known as "red peas") are good and "filling" food, but the plan of planting corn and beans through young coffee cannot be too strongly condemned, the cost of weeding the young coffee would be greatly increased by this plan, and a good deal would be taken out of the land that ought to go solely to the coffee trees.

Pruning.—As regards the pruning of lower fields, Laborie has said all there is to be said, but my system on the higher fields differs from his. My system on the high fields is—cut out many of the under boughs right "home" to the main stem, so as to let in air and light under the trees, to dry up the moisture of the ground, doing as little as possible to the heads of the trees; from the heads of the trees only cut back exhausted boughs, break out dead wood, pull suckers, single riders, and "lead out" what riders are left on, so—



cut off A B and leave on C to spread out and increase the circumference of the tree; by this plan the trees become more or less "umbrella trees," but they bear more than the few berries on the heads that Laborie despises.

PARA GRASS versus GUINEA GRASS.

Some time ago, a penkeeper in St. Ann stated that a weed which he called "White Head" was growing up through his Guinea Grass, and killing it, and that he was therefore substituting Para Grass for Guinea Grass.

Lately, another Correspondent writes as follows, to complain of this same weed:—

"Can you tell me anything about the enclosed. It is a 'weed' that, I am told, made its appearance in St. Ann shortly after the '81 hurricane, and has become a great nuisance in the Guinea Grass pieces? Stock eat it readily, and on the Commons it is not out of place. Sheep are so fond of it they soon eat it out, but in Guinea Grass it does damage, suppresses the grass, and costs a good deal for cleaning."

The weed is one of a number of different species which are known sometimes as "Button Weeds." This particular species, *Spermacoce tenuior*, is very widely distributed throughout the West Indies, and tropical and sub-tropical America.

Careful watching and instant killing may keep it out, but there is no means of exterminating it, if it has once got possession of a field of Guinea Grass.

On enquiry as to the success of the Para Grass in St. Ann, the following reply has been received:—

"I have planted Para Grass and am still planting it in all my Guinea Grass pastures, as it is the only grass that kills the White Head Weed. It is a perfect success. On wet soil plant the Para Grass about 14 inches apart and on dry soil 6 inches. If time is given, on the very poorest soil, it will take strong root and kill even hog-neat and other bad creepers. The above grass fattens quicker than Guinea Grass, produces much heavier crops and lessens cleaning expenses. When thoroughly established, it requires no cleaning, and, of course, this gives it a pull over all other feeding."

The whole subject of grasses for fodder is so important to Penkeepers in the Island, that in this month's issue is reprinted a most valuable article from the KEW BULLETIN on *Tropical Fodder Grasses*.

THE VANILLA MARKET.

The extraordinary advance in the price of vanilla which has been going on for some months is sufficiently peculiar to warrant a review of the causes that have brought about the ruling quotations.

Mexico, the country from which, originally, all the vanillas of commerce were derived, has long ceased to have any direct interest for the European vanilla-dealer. The bulk of that portion of its crop which is exported finds a sale in the United States, and it is only when an abundant Mexican supply causes an overplus to be thrown upon the European market, or when, in scanty years, the United States have to supplement with Eastern vanilla the want that Mexico is temporarily unable to fill, that the condition of the Mexican crop arouses a certain amount of interest in England and France.

In normal times the European vanilla supply is drawn from the islands in the Indian Ocean that cluster around Madagascar, to wit, the English possessions of Mauritius and the Seychelles Islands, and the

French colony of Réunion, or Bourbon, as it used to be called. To these sources of production must be added intermittent supplies from the Comorin Islands (French), north-west of Madagascar, from Madagascar itself, from Fiji, from Ceylon, and from a few West India islands. But the last-named islands supply only small quantities, and as their vanilla is usually of a very inferior quality it may be left out of account in a review of the general market position.

The lineage of almost all the vanilla now produced in the eastern hemisphere can be traced back to plants of *Vanilla planifolia* brought to England from Mexico early in the present century, and propagated in the botanical collection of the Right Hon. Charles Greville in the unromantic neighbourhood of Paddington. From those suburban hot-houses plants were sent to Java and to Réunion, where, after a few unsuccessful attempts, a valuable industry was established. In an account of the Réunion vanilla culture, published over twenty years ago by M. Deltiel, it is recorded that the vanilla plants introduced into Réunion remained sterile until, about the year 1841, a slave named Albius discovered the method of artificial fertilisation of the flowers which has since been practised in the Indian islands. Two years earlier, however, Professor Morren, of Liège, had read a paper referring to the artificial fertilisation of vanilla before the British Association, and Albius may therefore have been a plagiarist, or—what seems more likely—an independent discoverer of the *sec et*

Be this as it may, the vanilla industry in the islands of the Indian ocean is now firmly established, although its profits are precarious. When vanillin was first introduced as a commercial article, now a good many years ago, the planters and others interested in the vanilla trade were much scared at the new competition; but events have shown that their fears were unfounded, for although the use of vanillin may have prevented the consumption of vanilla from assuming such large proportions as it would otherwise have done, it has not in the least proved an obstacle to the profitable cultivation of the vanilla plant, and it is notorious that the employment of vanilla has greatly increased of late years. It is also noteworthy that vanillin is now lower in price than it has ever been, while fine vanilla realises higher figures than it has done for years. It seems, in fact, that in many instances the commercial preparation of a synthetic product, after creating a temporary depression in the market of the natural drug which it is intended to replace, finds a place side by side with the sale of that product, and remains thereafter comparatively powerless to affect the commercial position of the natural article. Cumarin and artificial musk are cases in point in addition to vanillin.

The future course of the vanilla market will be largely influenced by the receipts of Réunion (Bourbon) and Seychelles vanilla in the course of the next three months. When the first arrivals of the new vanilla crop came to hand in October, the stocks had fallen to a very low point everywhere. Since then there has been but little chance of accumulation owing to the strong demand, but at present the bulk of the crop is coming in, and it remains to be seen whether buyers will be able to absorb it with a rapidity approaching that with which it arrives. The principal stock of vanilla in Europe is usually kept in France, especially at Paris and Bordeaux, where the bulk of the Bourbon crop is received

in consignment, and whence considerable quantities are habitually sent to London for sale. In September, just before the arrival of the new crop, a stock of from 15,000–20,000 kilos in Bordeaux, and as big a one in Paris and Marseilles combined, used to be a fair average, but this year the supplies in France did not by any means reach the lowest of these figures, while the London stock was below, rather than above, its usual scanty figure of about 2,000 lbs. The crops of vanilla in Réunion, Maritius, and the Seychelles have been unusually small, and it is said that the crop which is now beginning to arrive will again be a very poor one, while reports of total failure have come from Mexico for many weeks. As the United States require from 130,000 to 150,000 lbs. of vanilla every year, they have been obliged for some time to purchase vanilla in Europe, and their orders have helped not a little to increase the competition and advance the market price of the drug. The American requirements are probably rather larger than those of the rest of the world together, and we do not estimate the total consumption of vanilla at much over 250,000 lbs. a year. Setting aside the Mexican production, and that from the smaller sources of supply, we can count upon an average output of about 160,000 lbs. a year in Réunion, and of about 60,000 lbs. a year in Mauritius and the Seychelles. With an average crop, therefore, the present production of vanilla is ample, and if the exceptionally high prices of this year should lead to an extension of cultivation, we may be confronted with a large over-production within a very few years. For although vanilla is very sensitive to climatic influences, the plant is easy of propagation and yields a rapid return, as the vines begin to bear in their third year, and may continue to yield fruit until their fortieth. Fortunately for those who sell the article, it seems that comparatively few planters can grow it successfully. In Java, where vanilla was introduced in 1819, the culture was at one time of great importance, but at present the island hardly counts as a producer. In Mauritius, also, vanilla-growing seems to be dying out. The exports from that island fell from 37,600 lbs. in 1892 to 15,400 lbs. in 1893 and 9,100 lbs. in 1894. Réunion exported her first vanilla to Europe in 1849. That shipment was only 7 lbs., but by 1870 the exports had grown to over 20,000 lbs. Since then the largest Réunion crops have been 190,000 lbs. (1891), 207,000 lbs. (1892), and 175,000 lbs. (1893); but last year there was a great decrease. The production of the Seychelles has been exceedingly erratic lately. These islands first sent their produce to Europe in 1885. In the succeeding years they quickly rose to an output of about 80,000 lbs., but equally quickly dropped off again to about 17,500 lbs. a year. According to the latest reports, however, the output next year is likely to show a great increase. The Seychelles and Mauritius vanilla is generally shorter, paler, and fainter in odour than that from Réunion, and realises lower prices.

The vanilla crop which is now arriving in Europe is that which flowered in the autumn of last year, and was collected from May to July. The last great advances in the market prices of vanilla have been in the autumn of 1886, after which prices remained high until the large crop of 1887 broke the market, and in April 1889, when the reported destruction by rain of the Mexican crop caused an advance of \$1 per lb. in New York in a single day. This movement also lasted several months.—*Chemist & Druggist*.

FERNS : SYNOPTICAL LIST—XXXIII.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Gardens, Demerara.

7. *Nephrodium oligocarpum*, Jenm.—Root-stock erect; stipites tufted erect, slender, 4–6 in. l. light brown, puberulous, with a few pale scales at the base; fronds bipinnatifid, lanceolate, reduced both ways, $1\frac{1}{2}$ –2 ft. l. 4–6 in. w., chartaceous, light green, surfaces more or less freely pubescent; rachis slender, channelled, light coloured, pubescent; pinnæ spreading contiguous, numerous, sessile, $2\frac{1}{2}$ – $3\frac{1}{2}$ in. l. $\frac{1}{3}$ – $\frac{2}{3}$ in. w. tapering to a finely acuminate serrate-entire point, deeply pinnatifid, lower ones dwindling distinct small auricles; segments close, connected at the slightly dilated base, linear-ablong, blunt, 1 – $1\frac{1}{4}$ li. w. $2\frac{1}{2}$ –4 li l., chartaceous; margins even or slightly crenulate and reflexed; veins simple, evident on the upper surface, 6–8 to a side; sori submarginal or nearer the margin than rib, involucre pubescent.—*Aspidium*, Kth.

Common both in forests and open places above 3,000ft. altitude. Dominica, Guiana, (Adpun n. 1138) This has much the character of *conterminum*, but is not so lax in habit. It is best distinguished by its light green colour, pubescent surfaces and sori closer to the margin than midrib. The pubescence of the surface, and the texture, varies with the situation of growth.

8. *N. Kaulfussii*, Hook.—Rootstock erect; stipites caespitose, 4–8 in. l. downy, slender; fronds bipinnatifid, 1 – $1\frac{1}{2}$ ft. l. 4–6 in. w. oblong-lanceolate, the acuminate apex pinnatifid, the lower 2–3 pairs of pinnæ reduced, the lowest conspicuously, firmly chartaceous, all parts grayish and more or less pubescent; pinnæ 3–4 in. l. 6–8 li. b. contiguous but apart, spreading, sessile, the tapering point serrate-entire, below this deeply pinnatifid; segments very close, round pointed, or subacute, 3–4 li. l. from the sharp sinus, $1\frac{1}{2}$ li w.; margins even or crenulate; veins simple; sori medial; involucre densely ciliate, fugacious or not.—*Aspidium*, Gr.

Infrequent or rare above 2,000 or 3,000 ft. altitude. There are Jamaica specimens of this in the British Museum Herbarium but none from this source at Kew. Grisebach unites it with *oligocarpum* Kth., and ascribes it to St. Vincent also. It has a grayish aspect something like *jamaicense*, but is less stiff and all the veins are quite free.

9. *N. conterminum*, Desv.—Rootstock erect; stipites erect, dark with a few deciduous scales at the base, 2–3 in. l.; fronds bipinnatifid lanceolate, or ovate-lanceolate, 2 – $2\frac{1}{2}$ ft. l. 6–9 in. w., reduced at the base to mere auricles; chartaceous or subcoriaceous, pellucid; naked, upper dark clear green, under paler; pinnæ in distant or subdistant widely spreading, opposite sessile pairs, which are broadest at the base and thence taper gradually to the attenuated long subentire finely acuminate point, central ones 3–5 in. l. $\frac{1}{2}$ – $\frac{3}{4}$ in. w. at the base, cut almost to the rachis into close, oblong, rounded or bluntnish segments, the inner ones of which are 3–5 li. l. 1 – $1\frac{1}{2}$ li. w., the basal pair the largest and crenate or lobate; margins entire, reflexed; veins simple, 6–10 to a side; sori intramarginal and often partly covered by the reflexed margin, involucre as large, pale, naked rachis channelled, stiff but rather

slender, bright glossy pale or chestnut brown.—Plum. Fil. t. 47.—*N. sitiorum*, Jenm.

Frequent or infrequent on open banks skirting forests at 4,000 ft. altitude; gathered at Moody's Gap, where it grows with *N. nimbatum*. It possesses the bright straw or semichestnut colouring of *N. Jenmani*, but is a much smaller plant. Stipes and rachises are slender, pinnæ in distant opposite narrow patent pairs, diminishing gradually in a direct line from the base outwards, the long acuminate and attenuated apices usually entire, the basal segments enlarged and increasing in size as the pinnæ dwindle to very minute auricles on the short stipites, the upper and larger of the two from the obliquity of the base of the pinnæ, overlapping the rachis, the sori intramarginal and the margins reflexed. There is a specimen from Wilson in Herb. Kew, assigned to *concinnum*, which species however has a wide-creeping rhizome.

10. *N. Sprengelii*, Hook.—Rootstock erect, stoutish, often a span high; stipites strong, cæspitose, stiffy erect, 4-8 in. l., channelled, scaly and dark-coloured at the base; fronds bipinnatifid, erect, 1½-4 ft. l. 6-12 in. w., chartaceous, naked or slightly glandulose, bright green; reduced gradually each way,—at the base to distant minute segments or mere glands, which reach nearly down the stipites; pinnæ contiguous above, subdistant or distant below, usually opposite, numerous, spreading, nearly horizontally, bearing a papillose gland at the base beneath, sessile, broadest at the base and tapering gradually outward to the finely acuminate serrate-entire point, 4-7 in. l. ½ nearly 1 in. w.; cut almost to the costæ in'o close spreading bluntish or acute subfalcate segments, which are 4-6 li l. and 1-1½ li. w. at the connected, but slightly dilated bases, the basal pair usually the largest the edges even and reflexed; rachis strong, subangular, stramineous, naked or with a few scattered fibrillæ toward the base; costæ and ribs puberulous; veins simple, 12-15 to a side, close; sori medial or nearer the margin; involucre pale, naked, fugacious.

a. var. rivulorum. Fronds smaller; segments not reflexed at the edges.—*Polypodium rivulorum* Radd. Planl. Brasil, t. 35

Common on the open banks, by waysides, and in marshy places from the lowlands up to 4,000 or 5,000 ft. altitude. Probably spread from Florida right down through the West Indies, but the species has been much confounded. It has the upright habit, especially the large lowland state has, of *resino-fætidum*, but is less stiff and the margins are less decidedly reflexed over the sori. The sori are really medial, but the folding back of the edges of the margins, makes them appear nearer thereto than to the midrib, except in *a*, the smaller mountain state.—*Aspidium*, Klf.

11. *N. limbatum*, Desv.—Rootstock erect, scaly; stipites erect, 4-6 in. l., dark, and deciduously scaly at the base; fronds bipinnatifid, 1½-2½ ft. l., 6-8 or 10 in. w., chartaceous, naked or puberulous-glandulose, bright green above, paler beneath; reduced each way, gradually at the base to minute segments or mere glands; pinnæ numerous, spreading nearly horizontally, sessile, with a gland at the base beneath, where they are broadest, thence tapering to the acuminate serrate-entire point, ½-¾ in. b., 3-5 in. l., pinnatifid nearly to the costæ; segments close, linear-oblong, blunted or rounded, connected but not, or barely dilated at the bases, 1½ li. b. 3-4 li. l.; margins crenate-entire, or the

basal pair, which are largest, serrate; rachis stramineous, naked; veins simple, 8-10 to a side; sori submarginal, exposed or half covered by the reflexed edge; involucre pale.—Sl. t. 49. fig. 1.—*Aspidium*, Swartz. *Amauropelta*, Kze.

Infrequent at 4,000-5,000 ft. altitude. Resembling somewhat some of the forms of the preceding, but distinguished by the distinctly submarginal sori. In my specimen the pinnæ are alternate, and the rachis is rounded and muricate beneath. The segments are nearly an equal width from base to apex, and the margins are subcrenulate and reflexed on to the sori.

12. *N. Sheringii*, Jenm.—Rootstock stout, erect, often a span or more high, stipites many, cæspitose, erect, 4-10 in. l. strong, fibrillose, dark and paleaceous at the base; fronds erect, ample, bipinnatifid, 3-4½ ft. l. 1-1¾ ft. w. reduced at the base to distant segments or mere glands; pinnæ very numerous, distant at the base, contiguous, above, spreading nearly horizontally, opposite, or contiguously alternate, 6-10 in. l. 1½-2½ in. b., sessile, with a strong gland at the base beneath, pinnatifid, almost to the costæ; segments linear, ¾-1¼ in. l. 1½ li. w. acute or blunted, crenate, serrate, lobed or even pinnatifid with a rounded sinus and their own width, more or less, between them, slightly dilated at the connected bases; rachis strong, sub-angular, channelled, glandulose puberulous, stramineous or brown; above, costæ stramineous, channelled, finely ciliate; veins pellucid, simple, forked, or pinnate in the pinnatifid pinnulæ, 16-20 (or 25) to a side; sori medial; involucre pale, puberulous-glandulose, enclosing the sori at first.—*Journ. Bot.* vol. 8. p. 261.

Common in open places among the Port Royal and Portland mountains at 2,000-4,000 ft. alt.. This is probably a variety of *Sprengelii*, tending to a tripinnate state. The two plants are however sufficiently distinct. The pinnæ do not taper from the base outwards as in that species, but widen rather above the base. It rivals even *Jenmani* and *resino-fetidum* in size, and the plants form large masses, several growing together, standing 4-5 ft. high. The segments are generally of irregular length and the space between them varies.—Endemic.

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

- Bulletin Royal Gardens, Kew. No. 107. Nov., 1895. App. I. 1896. [Kew.]
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 Prac. Agri. Horti. Socy. of Madras. July-Sept., 1895. [Secy.]
 W. I. Home Builder. Dec., 1895. [Editor.]

SEEDS.

From Royal Gardens, Kew.

Bentinckia nicobarica Cyrtostachys Renda var. Singaporiana
 Protea longiflora Fuchsia Kirkii.

From P. L. Vendryes, Esq.

Begonia (two packets).

From W. Jekyll, Esq.

Orange.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of March:—

IN FLOWER.	IN FRUIT.
Acacia cyanophylla, Lindl.	Araucaria Bidwillii, Hook.
Archontophoenix Cunninghamii, H. Wendl. & Drude	Areca Catechu, Linn.
Artocarpus Lakoocha, Roxb.	Archontophoenix Cunninghamii, H. Wendl. & Drude
Aspasia variegata, Lindl.	Barringtonia Butonica, Forst.
Bignonia magnifica, Bull	Bignonia magnifica, Bull
Brownea Rosa-de-monte, Berg.	Cananga odorata, Hook. f. & Thoms.
Cananga odorata, Hook. f. & Thoms.	Caryota urens, Linn.
Carludovica gracilis, Liebn.	Cocos flexuosa, Mart.
Cinnamomum Camphora, T. Nees & Eberm.	Coffea liberica, Hiern
Cinnamomum zeylanicum, Nees	Colvillea racemosa, Boj.
Cocos australis, Mart	Diospyros discolor. Willd.
Coffea liberica, Hiern	Dictyosperma album, H. Wendl. & Drude
Dictyosperma album, H. Wendl. & Drude	Dillenia indica, Linn.
Diospyros discolor, Willd.	Diplothemium caudescens, Mar.
Dypsis madagascariensis, Hort.	Dypsis madagascariensis, Hort.
Elettaria Cardamomum, Maton	Elettaria Cardamomum, Maton
Erythrina umbrosa, H. B. & K.	Entada scandens, Benth.
Erythroxyllum Coca, Lam.	Erythrina umbrosa, H. B. & K.
Faradaya splendida, F. Muell.	Hibiscus elatus, Sw.
Garcinia indica, Choisy	Livistona australis, Mart.
Hevea brasiliensis, Muell. Arg.	Livistona chinensis, R. Br.
Hibiscus elatus, Sw.	Manihot Glaziovii, Muell. Arg.
Jacaranda filicifolia, D. Don	Mimusops Elengi, Linn.
Landolphia florida, Benth.	Musa textilis, Néé
Mesua ferrea, Linn.	Oreodoxa regia, H. B. & K.
Michelia Champaca, Linn.	Pachira aquatica, Aubl.
Mimusops Elengi, Linn.	Pachyrhizus tuberosus, Spreng.
Musa textilis, Néé	Pandanus utilis, Bory
Napoleona imperialis, Beauv.	Pterospermum acerifolium, Willd.
Pachira aquatica, Aubl.	Sapindus Saponaria, Linn.
Pachira Barrigon, Seem.	Semecarpus Anacardium, Linn.
Pithecolobium dulce, Benth.	Strychnos Nux-vomica, Linn.
Pterospermum acerifolium, Willd.	Terminalia Arjuna, Wight & Arn.
Quassia amara, Linn.	
Stiftia chrysantha, Mikan	
Strychnos Nux-vomica, Linn.	

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

Agricultural Chemistry of the Sugar Cane	-	49
Cultivation of Tomatoes	-	61
Notes on Oranges and Lemons	-	62
Distribution of Seeds and Plants	-	63
Pasteurisation of Milk	-	63
Orchids at Hope Gardens	-	65
Ferns: Synoptical List.—XXXIV	-	66
Contributions to the Department	-	69
Castleton Gardens	-	71

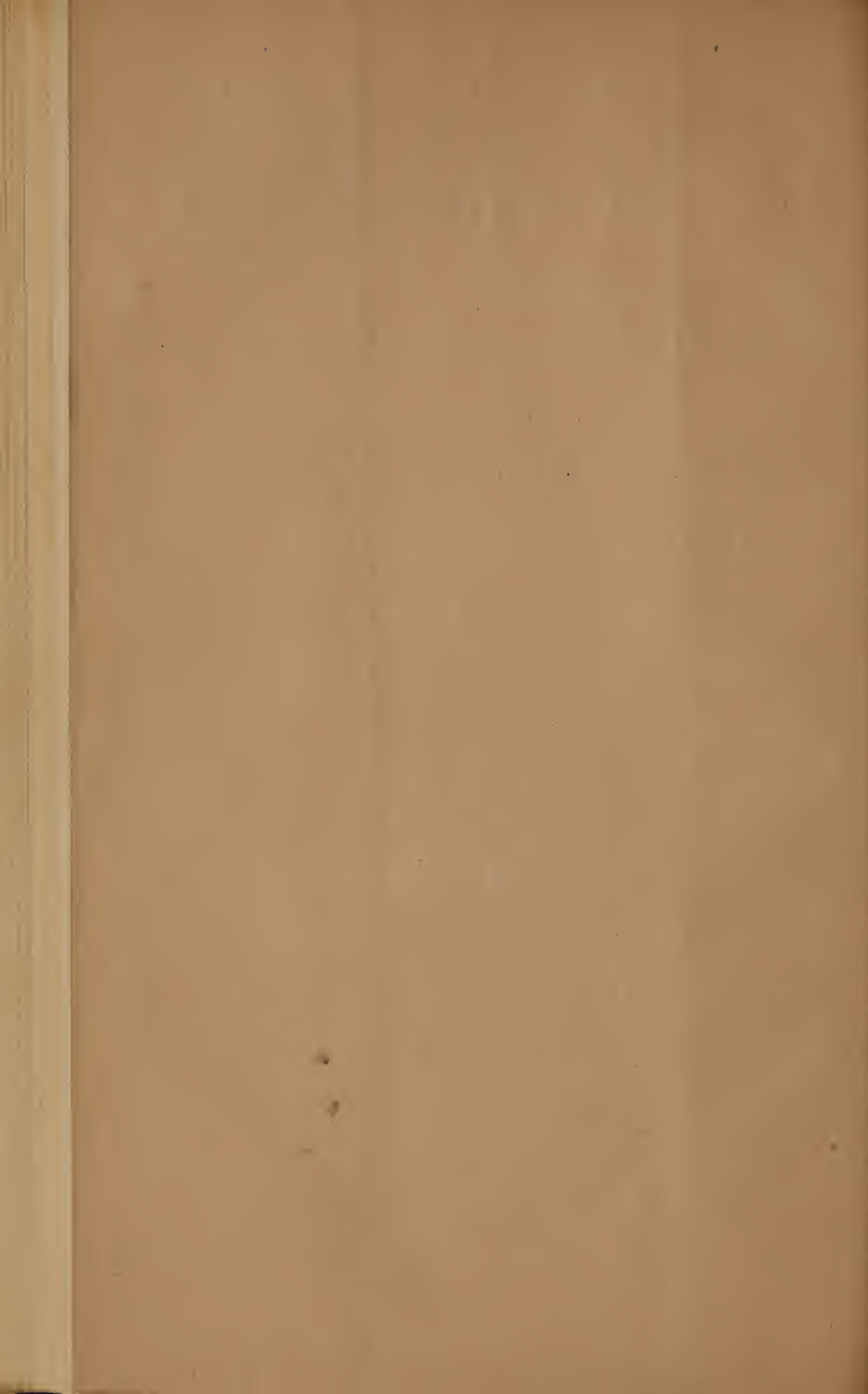
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BULLETIN

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Vol. III.

Part 3.

OBSERVATIONS OF THE AGRICULTURAL CHEMISTRY OF THE SUGAR-CANE.

By T. L. PHIPSON, PH. D., F. C. S. *

I.

About the year I a remarkable man, named Columella, left his native town of Gades, now called Cadiz, and travelled through Spain, Gaul, Italy, Greece, and Asia Minor, in order to collect facts for a great treatise on Agriculture. He even extended his journeys to the coast of Africa, and finally settled at Rome, where he produced his work, "De re rustica," in twelve books and a preface. The latter, I must confess, is that portion of the work which has interested me more than the rest; for after an interval of nearly 2,000 years, I find his words as full of truth and wisdom as they were at that distant period above-mentioned.

Whilst deploring the degraded state of Agriculture in his time, he exclaims: "I see around me schools for preachers, dancers, musicians, and tumblers; cooks and barbers are also in vogue; houses of ill-fame and gambling establishments everywhere attract the imprudent youth; but, as to the Art which teaches how to fertilise the earth, it has neither professors, pupils, justice, nor protection. * * * And if I complain of this neglect I am told that the soil has become barren * * * !"

It is hard to think that little progress has been made in Agriculture since the year I; but we must concede that whatever has been done since that remote epoch has been achieved almost entirely within the last fifty years. We have now several schools of Agriculture properly so-called, but we find the professors devoting much of their time to commercial analyses, instead of employing their precious moments to unveil the hidden secrets of the earth. It seems to be of greater importance to them to determine whether a sample of artificial manure is adulterated or not by the maker, than to discover why a field of canes is productive in one case and unproductive in another.

* This article appeared first as a pamphlet in 1873. As it is a valuable essay from which much can be learnt, even by those who cultivate other products besides sugar, and as it cannot now be obtained, it has been thought well to reprint it here.

To the sugar-planter the question of soils and manures is doubtless becoming more important every day, and any practical observations upon a subject which affects to so great an extent the future prosperity of our West Indian Colonies cannot fail, I believe, to have a certain degree of interest at the present time.

II.

It is not very long ago since the great chemist, Justus von Liebig, showed that by burning a plant and analysing the ash we not only learnt what that plant derived from the soil, but the food necessary to render it luxuriant in a given soil. However, when Liebig asserted that the mineral ingredients found in plants were its only true and natural food, Professor Boussingault, who, with Dr. Mulder and Sir H. Davy, must be looked upon as one of the fathers of Agricultural Chemistry, simply refuted the theory by applying the ashes of farm-yard manure and an equivalent of farmyard manure itself, side by side, upon the land. The latter gave luxuriant crop; the former produced nothing. In fact, I have convinced myself that *the burning of a vegetable to procure the ash renders the mineral food it naturally contains almost useless as manure.*

More recently the laborious experiments of Lawes and Gilbert have weakened the faith of agriculturists in mineral manures, though Lawes himself has long been a manufacturer of them, and at the outset of his agricultural researches took out a patent for making superphosphate. The results obtained by these gentlemen *have not overthrown the fact originally proclaimed* by Liebig, that the mineral substances found in the soil and in the crops are of the greatest importance to the agriculturist; they have merely shown once more that nitrogen is likewise necessary, and after some twenty years of experiments have arrived at the conclusion that *the largest crops were obtained when the mineral and nitrogenous manures were employed together.*

This applies more particularly to the wheat plant, which belongs, however, to the same family as the sugar-cane. Both are plants of the grass tribe; but the one is cultivated for the *seed*, and the other for its *saccharine juice*. Turnips, on the other hand, are grown principally for the roots, and it has been found by direct experiments that on most soils acid superphosphate is a very advantageous manure for this crop. But should we send out turnip manure for the sugar-cane? I think not. Direct experiments, extending over a long series of years, have shown that on the average soils superphosphate alone does little or no good to wheat; how can we expect that it will affect the sugar cane? It contains a large amount of free acid, which the cane cannot touch until it is neutralised by the lime or potash of the soil; and long-worked cane soils are for the most part already much too acid.

Sulphate of ammonia, largely employed in Demerara and elsewhere, acts as a powerful stimulant upon all graminaceous plants growing on average qualities of soil. With regard to the sugar cane, its immediate effect is the rapid rise of the green cane, and often the production of a watery juice, poor in sugar. It is moreover a highly exhaustive manure, causing the plant to take up lime, potash, and phosphoric acid from soils well-nigh worked out, and giving, *for the time, the appearance of extraordinary fertility.*

We know also that cane trash is burnt and the ash restored carefully to the soil in almost all the West India Islands and Demerara. Unfortunately for the cause of the sugar-planter, this cane trash is used there as fuel, and we cannot expect to get work twice out of the same material. If it were fermented in a moist heap like stable manure, it would yield its fertilising elements to the soil and the plant; but when burnt its nitrogen is gone, its silica and lime have become almost completely insoluble and unavailable, and it can only supply directly a certain moderate amount of potash. But cane soils lose their lime long before their potash is all gone.

Add to the substances already named Peruvian guano—not only a very costly manure, but one which, injudiciously applied, is very apt to endanger a crop of sugar—and we have nearly all the auxiliaries to labour which, until recently, the sugar-grower has had at his disposal, and has employed in many cases without sufficient knowledge of the requirements either of the cane or the soils in which it is planted.

III.

Let us now proceed to glance at the requirements of the sugar-cane, and those of the long-cultivated soils of our Colonies; the differences presented by the soils of new and old plantations; the manures best suited to restore the soil of partially-exhausted estates, and to ensure the largest yield of sugar in the stiff clays of Demerara, Barbadoes, Jamaica, &c.

The composition of the fully-developed sugar-cane may be very fairly represented by the following good average analysis:—

SUGAR CANE.			
Water	...	...	71.04
Sugar	...	...	18.02
Cellulose	...	...	9.56
Albumine	...	...	0.55
Fatty and colouring matters	...	...	0.35
Salts soluble in water	...	...	0.12
“ insoluble “	...	...	0.16
Silica	...	...	0.20
			100.00

So that a thousand tons' weight of cane takes up from the soil a little more than four tons of mineral ingredients, and if the soil cannot supply these four tons in the proper form—*i. e.*, capable of being assimilated—no crop of sugar can be raised. About one ton of nitrogen is required to form the albuminous matter of one thousand tons of cane.

The next question that presents itself is, What are the nature and relative proportions of these mineral ingredients derived from the soil? This is obtained by careful analysis of the ash of the full-grown cane and its leaves. There exists great discrepancy in the various analyses of cane ash that have hitherto been made, the cause of which I shall

allude to immediately; so that for the present I can only give the following rough average of a certain number of analysis of the ash of the ripe cane with its leaves. It will serve us to form at least a very approximate notion of the relative proportions of each substance taken from the soil during the life of the cane :—

ASH OF FULL-GROWN CANE AND LEAVES.			
Silica	...	...	43.0
Phosphoric acid	...	...	6.0
Sulphuric acid	..	...	8.0
Chlorine	...	...	4.5
Lime	...	...	10.0
Magnesia	...	...	6 5
Potash	...	...	18.0
Soda	...	...	2.0
Oxide of iron, manganese, and loss in analysis			2.0
			100.0

The largest figures are those of *silica*, *potash*, *lime*, and *phosphoric acid*; but *sulphuric acid* and *magnesia* appear to have their importance also, whilst *chlorine* and *soda*, though represented by comparatively small figures, are usually present as chloride of potassium and chloride of sodium to the extent of 4 or 5 *per cent.* The principal substances required in an available state in a cane soil are, therefore, nitrogen, potash, silica, phosphoric acid, sulphuric acid, lime, and magnesia. We may state at once that oxide of iron and oxide of manganese are, perhaps, also essential, for in a long series of interesting experiments made in 1849 by the Duke of Salem-Horstmar, a chemist of much experience, the conclusion was drawn that a graminaceous plant (the oat) absolutely required for its complete development *all* the mineral substances we have just mentioned.

As to the relative importance of each substance in particular, it is a difficult problem to solve. We know by experience that the composition of the ash of any plant varies very considerably with the period of the year at which the plant is cut, and the parts of the plant that are burnt for analysis; so that it is by no means an easy task to state with scientific accuracy what substances any plant takes in largest quantities from the soil.

It is, however, a fact of the greatest interest that for a given plant the mineral ingredients derived from the soil are constantly found *in the same relative proportions*, and the same law holds good for the various portions of a plant, provided that we consider them *in a state of maturity*—*i. e.*, when each portion has done all the work that is allotted to it by Nature.

I was requested some time ago to draw up a report upon a number of analyses of sugar-cane executed by chemists whose results could be thoroughly relied upon, and to explain, if possible, why they differed so widely with regard to the relative amounts of potash, phosphoric acid, silica, &c., found by each of them, and occasionally by the same chemist. After submitting the matter to a careful investigation it was found, not

without some difficulty and a voluminous correspondence, that the only conclusion possible was that the canes had been submitted to analysis *at various periods of their growth*, consequently the results could not be expected to coincide.

More recently I undertook an extensive series of analyses of the coffee-plant and the soils on which it grew. This furnished me with the counterpart of the above proposition. I was requested to make these analyses in order to ascertain what materials the coffee-tree took from the soils, what the soils supplied in largest quantities, what they were deficient in, and what kind of manure would be requisite to increase the crops of berries without impoverishing the soil of the estates.

I sought in vain through the works and journals which I possess, or have access to, for some analysis of the kind. It was only when the work was finished and my results obtained that a friend found for me an old analysis of coffee-berries, made by an eminent chemist about thirty years ago, and the figures coincided in a most remarkable manner with those I had just obtained. Now these coffee-berries had been grown in the *West Indies* some thirty years before, and mine came from Ceylon! It then struck me for the first time that the analyses of the mineral ingredients of *plants burnt after they have arrived at maturity* must generally coincide, and *can alone teach us accurately what any plant takes from the soil*. The reason that the analyses of these coffee-berries gave results so precisely similar was that *the berry in both instances was ripe*.

Again, I was exceedingly interested to find that the analysis of the ash of some Virginian tobacco grown in the Royal Botanical Society's Gardens in London, and kindly forwarded to me by Colonel Platt, presented precisely the same composition as that grown in America; so that neither change of soil nor of climate had influenced the relative proportion of mineral matter and organic matter, nor that of the principal ingredients. The plant had taken from the soil of London the same materials, and in the same relative proportions that it is found to take them from the soil of Virginia.

IV.

In order to appreciate the actual state of the cane soils in our West Indian Colonies we cannot do better than consider, in the first instance, the composition of two soils (chosen with care from a considerable number that have been analysed by me within the last few years), representing *a new soil* and *an old soil*. The first, A, is from an estate in Jamaica now under canes for the first time; the other, B, is from a plantation in Demerara which has been worked more than *fifteen* years consecutively. It is not difficult to see how valuable a lesson is to be learnt from these two analyses alone, but some others are given further on.

Let me simply add that to the eye of the most experienced planter or chemist there was scarcely any appreciable difference in the aspect of these two soils; the sample A was merely a clay of rather darker colour than B, but nothing in their external appearance could have indicated the widely-different composition which they gave on being carefully analysed:—

TYPES OF CANE SOILS.

	A.	B.
Moisture	12.25	18.72
Organic matter and combined water	15.36	6.03
Silica and insoluble silicates	48 45	68.89
Alumina	13.80	2.50
Oxide of iron	6.72	2.60
Lime	0.99	0.08
Magnesia	0.29	0.25
Potash	0.11	0.10
Soda	0.70	0.09
Phosphoric acid	0.10	0.03
Sulphuric acid	0 30	0.03
Chlorine*	0 51	trace.
Oxide of manganese, carbonic acid, and loss in analysis	0.42	0.68
	100.00	100.00
Nitrogen (in organic matter) ...	0.31	0.05

To persons accustomed to discuss analyses of soils nothing can be easier than to see that in A we have everything that is requisite to grow canes for a considerable numbers of years, whilst B is a soil fast approaching to exhaustion. I will merely call attention here to the greater amount of *organic matter* (humus), *nitrogen*, *lime* and *phosphoric acid* in A, and to the important fact that in B the quantity of lime, 0.08, is far below that of the magnesia, 0.25. This I have ascertained to be a very bad sign in cane soils, and it will probably be found to be so in soils devoted to the cultivation of almost any other plant.

It appears, indeed, from the results of a numerous series of analyses carried on in my laboratory for some years past, that *the degree of exhaustion which a cane soil has undergone can to a great extent be ascertained by comparing the relative amounts of lime and magnesia yielded to analysis*. Here are four examples from the *same estate* in British Guiana, from *various portions* of which the samples were taken:—

CULTIVATED.

	10 to 15 years.		Upwards of 60 years.	
Lime (per cent.) ...	0.44	0.64	0.11	0.40
Magnesia ...	0.32	0.50	0.36	0.51

I might, perhaps, have found still more striking examples, but these will suffice to show how the *lime* has disappeared (from the *same soil*) by prolonged cultivation of the cane, whilst the *magnesia* has remained pretty much as it was.

In coffee soils from Ceylon I have found that the same thing occurs also, but that the magnesia is more taken than with the cane. This is natural enough, since it forms an important ingredient among the mineral matters of the seed of the coffee-plant, which seed it carried away from the soil after each crop. However, even in coffee soils the magnesia diminishes less rapidly by cultivation than the lime. It is quite possible in some cases to judge very approximately of the number of years

* The quantity of chlorine is unusually high, which is accounted for by the proximity of a salt spring. Such springs are by no means uncommon in the island.

a soil has been in canes by the inspection of a careful analysis of this soil, more especially when the analysis can be compared with one made of the same soil from some uncultivated spot on the borders of the plantation.

When the quantity of lime has diminished so much by prolonged culture as to be present to the extent of only 0.1 per cent., and then only one-third that of the magnesia present (knowing that in the origin the lime was not only equal to, but higher than, the magnesia), we may rest assured that the crops of cane on this soil will fall off year by year, and that the most careful system of manuring will be necessary to place it again in its former lucrative condition.

I am sorry to say that such a state of things actually exists over a very considerable portion of British Guiana and Barbadoes; and though Jamaica and the other islands appear somewhat more fortunate in this respect yet we have here and there examples of long-wrought soils which are in quite as bad a condition as the most exhausted plantations in Demerara.

It is both difficult and laborious to choose from a very considerable number of analyses of cane soils those which may be considered to represent the actual state of things in the West Indies. I have nevertheless given, on the adjoining page, a few which represent some very extensive plantations, the owners of which have kindly permitted me to publish them. These, with the few remarks appended to them, will enable me to pass on to another important portion of our subject.

ANALYSES OF CANE SOILS.

	DEMERARA.								BARBADOES.		QUEENSLAND.
	A	B	C	D	E	F	G	H	I	J	K
Moisture ...	26.00	23.00	26.70	14.12	25.00	13.88	22.64	16.00	19.00	13.00	23.10
Organic matter and combined water ...	5.90	5.30	8.30	6.17	8.86	32.39	7.06	7.88	9.11	10.50	12.56
Silicate of alumina and silica ...	61.68	64.44	58.02	68.08	57.49	46.50	68.00	68.22	65.00	60.00	41.42
Lime ...	0.64	0.11	0.47	0.17	0.28	0.48	0.45	0.22	0.25	0.30	0.56
Magnesia ...	0.50	0.36	0.50	0.37	0.36	0.30	0.31	0.30	0.30	0.47	0.26
Sulphuric acid	0.01	trace	0.01	0.16	0.04	0.04	0.20	0.12	0.03	0.03	0.04
Phosphoric acid	0.08	0.05	0.19	0.07	0.09	0.03	0.16	0.10	0.07	0.06	0.06
Potash and soda	0.11	0.10	0.12	0.54	0.26	0.24	0.30	0.10	0.10	0.16	0.20
Chlorine ...	trace	0.02	0.01	—	0.01	0.06	0.05	trace	trace	trace	0.02
Oxide of iron, alumina, manganese, &c. ...	5.08	6.62	5.68	10.32	7.61	6.08	0.83	7.06	6.14	15.48	21.78
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Observations.—A, B, and C are soils in adjacent plantations of the same estate. A has been in canes about five years; C for a somewhat longer period—10 to 15 years; and B for about 60 years. D and E are from adjacent estates, far distant from the former; they have been in canes 20 to 25 years. F is a new soil, now growing ferns only. It is about to be planted with canes as an experiment. This soil, when it has been dried, burns like peat. G and H are from plantations only separated 100 feet from each other by a canal. G is a new soil; H has been in canes about 15 years. I and J are good average specimens of Barbadoes soils, and K is a sample of red clay soil from Queensland, Australia.

It is commonly held that soils in hot countries, especially in tropical climates, contain more organic matter than those of our latitudes: but it is evident from the above analyses that such is not the case for cane soils. The figure which includes organic matter and combined water owes a great deal to the latter, which is driven off by heat with the organic matter. In fact, putting aside soils of a peaty nature, it is rare that we meet with cane soils yielding more than from 2 to 4 per cent. of *humus* or "vegetable mould;" and the loss of this organic matter has been proved a source of sterility in Java by causing a want of porosity, of nitrogen, and of carbonic acid. Hence the danger of applying lime to these soils, much as most of them require it, since it tends to destroy the *humus* in a very short space of time. In our own climates lime is always "backed up," if I may use the expression, by a liberal supply of organic manure; and this is even more essential in Demerara than with us.

V.

The Java and Demerara clays when properly drained and worked will, from the moment they are put under cultivation, yield good crops of canes without manure for at least ten or twelve years. In Jamaica the same kind of clay will yield well for about fifteen years, and the red porous clay of South Australia for fifteen or twenty years. After this period the yield will become less and less each season; and for some years past it has been customary to dose the soils with sulphate of ammonia or Peruvian guano, which will usually raise the produce for the next two or three seasons; but after this their stimulating effect will cease almost completely, and the soil will be then in a worse condition than before. It is preferable in most cases to endeavour by a rational system of culture to restore these partially exhausted soils before they have gone too far, rather than to take in new land farther and farther from the boiling-houses.

When a soil has got into this partially exhausted state, no manure hitherto known, with the exception of good stable manure, well-fermented farmyard dung, or the urban manure made from excreta, can restore the equilibrium in favour of the planter. The reason of this appears to reside in the fact that these manures are *natural* products, and not only contain *all that the plant requires*, as is shown by analysis, but in the *proper state for assimilation*.

Anyone who will take the trouble of perusing the accounts of the old experiments made by Giobert, Lampadius, and others, will soon be convinced that very little *practical* knowledge has been added to what was perfectly well-known prior to the year 1820 regarding the effects of manures upon the soil. Giobert mixed together silica, alumina, magnesia, and lime, in the proper proportions, as he thought, to constitute a fertile soil: he planted vegetables therein, and watered them, but none of them grew until he moistened his artificial soil *with water from a dunghill*. Lampadius varied the experiment by forming several compartments, which he filled each with a different substance. The plants which he caused to grow in these extraordinary soils "did so because he watered with the liquor which exuded from a dunghill."

These are some of the oldest experiments on manures, and were made, as we see, with the most perfect manure yet known—*stable manure*. Centuries before this the natives of Peru used guano, and the manner

in which *night-soil* came to be known as a most active fertilizer is so lost in the mist of bygone ages, that we can only conjecture with Loudon, that man found it necessary to bury it in the earth in order to avoid its disagreeable odour, and immediately observed its effects on vegetation.

The idea of rendering phosphoric acid more available to plants by partially dissolving various kinds of phosphate of lime in sulphuric acid does not appear to be based upon very sound philosophy. At any rate the manure thus procured has, according to Professor John's researches, *little or no beneficial action upon graminaceous plants*, though it acted well on turnips.* Moreover, this process of making artificial manure (superphosphate) implies some ignorance of the methods by which the roots of plants absorb the mineral portion of their nourishment. It appears tolerably well proved that this is effected by the secretion of some vegetable acid, and was well shown by plates of marble exhibited in the Austrian department of the last French Exhibition, where the rootlets of wheat, maize, &c., had left their traces eaten into the marble. Again, M. Cloez, in his recent experiments, caused grains to germinate on blue litmus paper, the course of the rootlets being well marked by permanent red streaks, which did not disappear on drying, and were therefore not caused by carbolic acid. Moreover, I have observed that all cane soils are naturally more or less acid, and appear to become more so as they approach a state of complete exhaustion. Lastly, it is shown by Professor Déherain ("Annuaire Scientifique," 1868) that the most insoluble of mineral phosphates, reduced to powder and strewn upon soils deficient in phosphates, increase the yield of the fields at once; whilst if applied upon soils which contain a due proportion of phosphates, no increase of the crops occurs. The latter fact points very clearly to the importance of knowing something about the natural resources of a soil from which the crops of every kind are regularly raised.

VI.

In laying down rules to ensure the highest degree of fertility in our cane soils, we must remember that we are dealing with the *life* of the plant, and that the phenomena of life are mysteries that no one can solve completely. Hence the danger of adhering too firmly to a favourite theory; hence, also, the philosophy of following the indications of Nature as closely as possible. In other terms, we must allow ourselves to be guided by direct experiments independently of any theory. Such, for instance, are those remarkable trials made by Professor Polstorff, in which he found that *of all manures known, that derived from the excreta of animals gave by far the highest results.*† All who have devoted their time to this subject are of opinion that rich, well prepared farmyard manure is the most perfect fertiliser known. "We must never forget," says Dr. William Gregory, "*that the best and most economical of all manures is farmyard manure or, what is the same thing, the night-soil and urine of inhabited places.*"‡ The reason of this

* John, "Journ. für Prak. Chemie," vol. 50, p. 57 (1843 to 1845); see also Lawes and Gilbert's "Exp. on Growth of Wheat," 1864.

† Polstorff, "Annalen der Chemie," lxi., p. 180 (1847).

‡ Gregory, "Handbook of Organic Chemistry," 3rd edit., p. 479.

is because it contains all the ingredients that a plant can require, because its action is certain, because it gives up these ingredients in a proper state, in a readily assimilable form; and the more closely any artificial product approaches it, the more valuable is the action of such a manure upon the land.

But farmyard manure has one great drawback: it contains an enormous amount of water—60 to 80 *per cent.* of its weight; hence it can only be used on the spot where it is produced; carriage to any distance is out of the question. Within the last few years, however, a product has been obtained from night-soil, and urine, at Bloxwith, in Staffordshire, which may be well compared by its composition and eminent fertilising qualities to concentrated farmyard manure. It is got by evaporating the excreta of large towns as nearly as possible to the dry state, and forms, I believe, the most perfect manure actually known—that, indeed, which Nature evidently intended for our use. Instead of containing 60 to 80 *per cent.* of water, it contains only 12 to 16 *per cent.*; therefore its transportation to considerable distances can be effected as with guano. Upon analysis it is shown to contain all the ingredients of rich farmyard manure in a concentrated state, and in the same assimilable form.

Various kinds of costly apparatus have been erected at Bloxwith and Churchbridge by the Urban Manure Company in order to get this valuable product, and specimens of it have been submitted to the Royal Horticultural Society in London—the superintendents of whose gardens experimented with it as early as 1868 or 1869—and to myself. The former have drawn up an official report, sanctioned by the Council of the Society, upon its effects. This report coincides completely with the results of my own experience on a smaller scale, and both confirm once more the older experiments of Professor Polstorff, made in 1847, alluded to above.

Since then, being anxious to learn the effects of this new product upon the cane soils of our West Indian Colonies, with whose composition I was acquainted, I applied to my talented friend, Mr. W. Bancroft Espeut (who informed me that he had used it in Jamaica), and he replied that he had obtained most excellent results.

The able manager of the works above mentioned, Captain Hall, to whose skill and perseverance agriculture is mainly indebted for the possibility of obtaining so valuable a product, has also forwarded to me several letters from the cane-growers of Barbadoes, Demerara, and Mauritius, showing clearly that the urban manure is giving ample satisfaction, and is now very largely used. But for some time previously I had never hesitated to recommend it as the best manure for the long-worked Demerara soils.

In 1871 some hundreds of tons were experimentally mixed with bone meal and precipitated phosphate for the soils in British Guiana, which had been found wanting in lime and somewhat deficient in phosphoric acid, and have produced the most satisfactory results. I will give here three analyses of some large bulks of this kind that have been shipped, 1 to Demerara, 2 and 3 to different estates in the islands, and by the

side of these I place an average analysis of good farmyard manure for comparison :—

	URBAN CANE MANURE.			FARMYARD MANURE*
	No. 1.	No. 2.	No. 3.	No. 4.
Water ...	10.50	12.14	12.00	66.17
Organic matter, &c. ...	31.10	40.00	26.60	28.24
Phosphoric acid ...	8.70	10.41	11.61	0.27
Sulphuric acid ...	11.76	8.89	9.80	0.11
Chlorine ...	1.50	1.20	2.40	trace
Lime ...	18.06	14.21	17.59	2.18
Magnesia ...	0.80	1.14	2.50	0.10
Potash } ...	5.64	2.21	2.00	0.60
Soda } ...		1.10	1.70	0.07
Oxide of manganese ...	0.75	—	0.30	—
Oxide of Iron and alumina	2.19	2.25	4.00	0.20
Soluble silica ...	1.00	0.45	0.44	0.94
Sand, &c. ...	8.00	6.00	9.06	1.12
	100.00	100.00	100.00	100.00
Nitrogen, equal to ammonia	2.85	3.28	2.40	0.87

There is a test by which the urban manure can be distinguished from any other (except farmyard manure), namely, its property of yielding a certain amount of its organic substance to strong alcohol (rectified spirits of wine), and forming therewith a dark-coloured solution.

The above is an *ultimate* analysis of three cargoes of this urban cane manure prepared especially for certain estates, the soils of which had been previously submitted to me for analysis. The *immediate* analysis of this product shows that it contains all the ingredients, or compounds, found in well-made farmyard manure; and if we suppose the latter deprived of its abundant moisture, the composition of the two would present a great similarity.

Such, then, is the fertiliser which I more particularly recommend for the long-worked cane soils of our colonies, the action of which, with ^r proper amount of tillage, will, in the course of three or four seasons, prove of the greatest advantage to the planter.

VII.

The refuse of distilleries, and all other refuse collected during the concentration and clarifying of the juice, should be put together into a large *compost heap*, where these materials should be mixed with megass ash, leaves, straw, pen manure, stable manure, &c.; and a heap of this kind should be attached to every plantation. It should be piled high, so that its ingredients may be well pressed together; it should be protected from the rain, and any liquid that drains from it should not be wasted, but carried on to the ground with the manure itself, or soaked up by dry leaves or cane ash.

The best method of using the acid superphosphate manures would be to mix them intimately with one-quarter their weight of good Peruvian guano and one-quarter their weight of cane ash, and apply the mixture

at the rate of 5 to 8 cwt. per acre, according to the mechanical condition of the soil and its more or less effective drainage.

The mixture of sulphate of ammonia, chloride of potassium, and superphosphate, recommended formerly by my learned friend Dr. Anderson, of Glasgow University, to whom Scotch agriculture and chemical science generally owe so much, besides being very expensive, is too soluble and too acid for the Demerara clays; neither does it supply any *humus* or organic matter, in which so many of these soils are very deficient. Nevertheless it is quite equal to the very expensive chemical manure of Professor Ville, which is merely a similar mixture of mineral salts, and certainly not calculated to have much effect on sugar-cane crops, whatever results it may be said to have upon the highly-cultivated beet-root soils in Europe. In British Guiana such mixtures of nitrates, sulphates, and chlorides are washed out of reach of the cane roots by a single tropical shower, and in dry weather it is not certain that they would be absorbed.

A better mixture would consist of Peruvian guano, cane ash (or burnt trash), and stable manure or compost heap, to which mixture one quarter its weight of gypsum might be added for most Demerara soils.

Sulphate of ammonia, applied by itself in large quantities, acts as a poison to plants; in smaller doses its action is that of a powerful stimulant, somewhat as sulphate of quinine acts upon a delicate child. I have stated above that its use is to be avoided except in conjunction with relatively large quantities of other manures, or, better, as a powerful auxiliary to the compost heap.....

Hitherto manufactured manures, as is well known, have not been intended as perfect restoratives, and land treated with them alone generally fails in a few years to yield a heavy crop. They are rightly looked upon as auxiliaries in a system of farming—as a kind of supplement to a limited supply of farmyard dung. But in the urban cane manure above described we have a perfect restorative—the first of its kind—a manure that will not only cause the soil to yield its utmost when worked with proper care, but will also prevent its ultimate exhaustion.

Another auxiliary of some importance to the West Indian sugar-grower is lime. Even some of the newer soils would benefit by occasional dressings of lime in the shape of *marl* or carbonate of lime (not in the burnt or caustic state); and this should be followed at an interval of about two months by a liberal supply of manure.

There are, indeed, three special agricultural difficulties in the direct path of the cane-grower in the West Indies. The first is that he is dealing almost everywhere with a stiff clay soil, difficult to work even were labour more plentiful than it is; the second is a remarkable deficiency of lime in many districts; and the third is the very imperfect nature of the manures hitherto imported, and the implicit faith placed in the restoration of the megass ashes.

A certain amount of tillage is of course necessary, however perfect the manure applied. Perhaps we shall never possess a manure that will enable us to dispense with labour altogether; for putting aside the

question of weeding, *air* is one of the most necessary ingredients in the soil, and the more air can be enclosed the quicker the manure will disappear, and the more efficacious will be its action in a given time. I have insisted upon this point and several others in many of my papers contributed to "The Sugar Cane" magazine.

Marl or sandy limestone spread over these stiff clays at various intervals, as in the process which we call in England "top-dressing" will be carried down into the soil during the rainy season, and greatly improve its quality. Each application might be most advantageously alternated by a similar application of urban cane manure; for as the roots of the cane rarely extend to more than a foot in depth, we may, in many cases, trust to the rain to carry the fertilising ingredients within their reach.

It is evident that to grow the largest amount of *sugar* is the essential part of our problem. For this we do not require stimulants and incomplete manures, which will produce only a temporary gain of short duration and leave the land in a worse condition than before, but a careful application of those scientific principles which have been deduced from direct experiment and observation. This alone can claim to rank as true philosophy, and must serve as our guide in practice.

In giving professional advice upon these subjects I have never failed to bear this in view. Moreover, I have been anxious to prove an assertion published many years ago, to the effect that Agricultural Chemistry, in spite of the dogmatic and conflicting statements of some of its more enthusiastic cultivators, is quite capable, when conscientiously applied to any cultivated plant, of increasing to a very great extent the yield of that plant upon soils which have suffered from long cultivation. This is equally true whether the plant be cultivated for its saccharine juice, its seed, its bark, its leaf, or its fibre; and as a soil, however rich, must sooner or later lose its fertility by constant work, the most essential element in the problem is the discovery of the proper kind of manure for the plant in question.

If my efforts should hereafter be found to have realised this point for the sugar-cane, I shall be amply repaid for the time I have devoted to its study.

CULTIVATION OF TOMATOES.

By W. CRADWICK, Superintendent of Hope Gardens.

Sow in a well prepared bed, or in a box not less than four inches deep. First dip the seeds in Kerosine to prevent ants carrying them away; do this without letting them soak in the Kerosine. Be careful when sowing to put the seeds about half an inch apart; and do not put them more than about an eighth of an inch below the surface of the soil, if sown too deep they will not germinate. Put them in a cool place, but not under shade, and water lightly every day.

When they are an inch and a half high, transplant to another bed or box, or better still into five-inch clay pots, each plant in a separate pot. Keep them well watered until they are 6 inches high, then plant out in rows 2 feet apart, the plants to be 18 inches apart in the rows. Put to each plant a stout stick 6 feet high, and keep the plant tied to

it. Pinch out all the side growths, these spring from the base of the leaves, and are easily distinguished from the bunches of fruits. The plants will bear much more fruit if trained in this way, than if left to grow with several stems or branches.

Dig up the land thoroughly before planting. Water the plants as soon as they are planted if there is no rain, water every other day for three weeks after planting, after which water twice a week until the fruits begin to colour, when once a week will be often enough to water.

The land should be naturally rich as heavy manuring tends to spread disease.

Carter's Perfection and Dedham Favourite are excellent Tomatoes. Blenheim Orange is a good yellow Tomatoe.

A crop of fruit is now ripening at Hope Gardens, and those who are interested in the cultivation are invited to see the growing plants.

NOTES ON ORANGES AND LEMONS.

From U. S. CONSULAR REPORTS.

Orange and Lemon Crop in Southern Italy.—Consul Dean writes from Naples, October 7, 1895 :

The Island of Sicily is the most productive centre of southern Italy of oranges and lemons. The exportation of these fruits to the United States from the Bay of Naples is wholly from Castellamere di Stabia and Sorrento. After Sicily in productiveness come Rodi, the Sorrentine peninsula, and the province of Calabria. The harvesting of the Sorrentine crop usually begins the last of November and ends in August, while in some parts of southern Italy the season often begins as late as December and ends in July. From nearly every quarter I learn that last season's crop was greatly injured by the frost, rain, and strong winds, and that most of the shipments to the United States were at a heavy loss to the consignors. Rodi oranges of the best quality produced in Italy and enjoying a high reputation in America were absolutely depreciated. The trees are still suffering from the effects of the extreme weather of last year. The coming season is not full of promise. It is estimated that the orange and lemon crop will be less than last year, or two thirds of the average. The above applies to all citrus fruits of southern Italy.

Bitter Orange Trees for Grafting.—Consul Seymour writes from Palermo, October 22, 1895 :

In Sicily, the bitter-orange is mostly used for the grafting of orange and lemon trees, as the best results are obtained from it. The bitter orange tree is produced in the following manner: A well-manured bed is prepared, and in March bitter orange seed are inserted about 2 inches apart in it. The seeds sprout in April or May, and are left to grow in the same bed for about two years; the plants are then removed in January or February and planted in single rows, well manured, at a distance of 6 or 7 feet apart. After about three years, depending on the strength of the soil, the sprouts are again transplanted in January or February, placing them about 16 inches apart. When the trunks of the small bitter orange trees are three inches in diameter, they are ready for grafting purposes. The grafting is usually done in May, but may be done as late as August, provided it is not done in wet weather.

Increased Importation of Lemons.—Consul Seymour writes from Palermo, October 15, 1895 :

Owing to the exceptional high prices—as much as \$10 per box being paid for lemons in the United States during the month of September—40,000 boxes were imported during that month into the United States from Palermo, against 9,000 boxes for the same month of last year.

DISTRIBUTION OF SEEDS AND PLANTS.

Seed of the White Velvet Ochro is available for distribution at 1d. per packet on application to Director of Public Gardens, Gordon Town P. O. This variety is very smooth and delicate, and extremely prolific.

Seeds of four different coloured Iponœas (red, white, blue and claret) are also ready for distribution at 1d. per packet. These are generally known here by the common name of “Morning glory.”

Cocoa pods can be supplied shortly at 3s. per dozen.

Liberian Coffee in bamboo pots can now be delivered, packed, at 8s. per 100. Plants from the beds wrapped in moss, but not in pots, can be delivered at 2s. per 100.

PASTEURISATION OF MILK.

By G. B. LAWSON.

Milk when drawn from a healthy cow is in its purest state. As soon as it is cooled down to the same temperature as the surrounding atmosphere it begins to deteriorate. Milk very often absorbs its odours and the bacteria that are in its surroundings. As you cannot tell how long it has been exposed and how many bacteria it contains, it must, if it is required to be kept sweet any length of time for commercial purposes, be pasteurised. Pasteurising milk or cream is heating it to 160° to retard the growth of the bacteria it may contain, and then cooling it to 50° as fast as possible so as to give it keeping qualities.

One year ago last May we were selling cream to one of the local milk dealers who was furnishing cream to a restaurant for making ice-cream. If the cream was used early in the morning it was all right, but if it was kept till noon it would be soured so as to spoil it for freezing. About that time I saw an article in a dairy paper stating that if cream was pasteurised it would keep sweet for 24 hours. I did not have much faith in it, but I tried it with one quart of cream. I thought if I spoiled one quart of cream it would not be much loss. I put that quart of cream in a tin pail and put the pail in a tub of warm water, turned on the steam and heated the water until it was boiling. I kept the pail in the water, all the time stirring the cream with the thermometer, until it was heated to 150°, as that was the temperature to which the paper said it was to be heated. After it was heated enough I set the pail in a butter tub and packed it all round with broken ice and salt, and stirred it until cooled to 50°, then I put the cream in a quart measure and set it in the refrigerator which was at a temperature of from 45° to 50°. I examined that cream every day, and kept it sweet for four days; on the fifth day it began to sour. The first trial convinced me that pasteurising was what we needed to keep cream sweet and make pasteurised cream an article of commerce.

Since that time I have pasteurised cream every day during the ice-cream season, with good results if properly done. Shortly after that time we had an order for ten gallons of cream from a firm as a sample. The first ten gallons pleased them so well that we sent them ten gallons every day. In a week the order was doubled, and in a short time we were sending them thirty gallons a day—all the separator cream we had.

As there was a good deal of work in thus pasteurising this amount of cream, I tried cooling it on a different plan. One Saturday I had thirty gallons of cream I wanted to keep over till Monday. I heated it up as usual; instead of cooling it as I had been doing with ice, I put the cream in two twenty-gallon cans and set them in the refrigerator, expecting they would cool all right. Next morning that cream was sour, and by Monday morning it was quite thick. I thought that lot of cream was spoilt. As I did not like to throw it away and waste so much cream, I put it in the cream vat before any of the cream came in for the day. That cream being sour acted as a starter, and when the cream was churned next morning, I had the best flavoured butter for the Monday's gathering I had made that season. As pasteurised cream has such a fine flavour I experimented on a lot of it, and made a small tub of butter from pasteurised cream. We had three samples of butter in the creamery at the time—one of gathered cream, of one pasteurised cream, and one of raw separator cream. I showed these samples of butter to several commission men, and they all pronounced the sample made from the pasteurised cream the finest flavour. After hearing such favourable reports I concluded to send a tub of butter made from pasteurised cream where it could get an official score on it, so for the September exhibit at the World's Fair, I made a tub of butter from cream thus treated. The score was 97, three points "off" in flavour, all others perfect. At that time we were selling so much cream for ice-cream purposes that I had to keep the cream over for one day and mix it with the next day's cream to have enough to make a churning. That every butter maker knows, is not the best way to make premium butter. Even under these conditions, that tub of butter made from pasteurised cream two days old was one of the three that scored the highest for that month. I believe that if I had enough cream in one day for a churning the score would have been higher. For making that tub of butter I will get a medal and diploma. I believe that if all separator cream was pasteurised that we should have a better class of butter.

This last spring when we commenced pasteurising cream for sale purposes, the demand took all the separator cream we had, so I did not make any butter from pasteurised cream this past season, as there is more money in selling cream than in making butter.

When I first began pasteurising cream I did it in a very primitive way by heating the cream in an open pan set in a tub of boiling water. As our trade increased we could not get along fast enough that way, as we were sending as much as 90 gallons per day to one firm. As is always the case "necessity is the mother of invention." I got up a heater that would heat the cream as fast as it ran from the separator. The heater is made from the best tin. It is 8 in. in diameter, and high enough to be placed under the cream spout of the separator. It has an outside pipe with a funnel on top of it to catch the cream, and runs the cream to the bottom of the heater where it enters. As the cream rises in the heater

it is warmed to the proper temperature before it rises to outlet pipe. This outlet pipe is 3 in., from the top of the heater so as to give space for the froth to rise above it and not run over the top of the heater. The outlet pipe has a joint in it so that it can be easily cleaned. The heater is placed in a barrel of water which is kept boiling by having a steam pipe direct from the boiler into it. The barrel has a long staple on each side of it which reaches above the heater, and these staples hold a brace in its place that goes across the heater to hold it down. The barrel has to be full of boiling water before the cream goes into the heater so that the cream will be heated sufficiently before it rises to the outlet pipe.

If I was going to pasteurise for butter-making I would run the cream into a cooler made the same as the heater. Instead of setting it in boiling water I would place it in a barrel, and pack it all around with crushed ice and salt. Fine crushed ice and salt will make a temperature of zero, which will cool the cream to 80°, which is the temperature of the cream as it usually comes from the separator without pasteurising. Pasteurising, to be properly done, depends as much, on the cream being cooled to 50° or under, as quickly as possible as it does on heating it to 160°. The quicker the cream is cooled, the better it is, and the longer it will keep sweet.—(*American National Butter and Cheesemakers' Association*).

ORCHIDS AT HOPE GARDENS.

The following orchids have lately been in fine flower at Hope Gardens:—

Oncidium ampliatum.—This orchid was first discovered in the Gulf of Nicoya, in Costa Rica, and was subsequently gathered in various parts of Central America from Guatemala to the Isthmus of Panama. The flower-spike, which springs from the base of the matured pseudo-bulb, is from 1ft. to 3ft. long, branched, and many flowered. The flowers which sometimes exceed 1½ inches in diameter, have yellow sepals with red spots, and there are a few red spots about the base of the petals and lip, otherwise the colour is bright canary-yellow.

Dendrobium formosum var. *giganteum*.—First introduced to European gardens from the Khasia Hills, in 1837. It is widely distributed over north-eastern India and Burmah, from Sylhet and the Garrow Hills southward as far as Tavoy on the Tenasserim coast. In British Burmah it is abundant from Moulmein to Tavoy, especially about Amherst, where the native women use the flowers to adorn their hair. It is also a native of the Andaman Islands, and some of the very finest forms are found in Mangrove swamps along the sea-coast, where the plants are washed by sea-spray during stormy weather. In these islands there is rain during 11 months of the year, so that the plants have practically no resting season. This is the largest-flowered, and finest of the white dendrobiums. The flowers are produced towards the ends of the leafy stems, usually in clusters of 3 to 5; the individual flowers are about 4 inches across, of the purest white, save an orange-yellow blotch on the lip; the sepals are lance-shaped and pointed; the petals almost as broad as long, blunt; the lip has a large, tongue-like, reflexed front.

FERNS: SYNOPTICAL LIST—XXXIII.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Gardens, Demerara.

13. *Nephrodium resino-fetidum*, Hook.—Rootstock stout, erect, often a span or more high; stipites cæspitose, strong, erect, numerous, $\frac{1}{2}$ –2 ft. l. channelled, dark-coloured fibrillose and dirty-paleaceous increasingly downwards, and thickly coated in growth with mucous slime; fronds erect, bipinnatifid, 2–4 ft. l. $\frac{3}{4}$ –1 $\frac{1}{2}$ ft. w., subcoriaceous, viscid throughout but otherwise naked, dark green above; more or less suddenly reduced at the base, passing through distant dwindling auricles in mere muricate glands, which often reach nearly to the base of the stipites; pinnæ close above, more or less distant below, numerous, spreading, nearly horizontally, opposite or alternate, 5–9 in. l. $\frac{3}{4}$ –1 in. w., with a muricate gland at the base beneath, sessile and tapering outwards to the finely acuminate and serrate-entire point; cut nearly to the costæ into close blunt or acute entire subfalcate segments with involute edges which enclose the sori, 4–6 li. l. 1–1 $\frac{1}{2}$ li. w. at the rather dilated and connected bases, lowest pair largest but also entire; rachis strong, sub-angular and channelled, stramineous, puberulous, with a few scattered fibrillæ below; veins pellucid, simple, close, 12–16 to a side; sori copius, nearer the involute margin which covers it; involucre pale, naked, fugacious.

Infrequent on banks and in, often, wet open places from 4,000–5,000 ft altitude. A large coarse species resembling *Sprengellii* in outline and habit, but more rigid, and distinguished by the revolute edges, densely viscid fronds, and mucous stipites and caudex. In a growing state it has a delicious peach perfume, though in the Ecuador plant this scent is described as offensively resinous. The segments are really blunt or rounded, but the edges being folded they appear acute-pointed. The sori are at length confluent, and under the inflexed margins, the segments resemble some of the *Cheilanthes*. The pinnæ taper very gradually from the base to the point. First discovered on the mainland—Ecuador and Bolivia.

14. *N. Jenmani*, Baker.—Rootstock stout, erect, often several inches high; stipites cæspitose, erect, strong, 3–8 in. l., channelled, with a few deciduous dark-brown scales at the base; fronds erect, bipinnatifid, ovate-lanceolate, 2–4 ft. l. $\frac{3}{4}$ –1 $\frac{1}{2}$ ft. w., gradually reduced from the middle to both apex and base, chartaceous, pellucid-dotted, surface naked, the costæ above deciduously ciliate, dark clear green on the upperside, the under paler; rachis strong, channelled, sub-angular, bright pale or chestnut brown; pinnæ opposite or alternate, contiguous, or subdistant below, very numerous, spreading at a wide angle, 6–9 in. l. 1–1 $\frac{1}{2}$ in. w., sessile, the apex finely serrate-acuminate, pinnatifid to within a line of the costæ, the lower one very gradually reduced to less than an inch l., segments very numerous, flat, nearly straight, rounded, $\frac{1}{2}$ – $\frac{3}{4}$ ths in. l. 1 $\frac{1}{2}$ –2 li. b. above the rather dilated confluent bases close or with a more or less open sinus between them, basal pair enlarged, and often lobed or pinnatifid in the larger fronds, margins entire or crenulate; pale or chestnut brown; veins simple, 8–12 to a side; sori copious, medial; involucre as large, pale, naked.—*Journ. Bot.* 1877, vol. 5, p. 263.

Common at 5,000–6,000 ft., altitude near streams and in wet places;

gathered on the Government Cinchona Plantation, where it is abundant, and at Portland Gap. A fine robust species, with usually very short stipites; well distinguished by its dark clear colouring, and flat, broad segments with medial sori. The veins and ribs of live plants are pellucid. The habit is that of *Filix-mas*, and is stiff, shuttle-cock-like. The flat and broader segments distinguish it from any of the following.—Endemic.

15. *N. nimbatum*, Jenm., Rootstock stoutish, erect or sub-erect, the scales brown and rather small; stipites few, erect, 1–1½ ft l. channelled rather sparsely deciduously scaly, chiefly at the base, grayish upwards with fine down, as is also the strong channelled rachis; fronds bipinnatifid 2–2½ ft. l. 9–12 in. w., reduced at the base to minute remote auricles; chartaceous, pellucid, dark green above, beneath paler, both surfaces including rachis and ribs grayish pubescent; pinnæ numerous, distant, alternate, spreading often horizontally, sessile, central ones 5–8 in. l. about 1 in. w., the apex long-acuminate and serrate-entire, cut down $\frac{3}{4}$ ths.— $\frac{5}{8}$ ths. to the costæ into flat rounded straight or subfalcate segments 4–6 li. l. from the open acute or rounded sinus and 1½–2 li. w., with their own width between them at the apex; margins entire; veins simple, 8–10 to a side; sori small, medial; involucre pale, minute, ciliate and fringed with setæ, fugacious.—Gard. Chron. Mar. 3rd, 1894.

Abundant in places on banks skirting forests at 4,000 ft. altitude; gathered at Moody's Gap. It is clothed throughout with fine microscopic gray puberulæ. The scales of the rootstock ascend the greater length of the stipites, scattered and sparsely, but are soon deciduous. The pinnæ are remote and spread at a wide angle, dwindling at the base to minute segments. The upper ones are broadest at the base, but the lower are not; all are sessile. They are cut to within 1–1½ line of the costæ, and the pinnules are rather dilated at the confluent bases. The texture is thin, but hard when dry. The sori are small and involucre setose-fringed.

16. *N. velleum*, Baker.—Rootstock stout, erect or suberect, densely clothed with long narrowly-linear very dark-brown scales; stipites cæspitose, erect, 4–8 in l., strong, clothed at the base like the rootstock, and upwards densely, as also the rachis and costæ, with matted and fibrillose fulvous or reddish vestiture; frond 1½–2 ft. l. 5–9 in. w., not or hardly, narrowed at the base, oblong-lanceolate, the barren usually broader in the parts than the fertile; thinly chartaceous, pellucid, upper surface dark or bright green, naked; under pale, grayish, scaly on the rib; pinnæ spreading distant or sub-distant below and stipitate, oblong lanceolate, widest at the base and tapering to the point, which is usually bluntish, 3–4 in. l., $\frac{3}{4}$ –1 in. w., pinnatifid almost to the costæ, segments oblong, sub-falcate, blunt or rounded, 3–7 li. l., 1–2 li. br., contiguous or with an open space and rounded sinus between nearly or quite their own width, adnate-decurrent and slightly confluent at the base; margins entire, crenate or dentate; veins sub-distant, 6–8 to a side, simple or forked, sori copious, medial, or nearer the midrib, involucre small, scaly fugacious.—Hook. Sp. Fil. vol. 4. t. 246. *Aspidium aureovestitum*, Gr.

Common in forests on the Manchester mountains at 2,000 ft. altitude. A very clearly marked plant, not resembling closely any other

here included. By the dense appressed vestiture of small or minute pale scales which clothes the petiole rachis and ribs, quite concealing the surface, and shaggy dark-coloured coating of the root-stock in which the scales are 1 in. long and less than a line wide, it may be recognised at sight.

17. *N. firmum*, Baker.—Rootstock free-creeping, hardly thicker than a quill, thickly beset with the bases of former stipites, the advancing part densely clothed with narrow bark-brown scales; stipites scattered but contiguous, erect, 8-12 in. l. with a few deciduous scales at the base, brownish, glossy, channelled; fronds lanceolate, or ovate-lanceolate, 9-12 in. l. 4-6 in. w., very little narrowed at the base; naked, dark-green above and glossy, underside paler; coriaceous; rachis and costæ brownish, glossy, puberulous above, the latter rather wavy; pinnæ sessile, spreading nearly horizontally, subdistant below, the rather shorter based ones often deflexed, $2\frac{1}{2}$ - $3\frac{1}{2}$ in. l. $\frac{1}{2}$ - $\frac{3}{4}$ in. w., acuminate, deeply pinnatifid, or fully pinnate at the very base: segments close, $\frac{1}{4}$ - $\frac{1}{2}$ in. l. 1- $1\frac{1}{2}$ li. w., oblong bluntish, the barely crenulate edge slightly reflexed; veins very oblique, simple or forked, pellucid, raised above, sori small, dorsal, near the margin; involucre small, fugacious; sporangia ciliate. Journ. Bot. 1879, 260.

Common on the slopes of Blue Mountain Peak at 7,000 ft., altitude. Well distinguished by its free-creeping slender rhizome, stiff hard texture, and ciliate capsules. Most of the fronds are barren, so that the plants, growing among the undergrowth and brush-wood of the forest, resemble young tree-ferns. It is a much more coriaceous plant than *conterminum* or its allies, which have erect rootstocks, and the fronds are less reduced at the base. The stipites run in the direction of the rootstock at the bottom, and then curve upwards.—Endemic.

18. *N. crenulæum*, Jenm.—Stipites tufted, slender, erect, channelled, dark at the base with a few small deciduous brown scales and distant slight warts, upwards brownish or dark stramineous and naked; fronds ovate or oblong-lanceolate, 9-12 in. l. 4-5 in. w. erect, bipinnatifid, narrowed somewhat at the base, the apex pinnatifid passing to the serrulate acuminate point, membranous and pellucid, dark green, glabrous beneath, slightly ciliate above, especially on the ribs; rachis very slender, coloured like the stipites, channelled, glabrous or slightly ciliate and rather glossy; pinnæ spreading, lax, their own width or more between them, the inferior subdistant or distant, 2- $2\frac{1}{2}$ in. l. or over, $\frac{1}{3}$ - $\frac{1}{2}$ in. w. the lowest pair half as long, sessile, the inferior ones hardly so, and somewhat narrowed at the base, those above slightly enlarged or not there, and of a uniform width outwards, narrowing thence to the acuminate serrate entire sharp point; deeply cut into oblong, blunt distinctly crenulate segments, which are $1\frac{1}{4}$ - $1\frac{1}{2}$ li. w. 2- $2\frac{1}{2}$ li. deep, with a close or rather open sinus between to which the marginal crenatures nearly reach; veins simple, 5-6 to a side, one of the lowest opposite pair entering the sinus, the other above it; sori intramarginal, involucre cordate, rather ciliate.

2,000-3,000 ft. altitude. A very delicate plant both in substance and framework, with few open curved veins, that are conspicuous in the thin pellucid parenchyma, and rather thickened at the end, the outer ones especially excurrent, thus forming the crenatures of the margin. The slender habit, thin dark substance in which the veins are conspicuous, and crenate margins distinguish it at a glance.—Endemic.

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

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 The Forests of Canada and their Distribution by J. Macown. [Author.]

PLANTS.

From Messrs. Reasoner Bros., Florida.

Manzanillo Olives
 Nevadillo Blanco Olives
 Brown Turkey Figs
 White Adriatic Figs
 Double white Pomegranate
 Saharanpur red "
 Spanish ruby "
 Sweet "
 Chinese Mulberry
 French "
 English "
 Downing "
 Loquat

From Colonel Malcolm, Knockalva.

80 Frantojo Olives.

From Berkeley Agri. Exp. Station, California.

16 varieties Persian Grape Vines.

From Royal Horti. Society's Gardens, Chiswick.

20 varieties Fig (cuttings).

From Miss Stennett, Liberty Hill.

Euphorbia punicea
 Fersteronia floribunda.

SEEDS.

From Botanic Gardens, Bangalore.
Ipomœa tuberosa.

From Baron von Mueller, Melbourne.

Acacia linearis
Adansonia Gregorii
Atriplex halimoides
Callitris verrucosa
Cordyline australis
Eucalyptus calophylla
 " *marginata*
Diosma alba
Doryanthes Palmeri
Marsilea Drummondii.

From H. P. Deans, Esq., Priestmans River.

Lancewood
Bastard Cabbage
Wild Coffee.

From Miss Stennett, Liberty Hill.

Brunfelsia americana.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of April:—

IN FLOWER.	IN FRUIT.
<p>Baphia nitida, Lodd. Brownia Rosa-de-monte, Berg. Caryocar nuciferum, Linn. Cassia glauca, Lam. Cas illoa elastica, Cerv. Chrysobalanus Icacó, Linn. Chrysalidocarpus lutescens, H. Wendl. Cocos botryophora, Mart. Coccoloba uvifera, Linn. Coffea liberica, Hiern Copernicia cerifera, Mart. Couroupita guianensis, Aubl. Dalbergia Sissoo, Roxb. Dillenia indica, Linn. Erythrina Crista-galli, Linn. Eugenia Caryophyllata, Thunb. Fagræa obovata, Wall. Garcinia indica, Choisy Gynocardia odorata, R. Br. Hevea brasiliensis, Muell. Arg. Hippomane Mancinella, Linn. Hydnocarpus venenata, Gært. n. Mesua ferrea, Linn. Michelia Champaca, Linn. Pachira aquatica, Aubl. Pachira Barrigon, Seem. Posoqueria longiflora, Aubl. Pterocarpus indicus, Willd. Ravenala madagascariensis, J. F. Gmel. Samadera indica, Gært. n. Saraca indica, Linn. Shorea robusta, Gært. n. Simaruba glauca, DC. Sterculia carthagensis, Cav.</p>	<p>Diospyros discolor, Willd. Dillenia indica, Linn. Fagræa obovata, Wall. Oreodoxa regia, H. B. & K. Myristica fragrans, Houtt.</p>

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

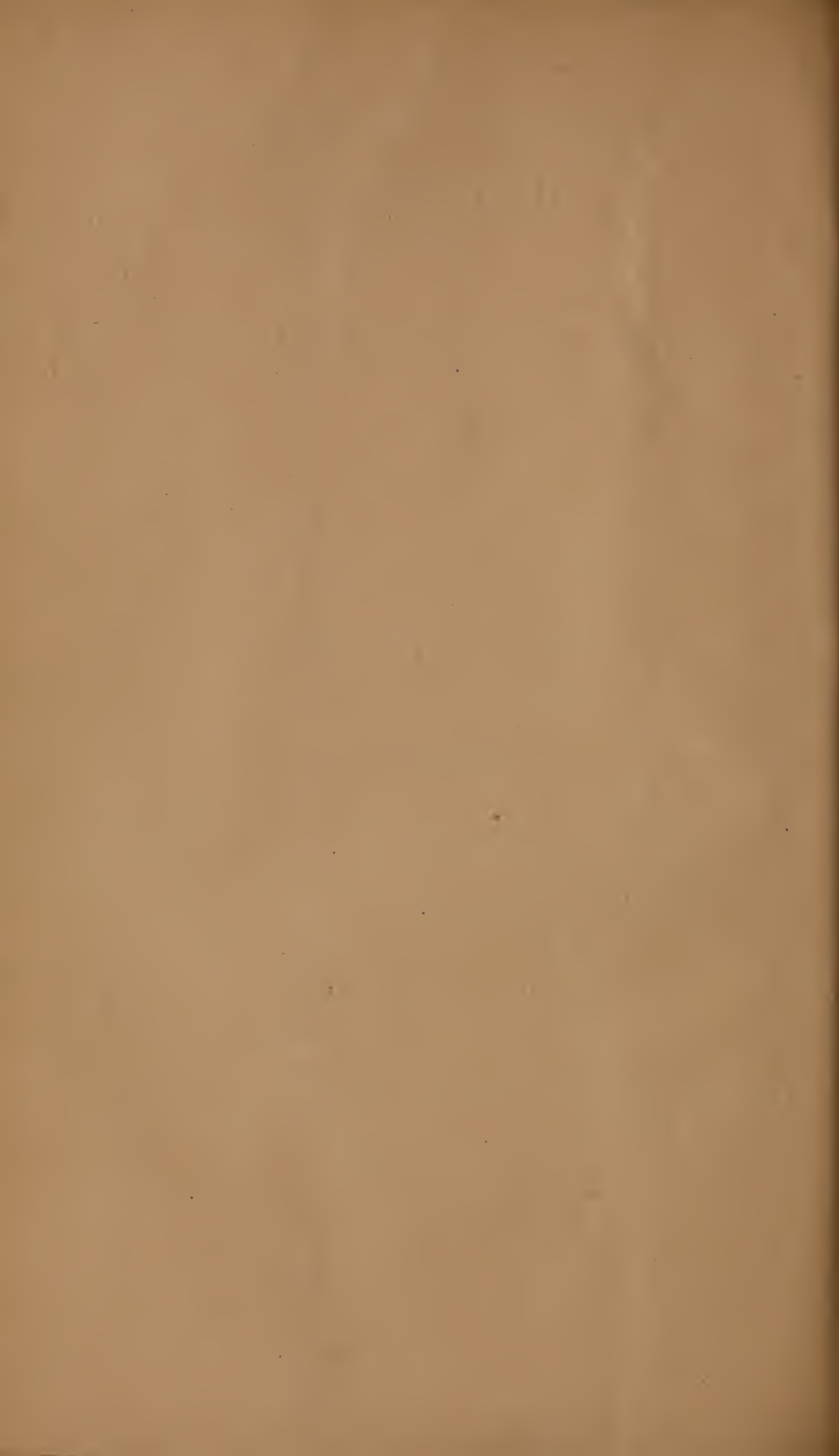
Ramie	- PAGE	73
List of Orchids	-	82
Ferns: Synoptical List.—XXXV	-	93
Castleton Gardens	-	95
Contributions to the Department	-	95

PRICE—Threepence.

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

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1896.



JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.]

APRIL 1896.

Vol. I(1).

Part 4.

RAMIE.

The following correspondence with Messrs. Danlop, Mr. Radclyffe, and the Subra Fibre Syndicate, on the subject of Ramie, is published for general information.

The "cleaned Ramie fibre" mentioned in Messrs. Danlop's letter of 17th October, was prepared by a chemical process by an engineer in Jamaica. It illustrates the difficulty that arises in such processes, that the fibre may look clean and white, but is in reality of very little value, as its strength has disappeared in the chemical action.

The sample of Ramie fibre reported on in their letter of 10th March, was in the form of ribbons. It was prepared by the Industrial School Boys at Hope, by hand, according to the plan described in the Bulletin for March, 1894, pages 37, first paragraph, taken from Mr. Hosie's report. The boys varied much in the quantity they could each clean, but all of them rapidly improved. For instance, the best boy cleaned in 3 hours on each of 3 consecutive days, as follows:— $2\frac{1}{2}$ lbs., 3 lbs. 10 oz., 6 lbs. 7 oz. Another boy, one of the worst who tried, cleaned on the same occasions 1 lb. 5 oz., 1 lb. 10 oz., and 2 lbs. 6 oz. As about $5\frac{1}{2}$ lb. green ribbons dried to weigh about 1 lb., it is scarcely possible to make it pay by-hand labour.

However, the time has probably now arrived when it would be well for those who are seriously thinking of taking up the cultivation, if suitable machinery be invented, to experiment with a small patch of about 1,000 roots. They would thus gain experience in the cultivation, and have a stock of roots ready for regular planting when it has been demonstrated by practical tests that a workable machine has been invented. The experience gained by an intelligent study of even such a small crop will be of immense benefit if the cultivation is undertaken on a large scale at a later period.

About two years ago Mr. Hollier gave us some information about the Allison machine for which he had acquired the patent rights for the West Indies. He promised to submit the machine to practical tests in Jamaica, and a supply of Ramie was grown in the Botanic Gardens for this purpose. It is understood that the machine was actually landed in the island, but so far it has not been brought forward. The same machine was tested by the United States Department of Agriculture in October, 1894, and was reported upon as "not fu-

filling the requirements of a successful decorticator." Mr. Allison made an entirely new and improved machine which was to have been tested last October, but the Department for some reason did not hold the trial.

Information is given in the Bulletin for March, 1894, on Ramie, and a report on experiments in cultivation is given in the Bulletin for last October (page 221).

The Chinese variety (China grass), with a very white under surface of the leaves, has been most successful in the Hill Garden at an elevation of 5,000 feet. The Malayan variety (Ramie) is the best kind for low elevations.

Roots will be available for planting during May. One thousand roots will be given free to each applicant who wishes to experiment. Applications for roots, stating number required, should be at once addressed to the Director of Public Gardens, Gordon Town P.O. No undertaking can be given that the number required by any individual over 1,000, will be supplied. To sell all or most of the roots to one wealthy syndicate would be to defeat the objects of the Public Gardens, and therefore, if necessary an allotment will be made—proportionate in some degree to the number required. The charge for each 1,000 after the first, is 2s. 6d.

The seed is very small, and requires a good deal of care in dealing with it. If any like to attempt growing from seed, they should prepare boxes with finely sifted soil; sow the seed on the top, not too thick; sprinkle a very little of the sifted soil over, and keep the boxes shaded from the sun until the seedlings are 2 or 3 inches high, when the sunlight may be gradually admitted. When they are 5 or 6 weeks old they may be planted out.

*Messrs. Dunlop Brothers & Co. to the Honourable the Colonial Secretary,
Kingston, Jamaica.*

49 Fenchurch Street, London, E. C.,
17th October, 1895.

Dear Sir,

We take the opportunity in replying to your letter dated the 24th September, which you addressed to Mr. S. H. Watson, concerning Ramie Fibre, to reply to you, through the medium of that gentleman, with regard to the article, taking especial attention to the letter from the Director of Public Gardens and Plantations.

We desire to express our appreciation of your kindness for the information so far given to us, and now desire to do our part as far as possible.

(1) With regard to the sample of cleaned Ramie Fibre which was sent to us by Mr. Fawcett, we desire to express that whilst it is of some value, probably worth £15 per ton in London, the quality and the value of the article has in reality been destroyed. It should not be broken up into knots the way that it is, but rather should be kept perfectly straight and unbroken. We don't want you in Jamaica to send it home to us in a cleaned state. It will cost you too much for experiments, and it will not be worth any more money than sending it home as a raw product.

(2.) What we recommend you to do is this:—

Open out sample No. 1 which we are sending you this week through Mr. Watson, and you will observe that it is the rough Fibre, with the pith and bark roughly scutched off. The fibre in this state is worth about £10 to £12 per ton in London, and our opinion is—that to get it to this stage the following would be the best plan to begin with for the growers in Jamaica to adopt, namely:—

To cut their stalks just between being green and brown after they have been in bloom, but before the seed is formed. Pass them through an old sugar roller mill so as to crush up the stalks, without destroying the fibre, and then by hand labour, scutch out the pith so as to get it as far as possible equal to sample No. 1. When this is done, no matter what quantity there is available as soon as it is dried and ready for shipment send it forward to London, even if it is only a few cwts. We will then be able to tell you in a practicable manner what is the next best thing to do, and that is strongly what we advise you to do first of all. Do not go to the expense of machines yet; there are several machines being made in London and it is not until we have tried some of your Fibre in London, that we can honestly recommend the best machine to select.

With regard to sample No. 2.

This is cleaned by a new patent process. The machine that does this only costs £40 free on board steamer, London, and the Fibre similar to sample No. 2 would be worth £20 per ton, but we do not recommend you to have this machine sent you until you have secured some definite report from us upon actual Ramie Fibre shipped home to this side from Jamaica.

Sample No. 3.

This is a sample of the cleaned Fibre ready for spinning, and you will see the difference at once between the texture and length of this sample, and the sample which you sent over to us.

If you could suggest anything at all by which we could be of the smallest possible assistance to you, please let us know, and we will gladly give the matter our best attention.

Placing at your disposal our services, and awaiting your early news.

We remain, Dear Sir,

Yours very truly,

DUNLOP BROTHERS & Co.

Messrs. Dunlop Brothers & Co. to Honourable Colonial Secretary.

49 Fenchurch St., London, 17th Dec., 1895.

Ramie Fibre.

Dear Sir,

We had the honour of addressing you through the Mayor of Kingston, Mr. S. H. Watson. Our present object is to inform you that recently the demand of Ramie Fibre has very much increased. Not only has the article attracted attention in Nottingham, but the best manufacturers of Belfast and Dundee are now anxious to adopt it for special purposes. The result has been an increase of 10 per cent. in the value of the raw material, and even now double the quantity available could be at once disposed of. We are therefore naturally anxious to know the progress of the crop in Jamaica. We think the prospectus which we

send you will be of great interest to you as showing the value of the article, etc. We have nothing whatever to do with the Company, but merely got the prospectus for the information therein contained.

Placing our services at all times at your disposal,

We remain, Dear Sir,

Yours respectfully,

DUNLOP BROTHERS & Co.

Director Public Gardens and Plantations to Messrs. Dunlop Bros.

11th December, 1895.

Dear Sir,

I have received a letter addressed by you to the Colonial Secretary. The Public Gardens here are growing large quantities of Ramie for distribution to planters as soon as a suitable decorticating machine has been discovered.

About a cwt. of dried Ribbons have been stripped by hand and will be sent to you as a sample by the next Mail, but as it will not pay by this process nothing further can be done until a machine is manufactured for the purpose.

Yours truly,

W. FAWCETT.

Messrs. Dunlop Brothers & Co., to Director Public Gardens.

49 Fenchurch Street, London, 10th March, 1896.

Dear Sir,

We duly received your esteemed favour of the 11th December last, and have since received the case of Ramie Fibre which you mentioned in that letter.

We assume and we trust correctly that you wish us to do three things with the sample of Ramie Fibre which you were good enough to send us.

First. To find out for you if the quality of the Fibre was good and suitable for manufacturing purposes, also if the condition in which it was sent over was satisfactory.

Secondly. To give you an idea of its value and the likely consumption that there would be of such Fibre.

Thirdly. The best means of decorticating the Fibre so as to reduce the expense of producing it as much as possible.

As we are practically advising the Government through you, we consider it our duty to give a practical report and not a theoretical one, we therefore, have gone to considerable trouble in visiting such manufacturing centres as Nottingham, etc., with regard to this Fibre, and we have also seen and are still in negotiations to see some of the most modern Machines for decorticating and working the Fibre, but we are not in a position yet to lay before you any Machine that we can say is better than others although we hope before next mail to give you our recommendations and also to name the Machine that we consider best. In the meantime it gives us great pleasure to inform you that all experts are unanimous that the sample of Ramie Fibre sent by you and grown in Jamaica is the best article that has ever been sent to London and in the state that you sent it over. We can find buyers of 50 tons up to 100 tons per month. We sold part of the sample @ 18/ per cwt. and had we had 10 tons of it, we could have realised the same price.

We are convinced that if the growers in Jamaica were in a position to produce large quantities that ample sale at remunerative prices could be made, but it is of the utmost importance to the growers and to the business that such sale be confined to the hands of one party, as it is naturally the great object to the consumers and manufacturers of the article in this country to put one source of supply against another, and one seller against another in order to reduce prices as much as possible..

Our opinion is that the best way for Jamaica producers to send the article over to this country will be similar to the sample case that you sent us, at least to start with, because any process employed to produce the article into a finer state will certainly be improved upon within the next few months, or at least within the next 12 months. There will be little or no advantage in sending the article either in the state of filase such as sample No. 1 that we sent to you, because the probability is that when producing it in this state in Jamaica, the people might only spoil it, and the probable value would not be more than £30 to £40 per ton, whereas they get three times the weight in the rough ribbons that you sent over, and we could probably contract at something like £16 to £18 per ton. Of course, you will understand that our opinion is that in the course of time when the production has grown to a considerable proportion in Jamaica, then the correct plan will be to produce all the fibre in Jamaica into a state of drawn silk, such as sample No. 2, or even to go the length of white silk yarn, such as sample No. 3, but to begin with, it will be far better to produce raw ribbons and ship them home baled in canvas, press-packed, and for that purpose we assume that what you want to obtain is the best and cheapest way of decorticating the stalks into the ribbon suitable for this market.

You will observe from this letter that we are very earnestly connected with the article, and that nothing on our part will be left undone to supply you with all the information you may require, and we have no hesitation in saying that you will be perfectly justified in strongly recommending the planters in Jamaica to at once begin to plant Ramie Fibre, as the demand now is very strong, and we are now in a position to place orders before you or any of the planters for considerable quantities, similar to that which you sent us. We wish to make this perfectly clear that we are treating this matter practically and in a business like way; there is no theory about it. We have sold what you sent over, and in course of time will account sale out to you, and we are now making quite sure of what machine we should recommend you to take up before we go too far and then find out afterwards that there was a better machine in existence.

Commending this matter to your earnest attention,

We are yours faithfully,

DUNLOP BROTHERS & Co.

Director of Public Gardens to Mr. D. Edwards Radclyffe.

29th July, 1895.

Dear Sir,

I am sending you by same mail samples of Rhea or Ramie for your opinion, which I hope you will be able to give me, as it may have an important influence on the cultivation in Jamaica.

- (1) One sample consists of ribbons simply stripped off the stems as they grow in the field.
- (2) are ribbons stripped as in (1), but afterwards steeped in water and then roughly scraped.
- (3) stems retted in water with potash, sulphur, and charcoal. according to formula given on page 52 of Bulletin for March, 1894, sent by same post.
- (4) wood only of ditto to see whether there is much fibre left attached, and so wasted.
- (5) ribbons from stalks treated as in (3) and stripped off (4) by hand.

Can you supply a machine which simply decorticates and leaves the ribbons for export? What is price, and would you send out one for trial free, as it would certainly be purchased if it answered the purpose?

We shall probably have to begin operations with a simple decortivating machine, and take up the process for producing filasse later. Does your decortivating machine do more than get the same result as (1) stripping by hand? What price is obtainable for each of above samples?

I enclose herewith also a sample for your kind opinion of some fibre—the result of retting the ribbons in an alkaline solution.

There is always a considerable difference in price between “China Grass” and “Ramie or Rhea ribbons.” e.g. in May last “China Grass” was quoted 28/ to 29/ and “Rhea” only 15/. Can you tell me whether this is due altogether to the condition in which it comes into the market—the China Grass being prepared much better, and the Rhea being only the ribbons, or is the fibre of China Grass much stronger and better?

You will see on pages 33 and 34 of pamphlet that the varieties appear distinct enough.

Very truly yours,

W. FAWCETT.

Mr. D. Edwards Radclyffe to Director of Public Gardens.
56 Gloucester Crescent, Regent's Park, London N.W.

January 6th, 1896.

Dear Sir,

I must apologise for delay in answering your letter of July 29th. I wished to be able to send you particulars as I now do below; also to announce we had started Mill for Ramie. As we are now in a position to treat for sale of Patents and open to buy Ramie I can answer your letter fully. First as to the samples you sent:—

No. 1. Rhea ribbons—The samples are not large enough to put through the process. The ribbons seem good, the pellicle is easily detached, in fact rubs off. How is this attained? With the samples we get from India, etc. this outer bark is not easily detachable.

No. 2. the scraped ribbons are not so good as the No. 1, and would not produce such good filasse as the fibre is partly spoilt. Would it not be better to scrape as the Chinese do in the green state without steeping?

No. 3. is good material spoilt and I should say is not likely to prove profitable

No. 4. It would not pay to handle.

No. 5. I should like to see a large sample. The fibre seems very much weakened.

Now as to machine the description will give full particulars. If you are going in for the treatment of Ramie my advice is to take the process up to filasse.

1st, ribbons are not likely to command much of a price, £12. £15 now obtained cannot possibly be maintained as the decorticator will produce a much superior article more resembling China Grass of Chinese, this fetches £23 and is cheaper than Ramie at £15, as the results are so much better. Filasse would fetch a higher price than China Grass. The samples enclosed in your letter are too small to test but they appear to be very rotten.

The causes regulating price of China Grass so much in advance of Rhea Ribbons are several, 1st the Chinese Grass is well cultivated, is of superior variety and being treated in a green state is so much easier to treat, with less waste, and produces a much superior fibre. I send you seed of *Urtica nivea* and *tenacissima*. Take care in sowing as seed may not germinate freely: treat part to gentle forcing.

Now as to starting an Industry in Ramie Cultivation, why not obtain a monopoly and treat with us for sole right for Jamaica. If you are able to influence capital, why not form a syndicate. If you think it would lead to business, I would run over to Jamaica and I think we could arrange terms acceptable to both sides.

Awaiting your reply,

Yours faithfully,

D. EDWARDS RADCLYFFE.

DESCRIPTION OF DECORTICATOR FOR RAMIE.

Hitherto planters have found it difficult to compete with the Chinese in producing Rhea Ribbons and China Grass, the price of labour has hitherto proved a stumbling block to profitable cultivation. The Chinese method is to strip the stems by hand, and with a ring of bamboo on the finger they clean the strips of bark so effectively that it at the same time removes the greater portion of the gum. Our machine is designed to imitate this operation and so enable the planter to put Rhea Ribbons on the market at a price considerably lower than the Chinese, even at their low priced labour. One machine would turn out as much as fifty men could do by hand labour. The machine, as will be seen in the illustration, is portable, and can be worked by water, steam, horse or bullock power. A great advantage is that it can be used on the field. It requires no skilled labour, a couple of boys can run it. It simply requires feeding, the stems are passed into the machine and returned as fibre, requiring only to be taken off and deposited on the drying racks. When properly dried there only remains to bale it up and ship it. We are prepared to negotiate with planters for regular supply or to act as agents for the sale of Ramie (Rhea) ribbons here.

PRICE OF MACHINE, PACKED AND DELIVERED f.o.b., £100.

Planters who have means to put up an apparatus for treating the ribbons in a green state, which is a great advantage, as the gum is more easily eliminated before it has had time to dry, will find it

advantageous to treat with us for a plant and process, whereby they would be enabled to procure filasse, saving the cost of drying and an important item in freight, besides obtaining a fibre of superior quality which would command an enhanced price, giving a very handsome profit on the extra cost of production compared with Rhea Ribbons.

The apparatus and process are simple and not costly.

We are prepared to negotiate for granting monopolies to districts. By this means planters acquiring the Rights could make a profit in converting neighbours "ribbons" into filasse.

We are also prepared to supply machines for extracting the fibre from leaves of such as Aloe, Agave, Banana, Sisal, Phormium, Pine Apple, Abutilon, Sansevieria, Sida retusa, Yucca, &c., &c., which do the work effectively and are free from the danger of accidents to workmen; they are self-acting and there is no necessity for the machine attendants to expose themselves to any risk.

All these machines are portable, the idea being to move them from one part of the plantation to another to follow the cutting of the leaves.

We are prepared to supply Ramie, Sliver, and Yarns, to manufacturers, and to make contracts for the regular supply of Ramie, in any form, to suit all purposes.

Mr. D. Edwards Radclyffe to Director of Public Gardens and Plantations.

March 14th, 1896.

Dear Sir,

I have pleasure in giving particulars requested in yours of 19th February.

Price of Machines to prepare 1 ton filasse per week.

2 Decorticators ungummer vats and presses £500 0 0. If your order is for 10 tons the machinery would cost about 50/o less, for 20 tons and upwards, 10 o/o in proportion, viz.: 10 tons £4,750 0 0, 20 tons £9,000 0 0.

In making your calculations add price to be paid for the process and rights or you could purchase the monopoly. Would you be prepared to pay a lump sum for the process and rights monopoly for Jamaica or would you prefer to give a Royalty on the out-put? I should like your opinion on this point before quoting. In the event of a Royalty we should have to have some guarantee as to quantity you would turn out and fix a minimum sum to be received per annum.

There is big business to be done.—We would take filasse or find you a market if not overstocked on receipt of reply.

Yours faithfully,

D. EDWARDS RADCLYFFE.

The Subra Fibre Syndicate to Director of Public Gardens.

10 Norfolk St, Strand,
London, W. C., 15th Nov. 1895.

Dear Sir,

We are obliged by your inquiry of 20th October and for the Jamaica Bulletin duly to hand this day. We regret, however, that it is not

possible for us to send our machine out to Jamaica. At the present time we are forming Syndicates and selling the rights of our patent for this machine to different countries, and shall no doubt very shortly conclude the sale of this patent for Jamaica for a Syndicate to take up the sole right of working in your country.

We are forming a Company in England at the present time, with a capital of £100,000, and in the course of a week or so, shall be pleased to forward you a proof prospectus, which will give you an idea of the lines upon which we intend to work. We may say that Dr. Morris, Assistant Director Kew Gardens, has seen our machine at work, he having provided green Ramie cut from Kew Gardens here. He is making an official report of what he saw, which he will publish in the next edition of the Kew Bulletin.

He was quite satisfied with the results and very much impressed with the ability of the machine.

The estimated cost of our machines by Messrs. Lawson & Sons, Leeds, is about £12 to £15. Each machine will treat on the field 6 tons green Ramie Stems and 12 tons of the same with the leaves on, per day of 10 hours, of course the difference between the bare stems and those with the leaves on being 4 tons. We state this to show you that our machine will decorticate green Ramie with leaves on as well as with them off.

Our machines have been at work on the field in Algeria, and these figures are the result of such working.

Any further particulars you may desire in this matter we shall be very pleased to furnish, and, on the appearance of the "Kew Bulletin," will send you a copy.

Yours faithfully,

THE SUBRA FIBRE SYD.

P.S.—We have not made arrangements up to the present for the disposal of the rights of our machine for Jamaica; and if you could put us in communication with any one who is interested in the product of the Ramie fibre and cultivation, and who might be of use to us in Jamaica, we should esteem it a favor.

DISTRIBUTION OF GRAPE VINE PLANTS.

A limited number of grape vine plants will be ready for distribution during the month of May, price 2d. each. Applications stating number and kinds required should be addressed to the Director of Public Gardens, Gordon Town, P.O.

The following is a list of the names of the kinds for distribution:—Black Hamburgh, Mrs. Pearson's Black Muscat, Lady Downe's, Foster's Seedling, Gros Colman, Alicante, Muscat of Alexandria, Muscat of Hamburgh, Muscat of Liguanea.

Notes on cultivation are given in Bulletins, Old Series, Nos. 38, 40, 41, and in New Series, Feb. and March, 1894.

LIST OF ORCHIDS GROWN IN THE PUBLIC GARDENS, JAMAICA.

COMPILED BY W. HARRIS, SUPERINTENDENT OF THE HILL GARDENS.

Although over 150 species of Orchideæ are natives of Jamaica, comparatively few are of much value from a horticulturist's point of view. We have nothing to compare with the gorgeous *Cattleyas* of tropical South America, or the magnificent *Dendrobiums* of the Old World; nevertheless, we have several pretty species, and others that are exceedingly interesting.

Jamaica orchids are found at all elevations, from the sea-coast,—(*Broughtonia sanguinea*, *Brassarola cordata*, etc.) to the Blue Mountain Peak, altitude, 7,423 feet,—(*Epidendrum serrulatum*, and various *Lepanthi*). In the Public Gardens will be found varied collections of native and exotic species suited to the climatic conditions of each Garden, and this List has been prepared as a guide to those who may wish to inspect the plants.

The nomenclature of the genera is that adopted in Bentham and Hooker's "GENERA PLANTARUM." Both genera and species have been arranged in alphabetical order for convenience in reference, and any well-known synonym has been added in italics, with a reference to the name under which the plant is cultivated in the Gardens. The sign x opposite a name, indicates the Garden in which the plant is grown.

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
<i>Aëranthes funalis</i> , <i>G. Rchb.</i> See <i>Dendrophylax funalis</i> , Benth.					
<i>Aëranthes micrantha</i> , <i>G. Rchb.</i> See <i>Campylocentron jamaicense</i> , Benth.					
AERIDES , <i>Lour.</i> [Vandææ.]					
<i>A. affine</i> , <i>Wall.</i> See <i>A. multiflorum</i> , <i>Roxb.</i>					
<i>A. Lawrencei</i> , <i>Reichb. f.</i>	Philippine Islands	x			
<i>A. L.</i> var. <i>Sanderianum</i> , <i>Reichb. f.</i>	Philippine Islands	x			
<i>A. multiflorum</i> , <i>Roxb.</i>	Assam, Burma, Andaman Islands, etc.	x			
<i>A. odoratum</i> , <i>Lour.</i>	Cochin China; India	.	.	.	x
ANGRÆCUM , <i>Thou.</i> [Vandææ.]					
<i>A. eburneum</i> , <i>Thouars</i> , var. <i>virens</i> , <i>Hook.</i>	Madagascar, etc.	x	x		
<i>A. sesquipedale</i> , <i>Thouars.</i>	Madagascar	x	x		
ANGULOA , <i>Ruiz & Pav.</i> [Vandææ.]					
<i>A. Clowesii</i> , <i>Lindl.</i>	Venezuela	x	x		
ANSELLIA , <i>Lindl.</i> [Vandææ.]					
<i>A. africana</i> , <i>Lindl.</i>	Tropical Africa	x	x		

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
ARPOPHYLLUM , <i>Llave & Lex.</i> [Epidendrææ.] A. spicatum, Llave & Lex.	Jamaica, and Central America	x	.	x	
ASPASIA , <i>Lindl.</i> [Vandæææ.] A. variegata, Lindl.	Guiana to Brazil	x	x	.	x
BIFRENARIA , <i>Lindl.</i> [Vandæææ.] B. aurantiaca, Lindl.	Trinidad and Guiana	x	.		
BLETIA , <i>Ruiz & Pav.</i> [Epidendrææ.] B. Shepherdii, Hook. B. verecunda, R. Br.	Jamaica ; Cuba West Indies	x x	x x	x x	x x
BRASSAVOLA , R. Br. [Epidendrææ.] B. cordata, Lindl. B. nodosa, Lindl. (<i>B. grandiflora</i> , Lindl.)	Jamaica ; Brazil West Indies ; Mexico	x x	x .	.	x x
BRASSIA , R. Br. [Vandæææ.] B. caudata, Lindl. B. Lawrenceana, Lindl. B. maculata, R. Br.	West Indies Centr. America Jamaica	x . x	x . x	.	x
BROUGHTONIA , R. Br. [Epidendrææ.] B. lilacina, Henfr. B. sanguinea, R. Br.	Jamaica ; Cuba ; Haiti Jamaica ; Cuba	x x	x x	.	x x
BULBOPHYLLUM , <i>Thou.</i> [Epidendrææ.] B. Careyianum, Spreng.	Himalayan Region	x			
CALANTHE , R. Br. [Epidendrææ.] C. mexicana, Reichb. f. C. Veitchii, Lindl. C. vestita, Lindl.	Jamaica ; Mexico Garden Hybrid Burma ; Malaya	.	.	x x	x
CAMPYLOCENTRON , <i>Benth.</i> [Vandæææ.] C. jamaicense, Benth.	West Indies ; Venezuela, etc.	x			
CATASETUM , <i>Rich.</i> [Vandæææ.] C. macrocarpum, Rich. (<i>C. tridentatum</i> , Hook.) C. sp.	Trinidad ; Guiana ; Brazil Trinidad	.	x		
CATTLEYA , <i>Lindl.</i> [Epidendrææ.] C. amabilis, Hort. See <i>C. intermedia</i> , Graham C. Bowringiana, Veitch C. crispa, Lindl. See <i>Laelia crispa</i> , Reichb. f.	Honduras	x	x		

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
CATTLEYA, contd.					
<i>C. guttata</i> , Lindl., var. Leopoldi, Hort.	Brazil	x			
<i>C. intermedia</i> , Graham	Brazil	x			
<i>C. labiata</i> , Lindl.	Brazil	x	x		
<i>C. l.</i> var. <i>Dowiana</i> , Batem.	Costa Rica	x			
<i>C. l.</i> var. <i>Dowiana aurea</i> , Hort.	New Granada	x			
<i>C. l.</i> var. <i>Gaskelliana</i> , Hort.	Venezuela	x	x		x
<i>C. l.</i> var. <i>Luddemanniana</i> , Reichb. f. (<i>C. speciosissima</i> , Hort.)	Venezuela	x			
<i>C. l.</i> var. <i>Mendellii</i> , Hort.	New Granada	x	x		x
<i>C. l.</i> var. <i>Mossiae</i> , Hook.	Venezuela	x	x		x
<i>C. l.</i> var. <i>Trinæi</i> , Linden & Reichb. f.	New Granada	x	x		
<i>C. l.</i> var. <i>Trinæi rosea</i> , Hort.	New Granada	x			
<i>C. l.</i> var. <i>Warneri</i> , Moore	South Brazil	x	x		
<i>C. l.</i> var. <i>Warszewiczii</i> , Reichb. f. (<i>C. Gigas</i> , Linden & André)	New Granada	x	x		
<i>C. Loddigesii</i> , Lindl., var. <i>Harrisoniae</i> , Lindl.	Brazil	x			
<i>C. Skinneri</i> , Lindl.	Guatemala	x	x		x
<i>C. superba</i> , Schomb., var. <i>splendens</i> , Hort.	Venezuela and Guiana	x			
<i>C. Walkeriana</i> , Gardn., var. <i>Schroederiana</i> , Reichb. f.	Brazil	x	x		
<i>C. spp.</i>	Colombia	.	.		x
CÆLIA, Lindl. [Epidendrææ.]					
<i>C. Baueriana</i> , Lindl. (<i>C. triptera</i> , G. Don)	Jamaica, Cuba and Mexico	x	.	x	
CÆLOGYNE, Lindl. [Epidendrææ.]					
<i>C. cristata</i> , Lindl.	Himalayan Region	x	.	.	x
<i>C. Dayana</i> , Reichb. f.	Borneo	x			
<i>C. flaccida</i> , Lindl.	Himalayan Region	x	x	.	x
<i>C. Massangeana</i> , Reichb. f.	Assam	.	x		
<i>C. ovalis</i> , Lin l.	Himalayan Region	x	x		
<i>C. speciosa</i> , Lindl.	Java	x			
COMPARETTIA, Poepp. [Vandææ.]					
<i>C. falcata</i> , Poepp. & Endl.	Jamaica; Cuba; Peru	.	x	x	
CORYANTHES, Hook. [Vandææ.]					
<i>C. sp.</i>	...	x			
CRANICHIS, Sw. [Neottieæ.]					
<i>C. diphylla</i> , Sw.	Jamaica	.	.	x	
CRYPTOPHORANTHUS, Barb. Rcdr. [Epidendrææ.]					
<i>C. atropurpureus</i> , Rolfe	Jamaica and Cuba	x	x		

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
CYMBIDIUM, Sw. [Vandææ.]					
<i>C. aloifolium, Hook.</i> See <i>C. pendulum, Sw.</i>					
<i>C. eburneum, Lindl.</i>	Trop. Himalaya	x	x	.	x
<i>C. elegans, Lindl.</i> See <i>Cyperorchis elegans, Blume</i>					
<i>C. giganteum, Wall.</i>	Trop. Himalaya	x	.		
<i>C. Lowianum, Reichb. f.</i>	Trop. Himalaya	x	x		
<i>C. pendulum, Sw.</i>	Trop. Himalaya ; Ceylon	x	x		
CYPERORCHIS, Blume. [Vandææ.]					
<i>C. elegans, Blume</i>	Sub-tropical Himalaya	x			
CYPRIPEDIUM, L. [Cypripediææ.]					
<i>C. barbatum, Lindl.</i>	Malacca	.	x	.	x
<i>C. caudatum, Lindl., var. roseum, Hort.</i> See <i>Selenipedium caudatum, var. roseum</i>					
<i>C. Chamberlainianum, O'Brien</i>	New Guinea	.	x		
<i>C. Lathamianum, Reichb. f.</i>	Garden Hybrid	x	x		
<i>C. Lawrenceanum, Reichb. f.</i>	North Borneo	x	x		
<i>C. Leeaanum, Veitch</i>	Garden Hybrid	x	x		
<i>C. Sedenii, var. candidulum, Reichb. f.</i> See <i>Selenipedium Sedenii, var. candidulum</i>					
<i>C. Spicerianum, Reichb. f.</i>	Assam	.	x		
<i>C. superbiens, Reichb. f.</i>	Malacca	x			
<i>Cyrtopera, Lindl.</i> See <i>Cyrtopodium</i>					
CYRTOPODIUM, R. Br. [Vandææ.]					
<i>C. Woodfordii, Benth.</i>	West Indies	.	.	x	
DENDROBIUM, Sw. [Epidendrææ]					
<i>D. aggregatum, Roxb.</i>	Burma and S. China	x	.	.	x
<i>D. barbatulum, Lindl.</i>	Hindustan	x			
<i>D. bigibbum, Lindl.</i>	Australia	x			
<i>D. b. var. giganteum, Hort.</i>	Australia	x			
<i>D. b. var. superbum, Hort.</i>	Australia	.	x		
<i>D. Calceolaria, Carey</i>	Himalayan Region	.	x	.	x
<i>D. chrysanthum, Wall.</i>	Himalayan Region	x			
<i>D. Dalhousieanum, Wall.</i> See <i>D. pulchellum, Roxb.</i>					
<i>D. Dearei, Reichb. f.</i>	Philippine Islands	x	x		
<i>D. densiflorum, Wall.</i>	Nepal to Assam ; Burma	x	x		
<i>D. Devonianum, Paxt.</i>	Himalayan Region	.	x		
<i>D. Draconis, Reichb. f.</i>	Burma	x			
<i>D. eburneum, Reichb. f.</i> See <i>D. Draconis, Reichb. f.</i>					
<i>D. Farmerii, Paxt.</i>	Himalayan Region	x	x	.	x
<i>D. fimbriatum, Hook., var. oculatum, Hort.</i>	Burma	x	x	.	x

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
DENDROBIUM, contd.					
<i>D. formosum</i> , Roxb. var. <i>giganteum</i> , Hort.	India and Burma	x	x		
<i>D. moschatum</i> , Wall. See <i>D. Calceolaria</i> , Carey					
<i>D. nobile</i> , Lindl.	India and China	x	x		
<i>D. pendulum</i> , Roxb.	Burma	x			
<i>D. Phalaenopsis</i> , Fitzg.	Australia	x	x		
<i>D. P.</i> var. <i>Schroederianum</i> , Hort.	New Guinea	x	x		
<i>D. P.</i> var. <i>Statterianum</i> , Hort.	Timor Laut	x	x		
<i>D. Pierardi</i> , Roxb.	India and Burma	x	x		x
<i>D. pulchellum</i> , Roxb.	India and Burma				x
<i>D. speciosum</i> , Sm., var. <i>Hillii</i> , Hook	Australia	x			
<i>D. thrysiflorum</i> , Reichb. f. See <i>D. densiflorum</i> , Wall.					
<i>D. tortile</i> , Lindl., var. <i>roseum</i> , Hort.	Burma	x			
<i>D. undulatum</i> , R. Br.	Australia	x			
<i>D. veratrifolium</i> , Lindl.	New Guinea	x			
<i>D. Wardianum</i> , Warner. See <i>D. pendulum</i> , Roxb.					
<i>D. spp.</i>	...	x			x
DENDROPHYLAX, Reichb. f. [Vandaeæ.]					
<i>D. Fawcettii</i> , Rolfe	Cayman Islands	x			x
<i>D. funalis</i> , Benth.	Jamaica	x	x		x
DIACRIUM, Lindl. [Epidendreae.]					
<i>D. bicornutum</i> , Benth.	Trinidad; Guiana	x	x		
DICHÆA, Lindl. [Vandaeæ.]					
<i>D. echinocarpa</i> , Lindl.	Jamaica, Cuba, etc.			x	
<i>D. glauca</i> , Lindl.	Jamaica, Cuba, Mexico			x	
<i>D. graminoides</i> , Lindl. (<i>D. graminea</i> , Griseb.)	West Indies			x	
ELLEANTHUS, Presl. [Epidendreae.]					
<i>E. capitatus</i> , Reichb. f.	Jamaica; Trinidad; Brazil			x	
<i>E. longibracteatus</i> , Benth.	Jamaica; New Granada, &c.			x	
EPIDENDRUM, L. [Epidendreae.]					
<i>E. anceps</i> , Jacq.	West Indies	x	x	x	
<i>E. atropurpureum</i> , Willd.	Venezuela	x			x
<i>E. bicornutum</i> , Hook. See <i>Diacrium</i>					
<i>E. bifarium</i> , Sw.	Jamaica			x	
<i>E. bletioides</i> , Griseb.	Jamaica			x	
<i>E. ciliare</i> , Linn.	Trop. America	x			
<i>E. cochleatum</i> , Linn.	West Indies, etc.	x	x	x	x
<i>E. difforme</i> , Jacq.	Trop. America			x	
<i>E. diffusum</i> , Sw. See <i>Seraphyta multiflora</i> , Fisch & Mey.				x	

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Gardin.	King's House.
EPIDENDRUM, L. [Epidendræe.]					
<i>E. fragrans</i> , Sw.	. Trop. America	x	x	x	x
<i>E. fuscatum</i> , Sw. See <i>E. anceps</i> , Jacq.					
<i>E. Godseffianum</i> , Rolfe	. Brazil	x	x		
<i>E. jamaicense</i> , Lindl.	. Jamaica	.	.	.	x
<i>E. macrochilum</i> , Hook. See <i>E. atropurpureum</i> , WILLD.					
<i>E. nocturnum</i> , Jacq.	. Trop. America	x	.	x	x
<i>E. nutans</i> , Sw.	. Jamaica	x	x	x	x
<i>E. Obrienianum</i> , Rolfe	. Garden Hybrid	x			
<i>E. paniculatum</i> , Ruiz & Pav.	. Trop. S. America	x			
<i>E. polybulbon</i> , Sw.	. West Indies, etc.	x	x	x	
<i>E. radicans</i> , Pav.	. Mexico	.	x	x	
<i>E. ramosum</i> , Jacq.	. Trop. America	.	x	x	
<i>E. rivulare</i> , Lindl.	. Jamaica; Cuba	.	.	x	
<i>E. serrulatum</i> , Sw.	. Jamaica	.	.	x	
<i>E. spondiadum</i> , Reichb. f.	. Jamaica; Costa Rica	.	.	x	
<i>E. Stamfordianum</i> , Batem.	. Central America and Colombia	x	x	.	x
<i>E. tridentatum</i> , Fawc.	. Jamaica	x	.	x	
<i>E. umbellatum</i> , Sw. See <i>E. difforme</i> , Jacq.					
<i>E. verrucosum</i> , Sw.	. West Indies	x	x	x	x
<i>Evelyna</i> , Popp. See <i>Elleanthus</i> Presl.					
GONGORA, Ruiz & Pav. [Vandæe]					
<i>G. atropurpurea</i> , Hook.	. Trop. America	x	x		
<i>G. maculata</i> , Lindl. See <i>G. quinquenervis</i> .					
<i>G. quinquenervis</i> , Ruiz & Pav.	. Peru, etc.	.	.	.	x
GOVENIA, Lindl. [Vandæe.]					
<i>G. utriculata</i> , Lindl.	. Jamaica; Cuba, etc.	.	.	x	
GRAMMATOPHYLLUM, Blume. [Vandæe.]					
<i>G. Rumphianum</i> , Miq.	. Moluccas	x	x	.	x
HABENARIA, Willd. [Ophrydæe.]					
<i>H. maculosa</i> , Lindl.	. West Indies	.	.	x	
HORMIDIUM, Lindl [Epidendræe.]					
<i>H. uniflorum</i> , Heynh. (<i>H. pygmaeum</i> , Benth.)	. Jamaica; MEXICO, etc.	.	.	x	
IONOPSIS, H.B.K. [Vandæe.]					
<i>I. testiculata</i> , Lindl.	. Jamaica; Haiti	x	x		
<i>I. utricularioides</i> , Lindl.	. Jamaica; Cuba, etc.	x	x	.	x
ISOCHILUS, R. Br. [Epidendræe.]					
<i>I. linearis</i> , R. Br.	. West Indies to Brazil	x	.	x	

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
LÆLIA , <i>Lindl.</i> [Epidendreæ.]					
<i>L. anceps</i> , Lindl.	. Brazil	x	x	.	x
<i>L. crispa</i> , Reichb. f.	. Southern Brazil	x	x	.	.
<i>L. glauca</i> , Benth.	. Mexico	x	.	.	.
<i>L. grandiflora</i> , Lindl.	. Mexico	.	.	x	.
<i>L. grandis</i> , Lindl., var. <i>tenebrosa</i> , God. Leb.	. Brazil	.	x	.	.
<i>L. majalis</i> , Lindl. See <i>L. grandiflora</i> , Lindl.	.	.	.	.	.
<i>L. monophylla</i> , N. E. Br.	. Jamaica	x	.	x	.
<i>L. pumila</i> , Reichb. f., var. <i>Dayana</i> , Reichb. f.	. Southern Brazil	x	.	.	.
<i>L. purpurata</i> , Lindl.	. Southern Brazil	x	x	.	.
<i>Læliopsis domingensis</i> , Lindl. See <i>Broughtonia lilacina</i> , Henfr.					
LEOCHILUS , <i>Kn. & Westc.</i> [Vandææ.]					
<i>L. cochlearis</i> , Lindl.	. West Indies	x	x	.	.
LEPANTHES , <i>Sw.</i> [Epidendreæ.]					
<i>L. pulchella</i> , Sw.	. Jamaica	.	.	x	.
<i>L. rotundata</i> , Griseb.	. Jamaica	.	.	x	.
LIPARIS , <i>Rich.</i> [Epidendreæ.]					
<i>L. longipes</i> , Lindl. (<i>L. pendula</i> , Lindl.)	. Pacific Islands	.	x	.	.
<i>L. viridipurpurea</i> , Griseb.	. Jamaica ; Cuba	.	.	x	.
LYCASTE , <i>Lindl.</i> [Vandææ.]					
<i>L. aromatic</i> , Lindl.	. Mexico	.	.	x	.
<i>L. Barringtoniæ</i> , Lindl.	. Jamaica ; Cuba	x	x	x	.
<i>L. cruenta</i> , Lindl.	. Guatemala	x	.	x	.
<i>L. leucantha</i> , Klotzsch	. Costa Rica	.	.	x	.
<i>L. Skinneri</i> , Lindl.	. Guatemala	.	.	x	.
MACRADENIA , <i>R. Br.</i> [Vandææ.]					
<i>M. lutescens</i> , R. Br.	. Jamaica and Trinidad	.	x	.	.
MASDEVALLIA , <i>Ruiz. & Pav.</i> [Epidend- reæ.]					
<i>M. coccinea</i> , Linden, var. <i>Harryana</i> , Reichb. f.	. Colombia	.	.	x	.
<i>M. fenestrata</i> , Lindl. See <i>Cryptopho-</i> <i>ranthus atropurpureus</i> , Rolfe	.	.	.	.	.
MAXILLARIA , <i>Ruiz & Pav.</i> [Vandææ.]					
<i>M. alba</i> , Lindl.	. Jamaica ; Trinidad, etc.	.	.	x	.
<i>M. crassifolia</i> , Reichb. f.	. Jamaica ; Cuba, etc.	.	x	x	x
<i>M. grandiflora</i> , Lindl.	. New Granada, Peru	.	x	.	.

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
MAXILLARIA, contd.					
<i>M. palmifolia</i> , Lindl. See <i>Xylobium decolor</i> , Nichols.					
<i>M. tenuifolia</i> , Lindl.	• MEXICO	•	x	•	
<i>M. rufescens</i> , Lindl.	• Trop. America	•	x		
<i>M. variabilis</i> , Batem., var. <i>media</i>	• Mexico	x			
<i>M. spp.</i>	• ...	•	•	•	x
MICROSTYLIS, Nutt. [Epidendreae.]					
<i>M. spicata</i> , Lindl.	• Jamaica and Cuba	•	•	x	
<i>M. umbellulata</i> , Lindl.	• West Indies	•	•	x	
MILTONIA, Lindl. [Vandæe.]					
<i>M. Roezlii</i> , Nichols.	• Columbia	•	x		
<i>M. spectabilis</i> , Lindl.	• Brazil	•	x		
OTADESMIA, Benth. [Epidendreae.]					
<i>O. serratifolia</i> , Benth.	• West Indies	•	•	x	
DONTOGLOSSUM, H. B. K. [Vandæe.]					
<i>O. Alexandrae</i> , Batem. See <i>O. crispum</i> , Lindl.					
<i>O. cordatum</i> , Lindl.	• Mexico	•	•	x	
<i>O. crispum</i> , Lindl.	• Colombia	•	•	x	
<i>O. grande</i> , Lindl.	• Guatemala	•	•	x	
<i>O. Harryanum</i> , Reichb. f.	• South America	•	•	x	
<i>O. laeve</i> , Lindl.	• Mexico and Guatemala	•	•	x	
(<i>O. Reichenheimii</i> , Reichb. f.)					
<i>O. Roezlii</i> , Reichb. f. See <i>Miltonia Roezlii</i> , Nichols.					
<i>O. Rossii</i> , Lindl., var. <i>majus</i> , Hort.	• Mexico	•	•	x	
<i>O. triumphans</i> , Reichb. f.	• New Granada	•	•	x	
<i>O. spp.</i>	• Colombia	•	•	x	x
ONCIDIUM, Sw. [Vandæe.]					
<i>O. altissimum</i> , Sw.	• West Indies and Guiana	x	•	x	x
<i>O. ampliatum</i> , Lindl.	• Central America	x	x	•	x
<i>O. a.</i> var. <i>majus</i> , Hort.	• Central America	x			
<i>O. Cebolleta</i> , Sw.	• W. Indies & Centr. Amer.	x	•	•	x
<i>O. incurvum</i> , Barker	• Mexico	x			
<i>O. Kramerianum</i> , Reichb. f.	• Ecuador	x			
<i>O. Lanceanum</i> , Lindl.	• Guiana and Trinidad	x	x	•	x
<i>O. leucochilum</i> , Batem.	• Guatemala	•	•	x	
<i>O. luridum</i> , Lindl.	• West Indies, etc.	x	x	x	x
<i>O. macranthum</i> , Lindl.	• Central America	x	•		
<i>O. Micropogon</i> , Reichb. f.	• Brazil	•	•	•	x
<i>O. Papilio</i> , Lindl.	• Trinidad	x	x	•	x
<i>O. pulchellum</i> , Hook.	• Jamaica; Guiana	•	•	x	
<i>O. quadripetalum</i> , Sw.	• West Indies, etc.	x	x		
<i>O. sphacelatum</i> , Lindl.	• Central America	x			

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
ONCIDIUM, Sw. [Vandææ.]					
<i>O. tetrapetalum</i> , Willd. See <i>O. quadripetalum</i> , Sw.					
<i>O. tigrinum</i> , Llave & Lex.	· Mexico	x	.	x	
<i>O. t.</i> var. <i>splendidum</i> , A. Rich.	· Gautemala	.	.	x	
<i>O. triquetrum</i> , R. Br.	· Jamaica	x	x		
ORNITHIDIUM, Salisb. [Vandææ.]					
<i>O. confertum</i> , Grieb.	· West Indies	.	x		
<i>O. parviflorum</i> , Reichb. f. (<i>O. vestitum</i> , Reichb. f.)	· Jamaica ; Venezuela	x	x	x	
PERISTERIA, Hook. [Vandææ.]					
<i>P. elata</i> , Hook.	· Panama	x	x		
<i>P. pendula</i> , Hook.	· Guiana	.	.	.	x
PHAIUS, Lour. [Epidendrææ.]					
<i>P. grandifolius</i> , Lour.	· China ; Australia	x	x	x	
PHALÉNOPSIS, Blume. [Vandææ.]					
<i>P. amabilis</i> , Blume. (<i>P. grandiflora</i> , Lindl.)	· Malaya	x			
<i>P. sanderiana</i> , Reichb. f.	· Philippine Islands	.	.	.	x
<i>P. schilleriana</i> , Reichb. f.	· Philippine Islands	.	.	.	x
PHOLIDOTA, Lindl. [Epidendrææ.]					
<i>P. imbricata</i> , Hook.	· India	x	x		
PLEUROTHALLIS, R. Br. [Epidendrææ.]					
<i>P. longissima</i> , Lindl.	· Jamaica	.	.	x	
<i>P. racemiflora</i> , Lindl.	· Trop. America	.	.	x	
<i>P. testæfolia</i> , Lindl.	· Jamaica ; Cuba, etc.	.	.	x	
<i>P. tribuloides</i> , Lindl.	· Trop. America	x	.	x	
<i>P. uncinata</i> , Fawc.	· Jamaica	.	.	x	
<i>P. Wilsoni</i> , Lindl.	· Jamaica and Cuba	.	.	x	
POLYSTACHYA, Hook. [Vandææ.]					
<i>P. luteola</i> , Hook.	· Trop. America	x	x	x	
PONTHIEVA, R. Br. [Neottieæ.]					
<i>P. glandulosa</i> , R. Br.	· Jamaica ; Cuba, etc.	.	.	x	
<i>P. petiolata</i> , Lindl.	· West Indies	.	.	x	
PRESCOTTIA, Lindl. [Neottieæ.]					
<i>P. stachyodes</i> , Lindl.	· Jamaica ; Cuba, etc.	.	.	x	
PSEUDOCENTRUM, Lindl. [Neottieæ.]					
<i>P. minus</i> , Benth.	· Jamaica	.	.	x	
RHYNCHOSTYLIS, Blume. [Vandææ.]					
<i>R. retusa</i> , Blume, var. <i>præmorsa</i> , Reichb. f.	· Trop. Himalaya ; Ceylon	x			

NAME.	Habitat.	Where Grown.			
		Hope.	Castleton.	Hill Garden.	King's House.
RODRIGUEZIA, <i>Ruiz & Pav.</i> [Vandææ.] R. secunda, H. B. K.	Trinidad; Guiana, etc.	x	x	.	x
SACCOLABIUM, <i>Blume</i> [Vandææ.] S. præmorsum, <i>Lindl.</i> See Rhy- chostylis retusa, var. præmorsa, Reichb. f. S. sp.	India	.	x	.	.
SCHOMBURGKIA, <i>Lindl.</i> [Epidendreæ.] S. Lyonsii, <i>Lindl.</i> S. Thomsoniana, <i>Reichb. f.</i> S. Tibicinis, <i>Batem.</i>	Jamaica Cayman Islands Central America	x x x	x . .	x . .	x . x
SCUTICARIA, <i>Lindl.</i> [Vandææ.] S. Steelei, <i>Lindl.</i>	Guiana	x	.	.	.
SELENIPEDIUM, <i>Reichb. f.</i> [Cypripediææ.] S. caudatum, <i>Reichb. f.</i> , var. roseum, <i>Hort.</i> S. Sedenii, <i>Reichb. f.</i> , var. candidulum, <i>Reichb. f.</i>	Peru Garden Hybrid	x x	.	x	.
SERAPHYTA, <i>Fisch & Mey.</i> [Epidendreæ.] S. multiflora, <i>Fisch & Mey.</i>	West Indies	.	.	x	x
SOBRALIA, <i>Ruiz & Pav.</i> [Neottieæ.] S. sp.	Tropical America	x	x	.	.
SOPHRONITIS, <i>Lindl.</i> [Epidendreæ.] S. coccinea, <i>Lindl.</i> (<i>S. grandiflora</i> , <i>Lindl.</i>)	Brazil	.	.	x	.
SPIRANTHES, <i>Reichb. f.</i> [Neottieæ.] S. orchioides, <i>Hemsl.</i> S. speciosus, <i>Benth.</i> S. tortilis, <i>Rich.</i>	West Indies Jamaica; Cuba, etc. West Indies	.	.	x x x	.
STANHOPEA, <i>Frost</i> [Vandææ.] S. eburnea, <i>Lindl.</i> S. oculata, <i>Lindl.</i> S. Wardii, <i>Lindl.</i> S. sp.	Central America Mexico Guatemala and Venezuela ...	.	x . x .	.	x . . x
STAUROPSIS, <i>Reichb. f.</i> [Vandææ.] S. gigantea, <i>Benth.</i> S. lissochiloides, <i>Benth.</i>	Burma Moluccas	.	.	.	x x
STELIS, <i>Sw.</i> [Epidendreæ.] S. micrantha, <i>Sw.</i>	Jamaica	x	.	x	.

FERNS: SYNOPTICAL LIST—XXXV.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Gardens, Demerara.

19. *Nephrodium stipulare*, Moore.—Rootstock erect, stout or stoutish, often several inches high, scaly; stipites cæspitose, erect, 1–2 ft. l., pale-coloured, deciduously palaceous at the base, strong, subangular, not channelled; fronds erect, $1\frac{1}{2}$ –4 ft. l. $\frac{1}{2}$ – $1\frac{1}{2}$ ft. w., papyraceous, more or less pubescent throughout; light-green, rachis strong, subangular, not channelled, naked or pubescent; pinnæ very numerous, sessile, spreading, contiguous, the lower 1–3 pairs usually somewhat reduced and deflexed, central ones 5–9 in. l. $\frac{2}{3}$ rds–1 in. w., tapering from the base to the acuminate and serrate-entire point; cut down $\frac{3}{4}$ ths– $\frac{5}{6}$ ths to the costæ into close subfalcate, oblong, flat, blunt, entire segments $1\frac{1}{2}$ –2 li. b., the costal pair enlarged, often much, (the inferior of the two usually the larger) entire or more or less incised or pinnatifid; veins simple, 8–10 to a side, lowest pair free or running together to the sinus; sori medial, pale or dark-coloured eventually; involucres as large, pale, ciliate.—*N. patens*, J. Smith. *Aspidium*, Willd. Plum. Fil. t. 23.

a. var. *macrourum*.—Stipites 2 ft. l. fronds $2\frac{1}{2}$ ft. l. $\frac{3}{4}$ –1 ft. w.; segments narrower a line or less w., more falcate, the inferior pair more or less pinnatifid; surface less ciliate; texture firmer; rachis and stipe darker; lowest veins quite free.—Pl. Fil. t. 23. *Aspidium*, Willd. *N. macrourum*, Hook.

b. var. *pseudo-patens*, Jenm.—Stipites slender, 9–12 in. l.; fronds ovate-deltoid, widest below the middle, 9–12 or 15 in. l. 6–9 in. w.; pinnæ linear, serrato-acuminate, 4–6 l. w.; segments falcate, acute, $\frac{3}{4}$ –1 l. w. lowest veins quite free.

Common in open and half-open places, often growing among bushes in ruinated places, from the lower hills up to 5,000 ft. altitude. The plant described as the type is much larger than *patens*, from which it is distinguished definitely by the stout erect rootstock, but there are less robust forms, a foot or two high, possessing the same kind of upright caudex that must be associated with it. The latter come near *molle*, but have not the simple vein running to the sinus which is characteristic of that species. The venation is variable, and some of the forms might be placed in the next division. Var. b, is a large plant, not very common, well marked by its narrow segments with, when dry, reflexed edges. Var. b. grows on wet rocks by the sides of rivers. It is marked by the much smaller spreading fronds, their ovate-deltoid shape, and the narrow pinnæ, resembling those of *serra*.

The enlarged basal pinnulæ vary in the different forms; in the most developed state they are 1 in. l. $\frac{1}{3}$ in. w. and deeply pinnatifid. In most cases however they are much smaller and entire.

20. *N. Filix-mas*, Rich.—Rootstock stout, erect, densely palaceous on the crown. stipites densely cæspitose, strong, erect, 4–6 or 8 in. l. densely clothed like the rootstock; fronds erect, lanceolate or ovate-lanceolate, narrowed downwards $1\frac{1}{2}$ – $2\frac{1}{2}$ ft. l. 8–12 in. w. bipinnatifid;

firmly chartaceous, glabrous, bright green above, paler and lurid green beneath; pinnæ close, spreading horizontally, the reduced lower ones only a little apart, and deflexed, sessile and broadest at the base, tapering; thence to the finely serrate-acuminate point 4-7 in. l. $\frac{1}{3}$ rd 1 in. or over w. lower ones 2-3 in. l. pinnatifid almost to the costæ; segments straight, oblong or linear-oblong, rounded, close, with the base not dilated and the sinus sharp, $1\frac{1}{2}$ - $2\frac{1}{2}$ li. w. 4-6 li. l., even or slightly crenate; rachis strong, subangular, stramineous, densely clothed with ferruginous fibrillose scales as are also the costæ at the base. veins once or twice forked, curved; sori 1-serial on the anterior venules, nearly medial between ribs and margins; involucre ample, convex, naked.—*Polypodium*, Linn. *Aspidium*, Sw.

Infrequent on the highest ridges and peaks of the Blue Mountains at about 7,000 ft. alt., a very interesting discovery made a few years ago by Dr. Morris, while in charge of the Botanical Department. Though common on the mainland from Greenland to Peru, and often of late years sought for in Jamaica, it had not before been found in the West Indies. The form is identically the tropical American one, which is distinguished by the very dense bright shaggy coating of the rachis, very numerous close tapering horizontal pinnæ, and close equal ended entire or finely crenate segments. Though the fronds are gradually reduced below, the lower pinnæ are 2-3 in. long, with some variation of form in different countries, the species is widely spread in Europe, Asia, Africa and America.

21. *N. hirtum*, Hook.—Rootstock short, upright or oblique, very densely clothed with long linear undulate dark brown scales; stipites cæspitose, erect or somewhat spreading, 3-9 in. l. clothed at the base like the rootstock, copiously fibrillose and glandulose upwards; fronds deltoid or oblong-deltoid, 4 to 8 in. l. 3-5 in. br. tri-quadrifid,*

thin; ash-green, glandulose, slightly ciliate or naked; rachis costæ and costulæ more or less freely clothed like the stipites; pinnæ spreading lowest subdeltoid and deeper on the inferior side, petiolate, central oblong, stipitate or sessile, rather blunt-pointed, $\frac{1}{2}$ -1 in. w. $1\frac{1}{2}$ -3 in. l., those above to the acuminate apex gradually reduced, ultimate segments oblong, blunt, the outer ones at least, adnate and decurrent at the base, serrate with appressed bluntish teeth, lobed or deeply pinnatifid, the lobes a line or less w. and 1-2 li. d.; veins pinnate in the larger lobes; sori terminal on the short branches, medial; involucre brownish disappearing with age. *Aspidium* Swartz. *Polypodium crystallinum*, Kze.

Common in forests on and among calcareous rocks from 2,000-5,000 ft. altitude; generally distributed through the colony, variable in size; mostly found small, with spreading deltoid or elongate-deltoid fronds 3-5 in. l. well distinguished by its small size, copious vestiture, glandulose surface and pale colour. The largest state which is erect in habit, is plentiful in the forest above Moody's Gap, on the ridge between the parishes of St. Andrew and Portland.

* The measurements given of the pinnæ, pinnulæ, &c., in this division do not apply to the lowest pairs of pinnæ, which are deeper and more compound on the underside than are the rest above.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of May:—

IN FLOWER.	IN FRUIT.
<p>Amherstia nobilis, Wall. Arenga saccharifera, Labill. Averrhoa Bilimbi, Linn. Baphia nitida, Lodd Bassia latifolia, Roxb. Brownea Rosa-de-monte, Berg. Cæsalpinia Sappan, Linn. Castilloa elastica, Cerv. Chrysalidocarpus lutescens, H. Wendl. Couroupita guianensis, Aubl. Cratoxylon polyanthum, Korth. Diospyros montana, Roxb. Diplothemium caudescens, Mart. Eugenia javanica, Lam. " malaccensis, Linn. Garcinia Mangostana, Linn. Gmelina asiatica, Linn. Hydnocarpus venenata, Gært. n. Lagerstromia, Flos-reginæ, Retz. Landolphia Kirkii, Dyer. Mesua ferrea, Linn. Mimusops Elengi, Linn. Musa rosacea, Jacq. Nephelium Lit-chi, Cambess. Norantea guianensis, Aubl. Pachira aquatica, Aubl. " Barrigon, Seem. Platymiscium polystachyum, Benth. Plumeria acutifolia, Poir. Ravenia spectabilis, Engl. Vanilla planifolia, Andr.</p>	<p>Astrocaryum vulgare, Mart. Diospyros discolor, Willd. Duranta Plumieri, Jacq. Eugenia malaccensis, Linn. Garcinia Mangostana, Linn. Gmelina asiatica, Linn. Hevea brasiliensis, Muell. Arg. Mimusops Elengi, Linn. Michelia Champaca, Linn. Musa coccinea, Andr. Nephelium Lit-chi, Cambess. Pachira aquatica, Aubl. " Barrigon, Seem. Phoenix acaulis, Buch Ham. Samadera indica, Gært. n. Sapindus marginatus, Willd. (S. <i>inequalis</i>, D. C.) Shorea robusta, Gært. n. f. Spondias lutea, Linn. Vanilla planifolia, Andr.</p>

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

- Hooker's *Icones Plantarum*. Vol. V. Pt. II. [Bentham Trustees through Kew.]
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 Montreal Pharmaceutical Journal. No. 12. March, 1896. [Editor.]
 Contributions to the Flora of Yucatan. Vol. 1. No. 1. by C. S. Millspaugh.
 [Author, and Smithsn Inst.]
 Times of Ceylon. Nos. 4-7. Feby. 1896. [Editor.]

SEEDS.

- From Royal Gardens, Kew.*
 Schotia latifolia
 Leucadendron argenteum
 Ligustrum Walkeri
 Careya arborea.
- From Botanic Gardens, Bangalore.*
 Cassia montana.
- From Botanic Gardens, Hong Kong.*
 Cunninghamia sinensis
 Pinus sinensis
 Melastoma candidum
 " sanguineum
 Sida corylifolia.
- From Botanic Gardens, Saharanpur.*
 Phoenix rupicola.
- From Messrs. Dammann & Co., Italy.*
 Quercus Suber.
- From Mons. Ch. Patin, Colombia.*
 Welfia regia.
- From J. C. Farquharson, Lotimer, Montego Bay.*
 Shaddock.
- Mrs Barclay, Mandeville.*
 Cobæa scandens.

PLANTS.

- From Messrs. J. Veitch & Sons.*
 20 varieties each :—
 Fuchsia
 Pelargonium—French spotted
 Do. Zonal.
- From Botanic Station, Dominica,*
 Pimenta acris.
- From Dr. Pixton, Kingston.*
 Camellias (two plants)
 Wistaria.



BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

Notes on Citrus Fruits	- PAGE 97
Dairy Industry	- 98
Ferns: Synoptical List.—XXXVI	- 110
Castleton Gardens	- 116
Sarsaparilla	- 117
Alfalfa and Stable Manure	- 117
Contributions to the Department	- 119

P R I C E—Threepence.

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



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1896.

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.]

MAY, 1896.

Vol. III.
Part .

CITRUS FRUITS.

The following letter from the Manager of the Boston Fruit Co., will show what is being done by one Company alone in Jamaica.

The Mandarins referred to in the Enclosure are generally called Tangerine here. Notes on Lime Juice are published in the Bulletins for May and Sept. 1895.

Capt. L. D. Baker to Director of Public Gardens and Plantations.

Port Antonio, March 28, 1896.

Dear Sir,

I herewith send you letter which I have received from a very extensive travelling friend of mine, who has favoured me with his opinion in reference to oranges and citrus fruit. I thought perhaps it might suit you to add this to your Bulletin.

Oranges.—I am glad to say that the lot of oranges you ordered for me have been put out at Hyde Estate, and are looking bright and prosperous. I have, since that time, ordered from the same parties, nine dozen more. They have arrived and are being put out at "Golden Grove" and "Belvidere;" and I now have another order in for 1,000 trees for "Salt Pond" property. I think this will be quite enough this season to give us all the buds and grafts that we may need, and establishing the fact of growing oranges successfully in Jamaica. We have nurseries of our own to the extent of about 20,000 trees, two thousand of which were planted from seeds a year ago and are now from 18 inches to 3 feet high and almost ready to take the bud. The balance has been planted this last season.

I consider it very important that we should use every effort to put our orange production on a safe basis against any competition; and I see no reason why we cannot.

With kind regards,

Yours very truly,

L. D. BAKER.

[Enclosure.]

Mr. A. Van Winkle to Capt. L. D. Baker.

219 & 221 Market St., Newark, N.J.,

19th March, 1896.

Dear Sir,

Agreeably to promise, I send you the name of the town in Egypt noted for Mandarins, the following from page 227 of Baedeker's Lower Egypt:—

"Benha, 101 miles from Alexandria and $\frac{3}{4}$ hours from Cairo. The red oranges and the Yusuf Efendi Mandarins of Benha are much esteemed at Cairo, and excellent grapes are also produced here."

The Mandarins are certainly the finest I have ever eaten, although not as large as I saw growing wild as high up as Newcastle. There is a growing demand for this fruit here.

I find your Limes are cheaper and contain more juice than any I have seen in my travels. Has it occurred to you to make this into Citric Acid, or to neutralize with lime and export as Citrate of Lime? Twenty gallons of lemon juice yields 10lbs. of crystals of Citric Acid. Limes more than this. Price of Citric Acid here is 37 cts. per lb.

Yours truly,

A. VAN WINKLE.

THE DAIRY INDUSTRY IN DENMARK.

By F. E. H. W. KRICHAUFF, Cor. Mem. R. H. S.

Chairman of the Agricultural Bureau of South Australia.

(Reprinted from Agricultural Gazette of New South Wales.)

After considerable delay, I have at length secured a copy of the full report, in 133 pages, by Professor C. C. Georgeson, of Manhattan College, Kansas, U. S. A., upon "The Dairy Industry in Denmark," which I have endeavoured to condense into the following pages. Since the publication of the Professor's report the progress of dairying in the United States has been most remarkable.

Whilst giving the fullest credit to Mr. David Wilson, of Victoria, Reynolds & Co, of New Zealand, A. W. Sanford, of South Australia, and many managers of dairies in Australasia, and others, for improvements in our system of dairying, we can all agree with Professor Georgeson that the Danes are ahead of the rest of the world as regards butter-making. He says that the leading secret of the uniformly good quality of their butter is that "pure cultures of cream ferments" are in common use in all good dairies exporting butter. It always has the same bright straw colour, the same degree of saltiness, and it varies but very slightly in flavour, aroma, and texture; and this uniformity in quality gives both dealer and consumer confidence. Most of the exported butter is made in co-operative dairies, of which there were more than 1,000 (now probably nearer 1,500), besides about 400 owned by private individuals who purchase milk from smaller farmers. The first of these co-operative dairies was started in 1882—probably the first in existence.

Mr. E. B. Young, of our Wine and Produce Depot, telegraphed on April 22nd, 1895, recommending the pasteurising (*i. e.* sterilising) process and the use of selected yeasts (meaning pure cultures of bacteria), to counteract the "fishy" flavour of Australian butter. I had long held the same opinion, and had again written to the Bacteriological Station at Kiel, Holstein, for such pure cultures, as some of these had been successfully introduced into New Zealand, although apparently neglected or lost through the want of refrigerators.

Notwithstanding the most scrupulous cleanliness in milking-sheds or stockyards, and in the vessels used, it is not possible to avoid disagreeable flavour or to retain the aroma unless the milk or cream is sterilised and inoculated as soon as separated, with the particular bacterium in sufficient quantity, which will give the desired aroma and prevent the action of all organisms producing bad flavours. These latter float in the air—especially the butyric acid bacillus, which causes rancidity—and are not present in the milk as drawn from the cow. We too often forget the discovery made by M. Pasteur in 1860, that the process of fermentation is due to the presence of living organisms, or bacteria; and the buttermaker should imitate the practice of the brewer, who, instead of leaving the fermentation of his beer to chance and uncertainty, carefully cultivates a yeast containing only those bacteria which will give his beer the taste and aroma desired, and thus he secures a complete mastery over the fermentation.

The report is valuable, not only as evidencing how the Danes have adopted the teachings of science in their practice, but also as showing how much of their success is due to the wise aid given by the Danish Government to private enterprise. The increasing demand for Danish butter in England was, and is, largely due to the services of a civil servant, an accomplished scientist (Mr. M. Faber), whose duties were to aid by all means the sale in England, and to meet and correct through the press all false and damaging statements concerning Danish agriculture, and particularly the dairy industry. He had also to direct attention to frauds and adulterations with oleo-margarine and the like.

Professor Georgeson remained in Denmark from January 27th till March 6th, 1893. The population is about 2,000,000; contains 14,553 square miles; has a mean temperature of 43·7° Fah. to 47·3° Fah., and about 24in. of rain—never a complete failure of crops on account of drought. Large farms seldom contain more than 500 to 1,500 acres, of which class there are 1,954. Of medium farms, containing from 100 to 500 acres, there are 71,773; and smaller farms number 150,260. The average size of farms is about 30½ acres, if we exclude forests and waste lands, and take only what is under cultivation and in grass. These statistics are some years old, and the sub-division of the large estates is being carried on. Farmers now own more than 50 per cent of the area under cultivation, and the greater portion of the remaining land is worked by peasants under a life tenancy, which can be held by the widow so long as she does not remarry. They are thus sure of any improvements made by themselves, and the condition of agriculturists is prosperous—more especially in comparison with the period before the astonishing output of dairy products. In 1891 the total quantity of butter made was calculated to have been 170,074,642 lbs., of which 100,600,788 lbs. were exported; and this from a small country, which

contains in the Jutland Peninsula a very large quantity of poor heathy land. The kingdom is one-tenth the size of California, and less than one twenty-sixth the size of South Australia, exclusive of the Northern Territory. The number of square miles *alienated* in South Australia is somewhat in excess of the *total area* of the Danish Kingdom.

STATE AID AND PROGRESS MADE IN DAIRYING.

Up to sixty or seventy years ago dairying had been neglected in Denmark, except upon a few of the larger farms, and the breed of cattle was very poor. Farmers were best pleased with fattening a number of steers for the market; but since then matters have improved, first with the introduction of skilled dairywomen from Holstein. But it has been only since 1850 that smaller farmers began to take an interest in the dairy, and the Agricultural Society provided practical instruction for young women. Professors T. R. Segelka, von Stoch, and Fjord began in 1874 to change the empirical methods, by pointing out the reasons for the new practices to be followed, and showing how better results could be secured by the adoption of more exact methods. The thermometer was used instead of the finger, the milk from each cow was recorded, the quantity of cream weighed, the food and labour placed to the debit of each cow, and set against the product yielded by her. The separator, in 1878, began to supersede the system of straining the milk into shallow pans or tubs as introduced from Holstein. Instead of cooling the milk by water, ice was used in tubs or cemented basins in the cellars, and the milk set in deep cylindrical cans sunk in them, but the separator entirely did away with setting of the milk in cans on all of the larger farms.

For farmers who have no separator, I think the following account of experiments conducted by Professor Fjord will be valuable, and induce them to at least use as cold water as can be obtained:—He experimented largely in order to ascertain the relative values of setting milk in cold water and in ice water, the former ranging from 39° Fah. to 60° Fah. He proved conclusively that the milk ought to be at once cooled to a temperature as near to freezing as possible, and that the depth of milk in a can had but little influence on the rapidity of the rise of the cream if kept in a low temperature. From milk skimmed after standing ten hours he obtained nearly 3½ per cent. more cream if cooled on ice to 35° Fah. or 36° Fah. than if kept in still water at 39° Fah. to 40° Fah., and more than 25 per cent. excess if the water was only 50° Fah. If skimmed after thirty-four hours the loss was respectively 1·4 per cent. and 13·4 per cent. Milk standing thirty-four hours gave in either case much more butter than if the cream was taken after ten hours. The loss, if skimmed after ten hours, was 5·7 per cent. when cooled with ice, and 9 per cent. when cooled with water at 39° Fah. and 29·4 per cent. with water at 50° Fah. With regard to losses in butter, it may be remarked that making sweet cream butter, is like losing 1 lb. of milk for each pound of butter if compared with first souring the cream.

The Danish dairies have not reached a high standard, and the average butter fat is under 3½ per cent. On the islands the Angler breed of Schleswig-Holstein cattle have been largely imported to blend with the native "Red Dairy" breed; also some Shorthorns, Ayrshires, and Swiss cows have been introduced. There is now a gradual development of the milking qualities of this "Red Dairy" breed. While formerly the yearly

average yield of milk from cows was from about 4,200lb. to 5,300lb., there are now good average cows yielding, if well cared for, from 8,000lb., to 9,000lb., and a few up to 10,000lb. In 1868 the yearly average yield of butter per cow was 112 $\frac{3}{4}$ lb. in 1872 it was 146lb., and increasing ever since. The Jutland breed is black and white, and the dairy qualities are not well developed; they are better suited for beef. They resemble the Holstein-Frisian breed, but the cows are rather small where the soil is poor. The average yield of milk was, in 1892, between 3,500lb and 4,500lb. per year. In exceptional cases, after selection, the average of some herds was as high as 6,500.

The management of calves in Denmark is worthy of notice, especially in the south-east and elsewhere where tuberculosis has a foothold. The calf is at once put into a pen by itself, and within a couple of days it is injected with tuberculine, to test whether or not it is affected with tuberculosis from its mother. If there is a reaction from this injection, shown by a rising temperature, then it is killed at once. The healthy calves are put together by twos until they are two months old, and then four together, until spring, when they all have access to a yard. In May before being put upon grass, another injection of tuberculine is made, so as to be quite sure to have a herd free from tuberculosis. This disease is so frequent that the affected cows could not be all killed at once. The germs of the disease are without fail indicated by tuberculine, Professor Koch's great discovery.

All farmers in Denmark strive with might and main to improve their stock, especially through "bull associations." At Ringe, in Tunen, for instance, twenty-nine farmers owned a superior bull. They selected 100 of their best cows, and he was put to none but these. Inferior cows were not eligible. The service fee was nearly 3s. to provide for the keep of the bull, but the state paid one-third of it. Altogether, a yearly sum of about £2,700 is devoted by the state to this purpose. But the State pays in many other ways for the advancement of agriculture and dairying in particular. There are ten private agricultural schools, each of which receives state aid, according to the number of students, up to £162 a year. Besides these, there are somewhere about 100 ordinary high class schools, which give agricultural instruction, and about 2,000 dairies take pupils who receive board and lodging and a small salary for their services. The Royal Veterinary College of Copenhagen has ten professors besides assistants and lecturers, and nearly 400 students who pay; the State pays annually £324 for the instruction of twenty-two students, and the annual appropriation for the college, irrespective of salaries of the professors, is £1,762. For enlargement of the institution £44,711 has been voted. The State pays for nine "Konsulenter," or advisers, who deliver lectures and answer questions pertaining to agriculture, three of whom are specialists in dairy matters. Persons requiring the services of either of these advisers pay a portion of his travelling expenses, and give him board and lodging whilst at the place.

DAIRY UTENSILS AND BUTTER-MAKING.

In Denmark the Burmeister and Waine separator is mostly used. It can raise the skim milk and cream through its discharge pipes to a height of 8ft., whence it runs by gravitation to reservoirs. It is the only separator which will do this. The DeLaval "Alpha" separator is gaining

favour, and another separator manufactured by Koefoed and Hauberg is used to a considerable extent.

The vessels in which the cream is set to ferment are mostly wooden barrels, made of oak, or in some places large tin cans. Sometimes the latter are fitted into a wooden tub, with the object of maintaining an even temperature. The receiving tank into which the milk is poured after it has been received and weighed, is sometimes of wood, and in other places made of heavy tin. It is always placed on a high platform, so that the milk can flow by gravitation to the separators. The milk should be raised to a temperature of upwards of 75° Fah., and it is necessary there to heat it by steam, by passing through a jacketed tin or copper vessel placed inside another so that the space between them is filled with steam, while an "agitator" revolves slowly in the milk to warm it evenly. To regulate the inflow of the milk into the separator Professor Fjord invented a regulating funnel. Others put a "swimmer" in the funnel, which rises up against the end of the discharge pipe, partially closing it if the milk runs too fast. The cream from the separator runs from a suspended vessel through the steriliser to the cooler. Professor Fjord's steriliser or pasteurising apparatus is a copper cylinder, covered with tin, fitted steam-tight into a somewhat larger vessel of copper or galvanised iron, and then "lagged" outside with wood to prevent cooling. The steam passes direct from the boiler between the two vessels, and out by a pipe at the bottom. The milk or cream enters the vessel, which contains an agitator, from below and flows out near the top, where a thermometer can be inserted. The temperature must be from 170° to 180° Fah., and is intended to kill the microbes or bacteria. The steriliser is used for sweet, or for skim milk, or for cream. In nearly all cases where the sweet milk was sterilised before separation Mr. Georgeson found that the skim milk was again sterilised before leaving the separator, as if then fed to the calves it was claimed that all possible danger of infection with tuberculosis was avoided.

The cream, after passing through the separator and steriliser, must next be cooled. It is poured into a hopper on top of the cooler. This is either a round or square apparatus of corrugated metal containing a worm or thin zigzag pipe, into which cold water enters from below, passes through the pipe, and is discharged again below. The water is supplied from a vessel which contains broken ice, placed high enough to force the cold water through the pipe. The cream, on running in a thin stream over the corrugated metal, is cooled, so that a cooler 3ft. high may cool 5,000 lb. of milk per hour from 180° Fah. to about 35° Fah. above the temperature of the ice water. It requires 30 lb. of ice to every 100 lb. of milk to reduce the temperature to at least 41° Fah. (The difficulty in Australia may be to obtain artificial ice at a low price. In Denmark they store ice in winter near to the dairy. Well water, formerly used in Denmark, cannot lower the temperature sufficiently. The difficulty might, perhaps, be overcome by placing water beforehand in a freezing chamber, if such is attached to the dairy.) The sterilisation and the cooling can, however, be done without the aid of the steriliser and cooler, but it involves more labour. The cream must be put into tall cans, which have first been thoroughly cleansed by washing in mild lye, or by the addition of soda and a solution of lime to the water, and thereafter pouring scalding water or a jet of steam into them. After

filling the cans, sink them in hot water up to the rim and keep it near the boiling point by the addition of boiling water or a jet of steam. The cream must be kept constantly stirred with a paddle of galvanised iron, also thoroughly cleansed before use. When the thermometer shows a heat of 80° C. (176° Fah.), the cans are at once removed and immersed in ice water, and the cream is kept constantly stirred until it is rapidly reduced in temperature to 35° Fah. or 36° Fah., and remains now free, or nearly so from bacteria of all kinds, until it is convenient to begin the fermentation.

A few of the smaller farmers, however, do not artificially sterilise their milk, but allow it to sour naturally, and may make thoroughly good butter, provided the temperature is not too high, the milk is from healthy animals, the stockyards, dairy utensils, store-room or cellar clean, the air free from bad odours, (even those arising from cheese), distant from dungheaps and stagnant waters, and finally if the manipulation is perfect. But there are so many favourable conditions necessary to ensure butter of first rate quality that it is necessary to adopt the most modern methods of fermentation, and this practice is becoming more and more general. In every case the temperature of the cream should be raised to between 70° Fah. and 95° Fah. before the butter milk or other ferment is added. The easiest way to do this seems to be to immerse a can filled with boiling water in the cream, which should be stirred, or else by means of a "fore-warmer," or by immersing the cream can itself in boiling water.

The methods of fermentation are—firstly, the addition of a portion of the butter milk (taken from the churn immediately after the butter is removed) to the cream barrel. The *quantity* differs according to the *quantity* of fresh cream, the sourness of the butter milk, the season, and also to the length of time the butter-maker desires to give to the souring, the quantity may vary between 5 and 10 per cent. The objections to the use of butter milk are that if there is any defect in the churning from which it is taken those undesirable qualities are of course transmitted. In such a case it is a common practice to resort to a neighbour for butter milk. It varies also much more in acidity than any other ferment, and it is more difficult to manage the fermentation. In the cool season, to prevent the falling of the temperature in the cream barrel to too low a point whilst the souring is in progress, the room is kept warm by a stove or steampipe, or the barrel is placed within a larger one, so that it can be packed all around with hay and the lid covered with a quilt. The proper degree of sourness being usually reached within eighteen to twenty hours, the ferment should be added about noon, when churning can commence at 6 o'clock next morning. In the interval the cream should be thoroughly stirred twice or three times. Secondly, a portion of the sour cream churned in the morning is occasionally added at noon to the cream to be churned next day; but this practice is even less desirable than that of adding the butter milk. Thirdly, it is best to make fresh ferment every week or two to prevent its degeneration through using either of the two former methods. Usually it is made with half skimmed milk from a nearly fresh milking cow, and which has stood no more than ten to twelve hours. This is heated to about 100° Fah., and then allowed to stand at a temperature of about 70° Fah. for twenty-four to forty hours according to the season, when

it will develop the ferment, but good judgment is required to obtain the right degree of acidity by smelling, tasting, and testing its strength. It should have a certain degree of density, show the formation of small granules, and have a clear sharp taste. Reject it if it smells or tastes badly, and does not thicken properly. As soon as approved the fermentation must be stopped by immersing the can containing it into cold water. From 3 per cent. to 5 per cent. of this ferment is added to the cream barrel after the top of the ferment has been thrown away, as it may contain injurious bacteria from the short exposure to the air. This method is not always satisfactory if the dairy buildings or the surroundings are impregnated with injurious bacteria, which are sure to infect the new ferment and cause it to fail.

Fourthly, the pure cultures of the beneficial bacteria, isolated and cultivated in bacteriological laboratories, are thoroughly safe to give a first class butter, and are in common use in Denmark. Presently they will be introduced into all the large dairies in the United States of America, and, although the local consumption there will absorb all the first class product for some time to come, we should not lag behind. Professor Conn has now isolated bacterium No. 41 from the best June butter, and by inoculating winter cream with it, has been enabled to impart the June flavour and other fine qualities to the butter produced from it. Expert bacteriologists will soon be able to isolate and cultivate bacterium No. 41 for the use of dairies all over the States. In Denmark the pure cultures were also obtained from the finest butter, but, whilst in one laboratory they separate only two beneficial bacteria, others isolate and cultivate several.

The purchasers are instructed how to apply these bacteria to the cream. One laboratory sells its ferment in bottles holding about a pint, which must be used all at one time. The pure culture is added to a small portion of sterilised milk or cream, and then set aside at a given temperature until it has attained the proper stage. It is then further propagated in more milk or cream, and when a sufficient quantity has been obtained it is added to the cream in the barrel, where it effects the necessary fermentation in eighteen to twenty hours. Up to the time of Professor Georgeson's visit the ferment could not be perpetuated outside the laboratories for any length of time, and it will always be a matter of greatest care to isolate the beneficent from the harmful bacteria. This work will probably have to be left to specialists. The pure cultures are, however, reasonably cheap, and may become cheaper with the increasing number of bacteriological laboratories. At the Bell Springs Creamery, Professor Georgeson tried samples which he had purchased from Mr. Quist, and they had a decided influence on the butter, the quality of which was superior to any previously made there, although the cream had not been sterilised. The cultures had to be specially prepared for their transit to Kansas, being on the road from the 10th March until the 5th June. One was in milk sugar, and one in a nutritive fluid of Mr. Quist's invention. In Denmark, where these cultures are only a few days prepared before use, they are cultivated in skim milk. It is to be hoped that Christian Hansen, who has now established a branch of his laboratory in America (or some other bacteriologist) will start one in Australia.

In order to obtain the finest quality of butter, that will keep well, the

fermentation must be strong, and should not be stopped until the cream has become thick and shows a peculiar granular appearance, developing the pleasant aroma of good butter. This is the time for churning. The cream should be of a temperature somewhere between 50° Fah. and 70° Fah., usually between 55° Fah. and 60° Fah. The milk from fresh cows does not require so high a temperature as that from cows about to go dry. It is better to churn at a low temperature, as the grain of the butter will be better preserved. If the butter fails to come within half an hour the temperature is not high enough; and in obstinate cases it is better to allow the cream to stand until next morning, after warming it to 5° Fah. or 6° Fah. higher. A stick with a deep furrow in it is inserted on one side of the churn through a hole in the lid, and is lifted from time to time to show the size of the granules of butter; when they are the size of small peas the churn is stopped, else the grain of the butter would be injured. After a small quantity of cold water has been thrown inside the lid and down the sides, the dasher is started again slowly until the butter has sufficiently gathered. In many places they are careful to use water that has been boiled and quickly reduced to about 60° Fah., for washing down the sides of the churn, so as to avoid contaminating the butter with any harmful bacteria the water might have contained. The butter is next gathered in a sieve—usually of fine hair—and put into a tub, and the butter milk is run through a strainer to collect any butter yet remaining in it. In but very few dairies is the butter touched with the hand; but at any rate, if the hand is used, it should be clean and cooled in water. The butter-worker is generally used, all implements and utensils being first washed in boiling water and then in clean cool water. The amount of salt added varies from 4 per cent to 5 per cent of the weight of the butter, as may be required in the particular market where it is to be sold. The butter is then placed in the butter-cooler, unless it be the cold season. After the salt has dissolved and penetrated the whole mass, and the butter attains the proper degree of firmness, it is again put under the butter-worker to work out the last of the butter milk and a portion of the brine formed from the salt. Frequently the butter receives another working one or two hours later, but care is taken not to overwork it, and thus make it greasy.

The churn used in Denmark is like our old upright, truncated barrel churn, but suspended by pivots near the centre of gravity, resting on upright posts, so that it can be easily tilted to any angle. The cream is churned by a revolving agitator of wood, and sometimes three or four cleats are nailed to the inside of the churn to break the rotary motion. The butter-cooler is used everywhere during warm weather, except in a few very small dairies. This is a box made of wood or zinc, containing one or more cleats inside, and slats are laid across these, upon which the butter is placed, sometimes rolled into the form of an arch, from the butter-worker, and remains there until it can be worked up. On the lid of the box is placed a layer of broken ice, and the ice water runs to the bottom of the box.

The Danish butter is always packed in barrels by means of a wooden mallet. Generally they contain 112 lb., and are manufactured on the farms from staves of beech held together by wooden hoops. After they have been scrubbed in scalding water they are filled with clean cold

water and then well rubbed inside with salt. Half an inch of salt is put in the bottom, and the sides and bottom are lined with paraffin paper. The butter is pressed into the barrel in lumps of 10 lb. to 12 lb. at a time until it is slightly above the top. The surplus is cut off with a sharp spoon, paraffin paper laid on, then a thin layer of salt, the lid put on, and then the hoops are tightened up. At Valdemar Castle the paraffin paper is soaked in brine for several hours, and thereafter in saltpetre for half-an-hour. Each barrel is rolled about for some time once a week, in order to prevent the brine settling too much in one part of the butter.

I think it is a good plan to have the weight stamped on the milk cans or on a brass plate soldered to the can, whereby the weighing of the can every time is rendered unnecessary.

The Danes use Professor Fjord's control apparatus in place of the Badcock milk tester, which latter involves the use of chemicals, but they are not needed with the Professor's method. The Milk Supply Company is an exception to the rule. Without the drawing which accompanies the report it is impossible to sufficiently describe the control apparatus, but when perfectly handled, it works with perfect accuracy.

The butter and cheese making in a number of creameries is fully described by the Professor. The creameries own all the cans and transport waggons; but the teams and drivers are hired and paid for at from $2\frac{1}{2}$ d. to $3\frac{3}{4}$ d. per 100 lb. of milk carried according to the length of the route. As the majority of the members own only from one to ten cows, this is a great advantage for them. The sterilised skim milk or butter milk is also delivered by the carrier in the evening. As the members generally milk three times a day the milk of noon and evening is kept at home in cold water or ice water until next morning, when the carrier fetches it. On receipt of the milk it is weighed, tested twice a week at uncertain times, and payment is made in proportion to the percentage of fat, ascertained by means of the aforesaid control apparatus. If anything is found wrong with any sample a case of small bottles of this apparatus is sent to the farm, and the milk of each cow is there sampled so that the milk of any particular cow may be excluded. For skim milk or butter-milk from three quarters of an öre to one öre per 100 lb is paid by the farmers. (This is equal to $\frac{1}{8}$ d to $\frac{1}{6}$ d.) On top of the creamery roof is sometimes kept a large reservoir, kept always full of cold water pumped from a well, which makes it easier to have cold water in all parts of the creamery. The manager generally receives a salary from which he must pay his assistants, and he also gets paid from any surplus which the butter may bring over the highest quotation on the exchange in Copenhagen. By becoming thus financially interested he will try to produce the finest quality possible.

Professor Georgeson visited Mr. E. A. Quist, a noted bacteriologist, who owns a creamery at Nonnebjerg, near Skanderborg, which he equipped chiefly to afford him opportunities for testing his pure cultures. He sterilises the milk as soon as received at a temperature of 167° Fah., and runs it at once through the separators. He would not separate at a lower temperature than 95° Fah. At 167° Fah. there remains $\frac{1.5}{100}$ of 1 per cent. of fat in the milk; at 95° Fah. $\frac{1.9}{100}$ of 1 per cent.; at 77° Fah., $\frac{2.3}{100}$ of 1 per cent. of fat. At a higher degree of heat than that required for their development is destructive to the bacteria.

so does a reduction of temperature retard their growth, and destroys them if below the freezing point.

CHEESE-MAKING.

The calves receive whole milk for fourteen days only ; after that it is gradually substituted with skim milk, and after the pigs have received their share the rest of the skim milk is used for cheese-making. The milk is warmed from 88° Fah. to 95° Fah., and sometimes from 8 per cent to 10 per cent of butter milk is added with the necessary rennet ($\frac{4}{100}$ part of a pound of rennet extract to 350 lbs. of milk) and, if thought requisite, colour also. After standing twenty to thirty minutes the curd is cut and then stirred fifty-five minutes (in another place twenty minutes are mentioned), and Mrs. Hermansen's method differs from others in that she did not permit the curd to be worked until it has been put under the press. She maintains that it makes the cheese tough ; nor should it be allowed to cool before it is put under the press. The temperature meanwhile may have fallen, and must be raised again to 96° Fah. by admitting steam under the vat. After drawing off half the whey the curd is worked by hand, $\frac{1}{4}$ lb. of salt is added for each 100 lbs. of milk, the curd is put into hoops and given half pressure. After half-an-hour it is turned again and replaced under the press. Two hours later it is again turned, and then full pressure is applied. Finally, in the evening, it is turned again and fresh cloth wrapped about it. Next morning it is taken from the mould and placed in strong brine for two days, when it is placed in the cheese room at a temperature of 52° Fah. to 55° Fah., and turned daily for three months, and rubbed with salt or strong brine once a week. This cheese sells at 3d per pound.

Mrs. Neilsen, a renowned practical dairy-woman and teacher of dairying as well, who supplies the King of Denmark every day with dairy products, and the Emperor of Russia with cheese, has her cows milked by her pupils at 4.30 a. m., and as soon as the milk is received, weighed and strained, takes as much as is desired for sweet-milk cheese. This is warmed to 88° Fah. by setting the cans of milk in kettles of warm water on the stove. She adds 64 lb. of skim milk to every 100 lb. of sweet milk, and on reaching the temperature of 88° Fah., the rennet is added at the rate of $\frac{2}{100}$ lb. of the fluid to 100 lb of milk and a little butter-milk. After it has coagulated (in twenty-five minutes) it is cut with a curd knife and gently stirred to separate the whey, but maintaining the temperature. When the curd has settled at the bottom the whey is drawn off, the lump of curd quartered, and the outside turned into the middle of the vat in order to drain it equally and make it of the same consistence throughout, else it would be firmer in the middle. The curd is next broken by hand into large pieces after the whey has drained off, and these are packed into the cheese mould with layers of caraway seed. No salt is added. The cheese mould can be enlarged or made smaller by the addition or removal of rings. At first but very light pressure is applied for about half-an-hour, then the cheese is turned, pricked through and through with a prong. About an hour and a half later, and again in an hour, and then four hours after, and once more in five hours the cheese is turned and turned again, and finally left in the press until next morning, when it is taken out of the mould rubbed with salt and put into a wooden bowl with round bottom, where,

the sharp edges are removed and the cheese takes a rounded shape. Rubbing with salt, and turning in the bowl is repeated three times a day for four days, and then it is put into the cheese room and rubbed with salt once a day until six weeks are passed. It is then removed to a room with slightly cooler temperature, and rubbed with brine every other day until it is sold. This rubbing keeps the rind soft, and the cheese is covered with a fatty layer drawn out by the salt, which prevents the access of air to the interior of the cheese. This cheese is sold at 1s. per pound.

Mrs. Neilsen also makes every morning from whole sweet milk a Camembert cheese, which is specially rich. The milk is warmed to 100° Fah., when $\frac{1}{100}$ lb. of rennet is added to each 10lb. of milk, which, after gentle stirring, is allowed to stand until in four and a half hours time it has coagulated to the proper degree. The vat used is a large earthen jar, which is kept wrapped up near the stove, to retain the temperature of 100° Fah. When coagulated the curd is cut into small cubes, but is not worked or pressed in the least. Curd and whey together are dipped out and put into small tin rings of moulds with holes in the sides, but with neither bottom nor top. Each mould consists of two rings, one placed on top of the other, making it 6 in. high by 5 in. diameter. They rest on a mat made of clean stiff rye straws, single straws being tied parallel to each other, and placed in a strainer on top of a vessel. The mat facilitates the turning of the cheese after the whey has drained off. When the rings are filled they are left for eight hours in a warm place near the stove; by this time the cheese has settled so much that the upper ring can be removed, and the cheese is turned, but left in the mould overnight. Next morning it is again turned, salted on one side, turned in three or four hours and salted on the other side. No pressure is applied at any time, and the temperature is kept above 78° Fah. After the second salting it is firm enough to be taken out of the mould, and is placed in a room of 55° Fah. to 60° Fah., where it remains two or three weeks, and then is placed in the cheese room with a somewhat higher temperature. It is ready for sale in two months, weighs $\frac{3}{4}$ lb. and commands 13d each. She makes fourteen cheeses daily of this kind from 80lb. of milk. Sometimes she adds a little cream to the milk before curdling it.

Madame Neilsen makes Myse cheese every morning from the whey obtained from the other cheeses, adding to it the milk of half a dozen goats. Six enamelled pots, each holding several gallons, are placed over the stove for evaporation, being constantly stirred and kept boiling. The quantity decreasing, the contents of one pot are poured into another until one pot contains the whole. Stirring is now constantly kept up and the mass becomes so thick that it must be removed to a trough where it is pounded and beaten with a club like a potato smasher, and when homogenous it is tamped closely into a square wooden mould and put under pressure. It forms a greenish-yellow sweetish mass, rather agreeable to the taste, and very nutritious. No rennet is added, nor any flavouring; but it is ready for use directly it comes out of the mould and it keeps for a couple of months, but should be kept covered to prevent it drying up. It sells at 1s. per pound.

A SMALL MODEL FARM.

Out of seventeen farms described by Professor Georgeson, I select

this as showing what an energetic man can do on only seven acres of land. P. Pedersen, a teacher in a village in Tunen, holds land of an ordinary quality, with clay sub-soil, since 1876. One acre is used for buildings and an orchard. The other six acres are divided into five lots, one being kept for hay and grazing ; the other four are cultivated in a four-year rotation. After rye and soiling crops, one acre was planted with roots, potatoes, and green peas ; the third year with barley and vegetables, and the fourth with grass and vegetables. High manuring and thorough cultivation made it possible to keep four high-class dairy cows and one heifer. The liquid manure was kept in a cistern, and applied to the grass land, the fruit trees, and plots devoted to seed-growing. The solid manure was applied to the root crops, the soiling crops, and the vegetables. He kept two brood sows, and fattened yearly eight to ten head of swine. He purchased yearly 200 lb. of kainit, 400 lb. of Thomas slag, and 200 lb. of Chili saltpetre, which he used for the grain crops, for his cows were fed both winter and summer to some extent on grain. He tethered them in summer for two hours daily on good pasture. (Tethering the cows and calves to a 20 ft. rope is very general in Denmark, even on large farms, as it is considered that it is the most economical way of using the pasture to begin at one side and gradually moving on to the other side). The entire herd is shifted five times a day, each cow being given 3ft. or 4ft. of fresh pasture at each change. Pedersen's five head of cattle consumed 10,788 lb. of grain feed mixture ground together, valued at £33 4s., and hay and roots at £12 16.—all of which, except some oilcake, was produced upon the place. The cows gave 30,438 lb. of milk, for which he would receive, at the co-operative creamery, £58 16s., but he made more of it in butter and cheese at home. The heifer sold for £9. The swine ate 8,845 lb. of grain, together with the whey and skim milk, not otherwise used, and offal from the garden, on which he put a total value of £40 16s. He slaughtered three for home consumption, and sold seven, also twenty-one suckling pigs, for £49 6s. The sum realised for fruit, vegetables, and seed was no inconsiderable item, but was not mentioned by Pedersen, and may be at least set against the expense for manure. He and his family had, however, everything from the seven acres and £30 6s. in cash, even if the milk had been sold to a creamery.

THE MILK SUPPLY COMPANY OF COPENHAGEN.

This company delivers somewhat less than one-fourth of the milk consumed in that city, at a slightly enhanced price ; but it is absolutely pure and wholesome. Forty-two dairy farms, with 4,600 cows, supply the milk under the strictest rules as to cleanliness, feeding, cooling the milk, &c. The company employs three veterinary surgeons and some trained dairymaids to constantly examine the dairies and surroundings and to look after the healthy condition of the cows. At the station at Copenhagen samples from each farm are tested by smell, taste, and by the Babcock tester, besides being occasionally analysed. No milk is accepted until twelve days after calving, or from cows almost dry. The cows must not be fed with distillery slops, turnips, kohlrabbi, rutabagas, or the leaves from root crops ; and if the milk is for children oilcake is prohibited, and only one peck a day of mangolds and carrots is allowed. The time for calving must also be distributed as evenly as pos-

sible over the year, and sufficient ice kept on the farm. The company owns and cleans all the cans, which hold 100 lb. of milk. From cans for delivery to consumers the supply is drawn from the bottom. The sweet milk is kept in round cans, and the skim in square cans. To equalise the distribution of cream with the milk, the tube or pipe, in which the discharge valve is placed is continued to the top of the can, and contains rows of small holes through which the milk is drawn from the whole depth of the milk.

FERNS: SYNOPTICAL LIST—XXXVI.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Gardens, Demerara.

22. *Nephrodium pubescens*, Desv.—Rootstock slender, about as thick as a quill, repent, slightly scaly; stipites contiguous or scattered, erect, rather slender, channelled, naked or lightly pubescent, 9–15 in. l.; fronds deltoid, acuminate, about a foot each way, bi-tripinnate, chartaceous; throughout pubescent; light green rather glossy above; pinnæ spreading, lowest pair deeper on the inferior side, all acuminate, and petiolate $\frac{1}{4}$ – $\frac{1}{2}$ in., central ones lanceolate 4–6 in. l. $\frac{1}{4}$ – $\frac{3}{4}$ in. w., the basal pinnule on the upper side the largest; pinnulæ ovate or lanceolate-acuminate, the smaller cuneate at the base, $\frac{3}{4}$ – $1\frac{1}{2}$ in. l. $\frac{1}{3}$ rd $\frac{3}{4}$ in. w. the point entire, lobed or pinnatifid within; the segments on the upper side at the base largest and more or less free, entire or toothed, $\frac{1}{3}$ rd $\frac{1}{2}$ in. l. $1\frac{1}{2}$ –3 li. w.; teeth sharply acute or mucronate; veins pinnate in the ultimate divisions, the branches not reaching the edge; with the sori dorsal or terminal upon them; involucre pale, delicate, fugacious.—Hook. and Grev. Icon. Fil. t. *Aspidium*, Swartz. Polypodium, Linn. 102. Phegopteris, Fée.

a. var. *breviculum*, Jenm.—Fronde small, elongate-deltoid (occasionally lanceolate) 4–6 in. l. $1\frac{1}{2}$ –3 in. w., bipinnate; stipites and rachises slender.

Common in damp woods among the lower hills, reaching up to 1,500 ft altitude; distinguished by its creeping rootstock, pale colour, pilose surfaces, relatively large pinnulæ, and sharp teeth, which would be pungent if the texture were stiffer. The lowest anterior veinlet often terminates about halfway to the margin. Var. a, of which *A. Klotschii*. Hook. Cent. Ferns, t. 23, is a good representation of its outline and cutting, is distinct in size and form from the type, which characters hardly vary, and are constant under cultivation. It grows in the fissures of rocks, often fully exposed. Usually only the interior segment on the upper side of the pinnules is free but in some states others are as well.

23. *N. ochropteroides*, Baker.—Rootstock erect or oblique, paleaceous on the crown; stipites tufted, a foot or more l. stone-brown, channelled, rather glossy, scabrous, clothed below with light or ferruginous linear-acuminate scales; fronds subdeltoid 9–12 or more in. each way, quadripinnate, coriaceous, light green, paler beneath, naked and glossy except the rachises which are pubescent, especially down the channel, and brown; pinnæ spreading, the upper lanceolate, the lower deltoid-

lanceolate, lowest pair largest, and most developed on the inferior side, those above these rather deeper on the superior side, acuminate and sharply serrate at the point as is the apex, of the frond, especially in the barren state; interior pinnule of all on the upper-side, the corresponding one of the inferior side being absent; tertiary segments lobed, pinnatifid or fully pinnate at the base; final one oblong-lanceolate, 2-4 li. l. 1-1½ li. w. cuneate at the base when free, the point acute and sharply toothed in the barren but usually entire in the fertile fronds; veins pinnate or forked in the final segments; sori more or less medial on the veins; involucres cordate, pale coriaceous, ample somewhat ciliate.—Annals of Botany, Vol. 5, 1891.

Gathered by Mr. Hart, a few years ago on the St. Andrew Mountains in the region of Mt. Moses, 3,000 ft. alt., intermediate between *denticulatum* and *pubescens*, having the texture of the form a., but wider final parts. The fronds are light green, coriaceous, the petioles and rachises stone-colour when dry, channelled and pubescent. The barren fronds are rather larger, and the teeth are almost mucronate. The very firm involucres are probably eventually deciduous.—Endemic.

24. *N. denticulatum*, Hook.—Rootstock woody, rather stout, erect—decumbent, densely clothed with long dark glossy linear attenuate scales; stipites cæspitose, erect, 1-1½ ft. l., castaneous, subangular and densely clothed at the base with falcate scales like those of the rootstock, which have scars when they drop; fronds deltoid, quadripinnate, 1-1¼ ft. l. and about the same w., acuminate, coriaceous and stiff, glabrous, glossy and dark green above, paler beneath; rachis and costæ bright light chesnut brown, channelled, often rather flexuose; pinnæ spreading, lowest pair subdeltoid, deeper on the underside, those above these equilateral, 4-6 in. l. 1½-2 in. w., lanceolate, acuminate, all petiolate; ultimate segments, ovate or oblong, 2-3 li. l. and about half as wide, cuneate at the base, the outer part cut into sharply pointed or spinulose teeth; veins pinnate in the final segments or forked; sori copious, terminal on the short anterior veinlet or spur; receptacles scaly: involucres dark, firm, at length deciduous.—*Aspidium*, Swartz.

Common in forests at 5000-7000 ft. altitude. The species is well marked by the very abundant dark narrow scales of the rootstock and stipes, its stiff texture, glossy naked surfaces, and sharp segments and teeth. It varies a good deal the size of the final segments.

Sub sp. *rigidissimum*.—Fronds nearly as large, less deltoid, pinnæ more numerous, closer and more spreading, the lowest pair, though usually rather the largest, not distinctly enlarged; ultimate segments ½ li. w. 1-2 li. l. mucronate, often forked, but not otherwise toothed.—*N. denticulatum* var. *rigidissimum*, Hook. *Polystichum dissectum*, Fée.

Gathered by Dr. Morris and Mr. Sherring near Blue Mt. Peak; still more rigid than the type, of more compact habit, with, as it were, the final segments of that cut between the teeth to the axis into narrow separate segments, sharply mucronate, but not toothed.

25. *N. effusum*, Baker.—Stipites subtufted from a strong shortly-creeping scaly rootstock, 2-3 ft. l., scaly at the base, glabrous, or with the channel puberulous; fronds deltoid in outline, 2-3 ft. l. and as much w. chartaceous; quite naked, vivid green and shining on the upper side, tri-quadripinnatifid; lowest pair of pinnæ largest and much

developed on the inferior side, those above these oblong-lanceolate, acuminate, 9-12 in. l. 4-8 in. w., lowest pair $1\frac{1}{2}$ - $1\frac{3}{4}$ ft. l. 1- $1\frac{1}{4}$ ft. w.; pinnulæ oblong-acuminate, 4-6 in. l. $1\frac{1}{2}$ -3 in. w., petiolate as are the pinnæ, the lowest one on the superior side usually the largest; the costulæ flat and narrowly green-winged; ultimate segments flat-oblong or ovate-oblong, acute, sharply toothed throughout, 2-6 li. l. 1- $2\frac{1}{2}$ li. b., teeth about $\frac{1}{2}$ li. b.; rachis and costæ glossy, naked or slightly puberulous down the face, green; veins pinnate in the final segments, the branches simple, not reaching the edge; sori dorsal, very small, copious, reddish-brown. -- *Polypodium*, Swartz. *P. divergens*, Hk. *P. multifidum*, Jacq. Icon. t. 643. *Aspidium* Gr. *Phegopteris divergens*, Fée.

Common from the low-lands, on banks way sides and in dry woods, up to 5000 ft. altitude, and generally distributed over the island. Distinguished by its decumbent short-creeping rootstock having the bases of past stipes persistent, naked shining bright green colour, thin but firm texture, green winged costulæ, sharp and freely toothed segments, and minute copious aureous sori. At the higher elevations it produces beneath a few inches below the apex, in the axil of a pinnæ, a large densely dark scaled radicate bud.

26. *N. mexicanum*, Hook.—Stipites 1- $1\frac{1}{2}$ ft. l. erect-spreading, pubescent, with scattered minute scales above the more paleaceous base; fronds oblong, acuminate, bi-tripinnate $1\frac{1}{2}$ -2 ft. l. 9-12 in. w. chartaceous, light green, slightly ciliate on the surface, rachis costæ and ribs finely pubescent and sprinkled with minute scales; lowest pair of pinnæ largest, and deeper on the underside, those above these equilateral, spreading; pinnulæ adnate at the base, or the lower ones quite free, cut more or less deeply on both sides into oblong round-ended segments, 1-2 li. w. 2-3 li. l.; veinlets simple not reaching the edge; sori medial; involucre deciduous or abortive. Hook Sp. Fil. vol. 4. p. 138 t. 267.

There are two sheets of this collected by Wilson; but without locality in the Kew Herbarium, which are marked in Grisebach's hand as a variety of *N. villosum*. Of other Jamaica species it comes nearest *Aspidium Christianæ*, but differs by deeper and more uniform cutting of the pinnules, lowest pair of pinnæ longest, the peculiar vestiture, and the reniform sori.

27 *N. ascendens*, Donnell Smith.—Root-stock strong, $\frac{1}{2}$ -1 in. thick, densely scaly, wide creeping on the ground or up the trunks of trees; stipites scattered, strong, 6-9 in. l. naked, except at the very base; fronds deltoid, dimorphous; the barren 2- $2\frac{1}{2}$ ft. l. and about the same wide, tri-quadrupinnate, broadest at the base and thence tapering to the apex; coriaceous; naked dark-green, glossy, rachis and costæ light or dark brown, the latter pubescent down the channelled faces; pinnæ petiolate, spreading, basal pair largest and deeper on the inferior side 12-15 in. l. 7-10 in. w., acuminate; pinnulæ much the same shape, stipitate, ultimate segments oblong, pointed, cuneate or obliquely-cuneate at the base, lobate or only dentate; veins simple or forked, entering the marginal teeth, pellucid; fertile fronds the same shape, but smaller, their segments contracted, sinuate, 1- $1\frac{1}{2}$ li. w.; the sori biserial, occupying the entire lobes of the under surface, involucre at first suborbicular, ultimately reniform, dark-brown, persistent.—*Dicksonia apiifolia*, Swartz. *Aspidium*, Heward. *Nephrodium duale*, Don. Sm., Amer. Bot. Gaz. 1890, 29 tab. 4. Common in the parishes of Manchester and St.

Ann, at 2,000 ft. altitude, growing on the skirts of forests, and often extending acre after acre, and ascending trees several feet from the ground, after the manner of *Polybotrya* and *Stenochlæna*. In the fertile fronds all the membrane is suppressed except a narrow sinuate wing to the ribs, on which the sori are borne, terminal, on the short spur-like veins. Sometimes the fronds partake of the character of both forms. The sori are very abundant, and the dark brown involucre remain till the fronds perish.—Guatemala, gathered by Baron von Turckheim.

28. *N. Grisebachii*, Baker. —Rootstock stout, usually decumbent, densely clothed with rusty-brown linear-subulate scales, that are $\frac{1}{2}$ -1 in. l. and less than a line w.; stipites cæspitose, dark-coloured, $1\frac{1}{2}$ -2 $\frac{1}{2}$ ft. l., hardly channelled, clothed at the base in a dense tuft-like the rootstock, above this with dark squarrose criniferous scales 2-4 li. l.; fronds $2\frac{1}{2}$ -3 $\frac{1}{2}$ ft. l. 2-3 ft. w., tri-quadrupinnatifid; thinly chartaceous or membranous, rather light vivid green, rachis costæ and costulæ somewhat fibrillose-scaly and puberulous-glandulose, surfaces otherwise naked; pinnæ spreading, petiolate, all but the lowest pair, which are enlarged on the inferior side oblong-acuminate, and 1-1 $\frac{1}{2}$ ft. l. 4-6 in. w.; pinnulæ contiguous, very numerous, the lower ones slightly stipitate, oblong-acuminate, 2-3 $\frac{1}{2}$ in. l. $\frac{3}{4}$ -1 in. w., deeply pinnatifid, but (except those of the enlarged basal pinnæ) not fully pinnate; tertiary segments oblong, blunt, $\frac{1}{2}$ - $\frac{3}{4}$ in. l., $1\frac{1}{2}$ -2 $\frac{1}{2}$ li. w., entire, serrulate, toothed or more or less lobed; the teeth sharp, $\frac{1}{2}$ - $\frac{3}{4}$ li. w. and deep; veins pinnate branches simple or forked; sori dorsal, rather nearer the midrib than margin; involucre pale, at first covering the sori, but fugacious.

Frequent in damp forests from 3,000 to upwards of 5,000 ft. altitude; of a more delicate texture than any other in the group. In some of the smaller conditions of its growth the basal pinnæ are very little, if at all enlarged. The dark petioles and richness have a bluish tinge when growing. It is characterised by the thin substance, vivid colour, the pinnulæ of all but the lowest pinnæ being simply pinnatifid to the base, the sharp teeth, the outer third or fourth part of every pinnæ being usually (though not always) devoid of sori, and the two kinds of scales which form the vestiture of the petioles, &c. The outer part of the pinnæ being nearly uniformly barren is a feature peculiar to this species, and sufficient at sight for its identification.

29. *N. amplum*, Baker.—Rootstock stout, upright, densely clothed with matted wool-like and silky-long tawny scales; stipites cæspitose, erecto-spreading, 2-3 ft. l., clothed at the base abundantly like the rootstock, and upwards with a rusty grayish, fine, closely appressed vestiture of small scales, faintly channelled; fronds about 3 ft. l. 2-2 $\frac{1}{2}$ ft. w., tri-quadrupinnatifid, dull brownish-green papyraceous, upper surface very slightly ciliate, under naked, rachis costa and costulæ furfuraceous-scaly like the stipes; pinnæ spreading, numerous, all but the lowest pair, which are much expanded on the inferior side, oblong-acuminate, the central ones 4-6 in. w. and 12-15 in. l., all petiolate; pinnulæ numerous, contiguous, the lower ones shortly stipitate, oblong-acuminate, fully pinnate at the base, upwards pinnatifid almost to the costulæ; ultimate segments mostly adnate-decurrent at the base, oblong, $\frac{1}{2}$ - $\frac{3}{4}$ in. l. $1\frac{1}{2}$ -3 li. b., blunt, serrulate lobed or deeply pinnatifid; the lobes $\frac{1}{2}$ -1 li. w. 1-2 li. d.; veins pinnate, branches forked once or twice; sori small,

situated on the anterior branch near the fork, nearer the midrib than margin; involucre very minute, early quite obliterated.—*Aspidium*, Gr. *Polypodium Sloanei*, Kze. Common in dryish woods and half-exposed or open banks at low elevations. The fronds present a peculiar colour, produced partly or chiefly by the dull furfureous-scaly vestiture of the vascular parts; which on the stipites has a rather fuscous variegated aspect. The rachis and costæ are not at all channelled. The involucre are exceedingly minute and only observable in the earliest stages of the sori. In cutting it resembles *Grisebachii* and *villosum* but is very dissimilar to either in colour and clothing, and may be easily recognised by the vestiture of the rachises and by the matted, shaggy, soft and silky tawny or yellow-red clothing of the rootsack, a considerable tuft of which is attached to the base of each petiole. Mr. Baker conjectures this may be Plumier's t. 34. *Aspidium lutescens*, Willd. Cuba and French Islands, Mexico to Ecuador.

30. *N. villosum*, Presl.—Rootstock stout, erect, $\frac{1}{2}$ -1 ft. diameter, densely clothed with linear-acuminate dark-coloured scales $\frac{1}{2}$ -1 in. l. $1\frac{1}{2}$ li. b.; stipites cæspitose, erecto-spreading, stout, 3-5 ft. l. $1-1\frac{1}{2}$ in. thick at the base, dark, slightly channelled, scaly throughout, but densely so at the base; fronds deltoid, 4-6 ft. l. and the same w., tri-quadrifid, chartaceous, dark brown-green, the upper surface silky-looking; pinnæ spreading, lowest pair far the largest amply developed on the underside, those above these oblong-acuminate, $1\frac{1}{2}$ -2 ft. l. 6-8 in. w. shortly petiolate, the upper one sessile; pinnulæ very numerous, contiguous, oblong-acuminate, sessile, 3-4 in. l. $\frac{3}{4}$ -1 in. b., pinnatifid nearly to the costulæ, or the inferior ones fully pinnate at the base; tertiary segments oblong, blunt, $\frac{1}{2}$ - $\frac{3}{4}$ in. l. $1\frac{1}{2}$ -2 li. w. serrulate lobed or pinnatifid; teeth $\frac{3}{4}$ li. b. less or more deep, blunt or rounded; rachis and costæ fibrillose-scaly and rusty-furfaceous; costulæ pubescent, other surfaces more or less ciliate, especially on the ribs and margins; veins pinnate, branches forked; sori copious, dorsal on the anterior branch, at the base of the teeth, medial; involucre ample dark-brown, permanent.—Pl. Fil. t. 27. Hooker Sp. Fil. vol. 4. t. 264. *Aspidium*. Swartz, *Polypodium*, Linn.

a. var. *Karstenianum*.—Fronds as large or larger rachis costæ ribs and general surfaces most densely clothed with a bright rusty or aureous villose down; involucre apparently uniformly absent at all stages of growth.—*Polypodium Karstenianum*, Klotzsch.

b. var. *subincisum*.—Fronds variable in size, final segments rather broader; vestiture very variable, the stipites, rachis and other variable, parts more or less freely scaly, the general surfaces often bare; destitute uniformly of involucre.—*Polypodium*, Willd. *P. spectabile*, Klf.

c. var. *reductum*.—Fronds much smaller, oblong-acuminate, pinnæ 1 ft. l. $3-4\frac{1}{2}$ in. w. the lower ones not enlarged, and the lowest nearly or quite equilateral.

Frequent in damp woods and forests, especially near water-courses, above 2,000 ft. altitude. This is a magnificent species, possessing the spread and ample dimensions of frond which as a rule characterise the true tree-ferns. In the lowest pair of pinnæ the pinnules on the upper side are not larger than those of the other pinnæ, but on the inferior side they are so greatly enlarged that the lowest are from $1-1\frac{1}{2}$ ft. l. and 4-6 in. w. In old plants the caudex is woody, from 1-2 ft. l. and

several inches thick. In this state it is prostrate, but in the early growth erect. *a.* is found in forests at 5000-7000 ft. altitude. It is well distinguished by the conspicuously rusty- villose rachises and ribs, and the copiously like coloured pubescence of the parenchyma, and which in the glinting sunrays of the forest give it a most lovely and charming aspect. *b.* is always destitute of involucre. Some states however are quite identical with the type in the character of their clothing, while others are almost or quite naked. *c.* is a smaller form in which the lowest pair of pinnæ are equilateral and not at all enlarged. It is common on the banks at Tweedside near 2nd Breakfast Spring, St. Andrew.

31. *N. patulum*, Baker—Rootstock erect, short stoutish, densely paleaceous with bright light tan-brown scales; stipites cæspitose, faintly channelled, stramineous, $\frac{1}{2}$ -1 ft. l. freely clothed at the base with deciduous scales like those of the rootstock which in old plants leave scars; fronds oblong lanceolate, acuminate, a little narrowed, or not, at the base, variable in size, less than 1-2 $\frac{1}{4}$ ft. l. 3-12 in. w.; pinnæ numerous, spreading nearly horizontally, opposite or alternate, distant or subdistant, nearly sessile, lanceolate-acuminate, 1 $\frac{1}{2}$ -6 in. l. $\frac{3}{4}$ -2 $\frac{1}{2}$ in. w.; chartaceous, pale, straw-green, naked but viscidulose beneath; pinnulæ oblong or lanceolate, blunt or tapering and acute or acuminate, contiguous or apart, the outer ones adnate-decurrent. the interior free, those on the superior side rather larger than on the inferior, $\frac{1}{2}$ -1 $\frac{1}{4}$ in. l. 2-6 li. w.; merely toothed or more or less deeply pinnatifid, segments on the superior side the larger, 2-5 l. l. 1-1 $\frac{1}{2}$ l. w. oblong, blunt, entire or crenate; rachis and costæ stramineous; veins pinnate, branches forked or simple; sori medial; involucre copious, convex, pale.

Frequent on open or half open banks at from 4000-5000 ft. altitude. This is intermediate in habit between the decomposed and simply pectinate-pinnæd groups. In fronds which are mature, and fully fertile, there is much variations in size, and in the character of the base. Some are reduced there, others are not, while the lesser ones are sometimes a little enlarged. Its shape, general pale straw coloured surface, and pale dough-coloured involucre well mark it. The habit of growth, is spreading or pendent. To be compared with *Nephrodium mexicanum* which see.—Mexico southwards according to the Syn. Fil.

32. *N. nemorosum*, Jenm.—Rootstock stout, erect, the crown densely clothed with long, finely attenuated ferruginous scales; stipites 1-1 $\frac{1}{4}$ ft. l. cæspitose, spreading, freely scaly, the base with a tuft of bright ferruginous hair-like scales ascending from the rootstock, fronds bitripinnate, 1 $\frac{1}{2}$ ft. l. nearly or quite as wide, tinged from the vestiture aureous-brown throughout, chartaceous, the apex finely dentate-acuminate, the base less expanded than the middle, rachis costæ and ribs freely clothed with fibrillose and bullate fine aureous scales; pinnæ erecto-spreading bipinnate, sessile, 8-10 in. l. 3-4 $\frac{1}{2}$ in. w. linear-oblong, serrato-acuminate; pinnulæ contiguous, sessile, pinnato-pinnatifid, barely connected by the decurrent membrane, serrato-acuminate segments oblique, dentate, bluntish, 3-4 li. l. to the oblique open but acute sinus, 1-1 $\frac{1}{4}$ li. w.; veins pinnate, simple; sori copious, medial, in opposite pairs; involucre fugacious at maturity.—Pl. Fil. t. 43. *Aspidium*, Willd.

Grisebach, in his Fl. Brit. W. Ind. Is., quotes the above figure for

Nephrodium hirtum, Hook. (*Aspidium*, Sw. *Polypodium*, Sw.) either through not looking at the base plate, or by a misprint or blunder in its number. The figure is quite characteristic of the species, which is easily identified by the lower pair of pinnæ being smaller than the rest and not at all enlarged on the under side. But for these features; in vestiture, cutting, colour, &c., it resembles most *N. amplum*, Baker.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of June:—

IN FLOWER.	IN FRUIT.
<p>Allamanda Hendersoni, Bull. Averrhoa Carambola, Linn. Baphia nitida, Lodd. Bassia latifolia, Roxb. Bauhinia variegata, Linn. Brownea Rosa-de-monte, Berg. Cananga odorata, Hook. f. & Thoms. Caryocar nuciferum, Linn. Chrysalidocarpus lutescens, H. Wendl. Couroupita guianensis, Aubl. Derris dalbergioides, Bak. Dipteryx odorata, Willd. Eugenia caryophyllata, Thunb. " malaccensis, Linn. Fagraea obovata, Wall. Garcinia Mangostana, Linn. Gardenia lucida, Roxb. Gmelina asiatica, Linn. Heritiera macrophylla, Wall. Hevea brasiliensis, Muell. Arg. Lagerstroemia Flos-reginæ, Retz. " indica, Linn. Mesua ferrea, Linn. Michelia Champaca, Linn. Mimusops Elengii, Linn. Mussaenda frondosa, Linn. " luteola, Delile. Norantea guianensis, Aubl. Omphalea triandra, Linn. Oncoba spinosa, Forsk. Oreodoxa regia, Mart. Pachira aquatica, Aubl. Plumeria rubra, Linn. " acutifolia, Poir. Pterocarpus indicus, Willd. Stiffia chrysantha, Mikan. Swartzia grandiflora, Willd. Tabernaemontana longiflora, Benth. " Wallichiana, Steud. Tecoma stans, Juss.</p>	<p>Amherstia nobilis, Wall. Cananga odorata, Hook. f. & Thoms. Castilloa elastica, Cerv. Cinnamomum zeylanicum, Nees. Cordia myxa, Linn. Diospyros discolor, Willd. Eugenia javanica, Lam. Garcinia Mangostana, Linn. Hevea brasiliensis, Muell. Arg. Imbricaria maxima, Poir. Michelia Champaca, Linn. Mimusops Elengii, Linn. Morinda citrifolia, Linn. Myristica fragrans, Houtt. Omphalea triandra, Linn. Posoqueria longiflora, Aubl. Spathodea campanulata, Beauv.</p>

THE HONDURAS SARSAPARILLA INDUSTRY.

Next to bananas, sarsaparilla is the principal export-article from Puerto Cortéz, in Honduras. In the year ended August, 1, 1892. which is the last of which statistics have been published, the exports amounted to 62,561 lbs. The whole of this goes to the United States, whence the British and continental markets are supplied. The British Consul at Puerto Cortéz is strongly of opinion that the whole of it would go to London if there were direct steam-communication with that city, and he thinks that the bulk of the goods now imported from the United States for the Honduras market would, also in that case, be purchased in England. The price paid at Puerto Cortéz to the collectors of sarsaparilla varies, according to quality, from 7 to 9 soles per arroba (14s. to 18s. per 25 lbs). The sarsaparilla has to be assorted, made up into rolls, and packed in hide-covered bales before shipment, which adds 5c. per lb. to its cost. An export-duty of 8 per cent. on a conventional value of 16c. per lb. is also charged on the drug. It appears from these figures that the lowest price at which Honduras root can be shipped from the central American coast is $9\frac{3}{4}$ d. per lb. (collecting $6\frac{1}{2}$ d., packing, &c., $2\frac{1}{2}$ d., export duty, $\frac{3}{4}$ d. per lb). It has then to be shipped to New Orleans or New York, and thence to Europe. The present London market rate at 1s. 2d. to 1s. 3d. per lb. can, therefore, only leave a moderate profit to those concerned in the business.—*Chemist & Druggist.*

THE RELATIVE FERTILISING VALUE OF THE NITROGEN IN ALFALFA AND IN STABLE MANURE.

In pot experiments the author compared the fertilising value of young alfalfa and of stable manure produced by feeding the same quality of alfalfa to a steer. The steer was kept on a maintenance ration, neither increasing nor decreasing in weight. After being fed for a number of days on alfalfa alone the solid and liquid manure was saved separately and analysed. The solid and liquid excrement was used in the proportions produced: 185.95 gm. of solid excrement containing 0.361 per cent of nitrogen and 250 gm. of urine containing 1.38 per cent of nitrogen, were used on each pot of the manure series, the total nitrogen supplied to each pot being 4.1168 gm.

Each of the pots of the green-manure series received 4.1168 gm. of nitrogen in the form 565.5 gm. of green alfalfa not in bloom. This was applied at the rate of nearly 18,000 lbs. per acre, and supplied nearly 130 lbs. of nitrogen per acre, the same rate at which the nitrogen of stable manure was employed.

Another series of pots received each the same quantity of nitrogen (4.1168 gm.) in the form of sulphate of amonia, supplemented by phosphatic and potassic fertilisers, supply 49 lbs, of phosphoric acid and 70 lbs of potash per acre. These last mentioned fertilisers were intended to offset the phosphoric acid and potash in the green alfalfa and in the stable manure.

These minerals were also applied to another series of pots receiving no nitrogen.

Mustard was planted July 5 and harvested August 13. The following table gives the yield per pot in green mustard, dry matter, and nitrogen :

Yield of mustard in pots fertilized with different forms of nitrogen.

	Green Mustard.	Dry Matter.	Nitrogen.
	Grams.	Grams.	Grams.
Minerals, no nitrogen	1,164.0	124.5	3 304
Green alfalfa	1,504.0	147.8	4.519
Stable manure	1,606.0	154.9	5 277
Sulphate of ammonia and minerals	1,627.5	148.2	5.362

Comparing the amount of green mustard produced on the nitrogen pots with that on the pots receiving no nitrogen, there is found an increase of 463.5 gm., for sulphate of ammonia, 442 gm., for stable manure, and 340 gm., for 'green manure. This is equivalent to saying that the nitrogen of stable manure was 95 per cent. and that of young alfalfa 73 per cent. as effective as that of sulphate of ammonia.

Comparing the amount of nitrogen in the mustard growing on the nitrogen pots with that on the pots receiving no nitrogen, we find an excess of 2.058 gm for sulphate of ammonia, 1.973 gm. for stable manure, and 1.215 gm. for green manure

Comparing this excess with the amount of nitrogen applied (4.1168 gm. to each pot) it appears that 50 per cent. of the nitrogen in sulphate of ammonia, 48 per cent of that in stable manure, and 30 per cent of that in green alfalfa was utilized by mustard in its six weeks of growth.

The nitrogen of stable manure was more immediately available in the author's experiments than in those of previous investigators, a fact which he ascribes to his having used the manure with its full complement of urine as soon as it came from the animal.—(J. KUHN, abstract in *Experiment Station Record*.)

CONTRIBUTIONS TO THE DEPARTMENT.

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SEEDS.

From Royal Gardens, Kew.

Cupressus Benthami	Nemophila aurita
“ Lawsoniana	“ insignis
“ lusitana	“ maculata
“ nootkatensis	Nicotiana Langsdorffii
Daphne Mezereum	“ paniculata
“ flore albo	“ rustica
Deutzia crenata	Papaver orientale, var. majus
Elaeagnus longipes	“ Rhoeades, var. “ Shirley”
“ umbellata	“ somniferum
Himalayan Raspberry	Philadelphus hirsutus
Hemerocallis flava	Primula cortusoides
“ “ var. Kwanso	“ denticulata
Inula Helenium	“ japonica
Iris Pseudacorus	“ rosea
“ spuria var. notha	“ verticillata
Lupinus elegans	Pyrus floribunda
“ mutabilis	“ Maulei
“ pulchellus	“ Ringo
Lyonia ligustrina	“ Toirngo
Mesembryanthemum cordifolium	

- Rheum officinale
 " Raponticum
 " Webbianum
 Rosa moschata
 " multiflora
 " rubiginosa
 " " major
 Rubus laciniatus
 Spathodea campanulata
 Taxus baccata
 " " adpressa
 " " Dovastonii
 " " fastigiata
 " " fructu-lutea
 " " sinensis
 " " Washingtoni
 Thuja gigantea
 " occidentalis
 " orientalis
 Forsythia suspensa
 Viburnum Opulus
 Vitis Labrusca
 Widdringtonia Whytei
From Botanic Gardens, Trinidad.
 Eucalyptus rudis
 Eperua Jenmanii
From Botanic Gardens, Brisbaen.
 Araucaria Bidwillii
 " Cunninghamii
 Erythrina speciosa
 Elæodendron quadrangulatum
 Macadamia ternifolia
 Nephelium Lit-chi
From Baron Sir F Von Mueller, Melbourne.
 Acacia cyclopsis
 " stenophylla
 Albizzia pruinosa
 Atriplex halimoides
 Brachychiton populneum
 Clematis pubescens
 Doryanthes Palmeri
 Eucalyptus corynocalyx
 " Globulus
 " drepanophylla
 Neptunia spicata
 Owenia reticulata
From Messrs. Reasoner Bros., Florida.
 Eriobotrya japonica
 Cycas revoluta
From H. E. Aristakes Azarian, Constantinople
 Anona Cherimolia, var. loxensis.
From H. G. Bates, Arlebury, Hants, England.
 Vine and Fig cuttings.
From Botanic Gardens, Cape Town.
 Diosma alba
 Homeria elegans
 " Collina
 " miniata
 Lachenalia pallida
 " pustulata
 " racemosa
 " tricolor
 Lachenalia unifolia var. Wrightii
 Massonia pustulata
 Melaspharula graminea
 Gladolus gracilis
 Trichonema bulbocodioides
 " aurea
 Antholyza æthiopica major
 " minor
 Sparaxis bulbifera
 Albuca major
 Gladiolus recurvus.
 Geissorhiza mixed
 Ornithogalum aureum
 Diets iridioides
 Morea tristis
 Synnotia tricolor
 Ferraria undulata
 Pelargonium hirsutum
 Freesia refracta alba
 Erica baccans
 Ixia conica
 Bæometra columellaris
 Hesperantha falcata
 Polygala speciosa
 Hypoxis stellata mixed
 Homoglossum marianella.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

Directions for care of Young Grape Vines	- PAGE	121
Notes concerning budding Orange trees	-	122
Grapes for the U. S. Market	-	123
Notes on Cotton	-	124
Ramie stripped by boys at Hope	-	132
Directions for Planting Ramie	-	134
Coffee Pulpers for Settlers	-	135
Kola Nuts	-	136
Rules as to Sale of Lands to Settlers	-	138
Ferns: Synoptical List.—XXXVII	-	141
Castleton Gardens	-	143
Contributions to the Department	-	144

P R I C E—Threepence.

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

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BULLETIN

OF THE

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DIRECTIONS FOR CARE OF YOUNG GRAPE VINES.

By WM. CRADWICK, Superintendent of Hope Gardens.

On receipt of plants place the bamboo pots in a bath or pail of water for ten minutes, taking care that sufficient water is in the vessel to cover the pots, repeat this operation every other day until planting.

A border must be prepared as follows, dig out a trench four feet wide, two and a half feet deep; the length to be regulated by the number of vines to be planted, plant the first vine two and a half feet from the beginning of the trench, a space of four feet to be left between every successive vine.

In digging out the trench be careful to separate the good top soil from the subsoil if it be gravel, clay, sand or any such material which contains no plant food. When the trench has been dug the required depth, return the top good soil to the bottom of the trench; place on the top of this if possible a layer of good rotten cow manure six inches deep; to this may be added charcoal, wood ashes, bones, spent lime, forming a layer 2 inches thick; fill up the trench with good ordinary soil and give the whole a good soaking of water; allow two or three days to pass before planting.

Vines must be planted in an open situation at least 100 feet from any large tree; and the border must have a southern or a southeastern aspect, quite free from shade, as the early morning sun is indispensable.

To plant out the young vines, split the bamboo joint at the bottom, taking care not to injure the roots; make a hole in the border with the hand of sufficient size to receive the young plant easily, if the plant has a quantity of roots and they are matted together spread them out carefully, cover the roots with soil, press fairly firm with the hand, and water at once.

Nothing further requires to be done, but to support the plant with a good strong stake, which must not be placed in the ground nearer than 6 inches from the plant, and remove all side growths, allowing the plant to grow as long as possible; keeping it well watered up to the end of September, about which time they will naturally gradually cease to grow.

Further instructions as to the treatment of the plants for next year will be issued before it is necessary for anything further to be done to the plants.

NOTES CONCERNING BUDDING ORANGE TREES.

Those who are taking up Orange culture may proceed in various ways to increase and supplement the trees they already possess. They may bud mature trees of worthless kinds, either when they are growing, or after transplanting; they may grow their own sweet seedlings; or they may bud sweet or sour seedlings.

The reason for budding mature trees is that a crop is secured at a much earlier date, but the disadvantages are that the yield is not so large, nor is the tree so long-lived, as in the other cases.

The sweet seedlings are said to grow into larger trees and give a more abundant yield than any other; but there is no certainty that the fruit will be as good as that of the parent tree.

A sour seedling budded is said to give an earlier crop, but smaller than a sweet seedling budded or a sweet seedling unbudded.

This has been the experience in Florida, but so far has not been proved yet in Jamaica.

Advantage &c., in transplanting.—Budding on mature trees may be done either without moving them from where they are already growing, or after transplanting them.

The advantage in transplanting is that the trees can be placed in regular rows exactly where they are wanted, so long as the soil is favourable.

The disadvantage is that whereas a tree budded where it stands will bear in two years, it will not bear a crop for 3 years, if transplanted.

Transplanting.—When transplanting a tree for budding, saw off the top about 5 feet from the ground. It will afterwards be cut down to 3 feet, but it is well to leave the extra length at first to use as a lever in loosening it from the soil.

Cut off the roots all round with the spade at a distance of 2 to 2½ feet, from the trunk.

The tap-root should be cut off to a length of about 2½ feet, if the soil in the Orange grove is deep. If a marly or clay subsoil or rock approaches the surface, the tap roots should be cut off close up to the roots which branch away from it. Any broken roots should be cut away and the ends trimmed. Tar should be applied to all the larger cuts. The roots should be shaded from sun and dry air, and be kept moist whilst out of the ground.

Cutting top of stump.—The stumps are to be sawn off to 3 feet from the ground. Great care should be taken to cut them quite smooth. It is well to have the cut made sloping and on the north side. The wood and bark must not show any signs of separation, but be cut round smoothly with a sharp knife. If any space be left between the bark and the wood, water will settle, decay will commence, and very soon insects and fungi will begin their attacks. A little tar should be smeared on the cut surface.

Holes.—The holes in which the transplants are to be placed should be about 5 feet wide, and 10 or 12 inches deep with a deeper hole in

the centre for the tap root. It is very important that allowance be made for the fact that the Orange tree is a surface feeder, and not plant too deep. It is better to have the tree 2 inches higher in the new bed, after settling, than one inch lower, than it was originally. If the roots are too low, it may take years before it forms sufficient new roots near the surface to provide for the health of the tree.

If the weather is dry, the ground must be kept moist for some time, and a mulching of an inch or two of manure is useful, especially just over the ends of the roots.

A banana leaf may be struck into the ground on the south side to shade the trunk.

On treatment after budding trees.—It is advantageous to allow a few shoots to grow on the old stump but only below the buds, until the buds have grown to a proper size with enough leaves to provide for the wants of the tree. But the old shoots must be kept pinched back with only sufficient full-sized leaves and so as not to be higher than the buds, and they should be pulled off altogether as soon as the new shoots are ample.

When the buds have grown 10 or 12 inches, pinch them back by taking off the terminal bud and this process is to be repeated occasionally in order to make the shoot thicker rather than long, to mature the wood and leaves, and to cause branching near the stock.

The method of budding has already been described in the Bulletin for December, 1895, and need not be repeated.

GRAPES FOR THE UNITED STATES MARKET.

The following has been received on the price of Grapes in New York from Messrs. Gillespie Bros. & Co.:—

We beg to lay before you the following regarding English (or Hot-house) Grapes. These are saleable here during the winter months, the price depending considerably on the condition in which they are received here, as high as \$2.00 per pound being paid for the sound, and their least value would probably be \$1.00 per pound.

They should be packed in baskets of about ten pounds each, well protected against "bruising" by introducing between and around each cluster *excelsior* or other local substitute.

To ensure their arriving here sound, it will be necessary to have them brought on in the ships' refrigerator.

The duty here is 20c/o on invoice value.

Native grapes (grown in U. S.) are expected to come to market in May, however, if you have any fit for shipment at present we would recommend that you send on one basket of about 10 lbs. in order that buyers might get a chance to judge of the Jamaica article which at present is comparatively unknown here, and we ourselves would then be better in a position to offer fitting suggestions as to future shipments of these from your Island.

NOTES ON COTTON.

Soil.—Light and sandy soils are better than such as are heavy and clayey, and those which are moderately moist than those which are very dry or very wet. Free drainage is essential, and irrigation is necessary when the rainfall is small.

The soil must be of good depth on account of the long tap root.

It should not be too rich, otherwise the plants will run to stalk and leaf, and the flowers drop without forming seed. The cotton plant will flourish on inferior soils, where other plants will not grow. In Georgia the soil is described as a dry whitish sand, forming the "Pine-barrens," and yet it is so suitable to the growth of cotton that 3, 4, and sometimes 5 crops may be harvested without manuring.

Tillage.—In the States, where cotton has been cultivated with greatest success, the ground is thoroughly prepared by ploughing as deep as from 12 to 18 inches. If the ground has lain fallow for some time, the ploughing is done three times with a considerable time intervening between the ploughings, and if the ground is full of weeds, it is ploughed even oftener. Even if the land is well pulverised and free of weeds, two ploughings are considered necessary. A harrow or roller is used after every ploughing. The preparation of the ground is commenced in November, and continued until March or April when the seed is sown.

Seed.—Care should be taken that the seed is all of one variety, otherwise the crops may not be of equal value, nor come in all at the same time.

Sowing Seed.—The land is laid off in ridges 5 to 8 feet apart, and thoroughly hoed, all the weeds and grass being placed in the furrows between the ridges. A plough is then run along the ridges, throwing the soil on either side, and covering up the weeds, thus making the furrows into beds in which to sow the seed. As soon as the plough has passed, the beds are levelled. Holes are made 18 inches apart, a foot wide, and 18 inches deep, and filled in again. About 12 seeds are sown where each hole has been made, at equal distances apart, and covered lightly with mould to the depth of about an inch.

Selection of Seedlings.—After about a month when the seedlings are 3 or 4 inches out of the ground, pull up all but 3 or 4 of the strongest plants. Weeding must now be done and renewed every month. Some consider it necessary to weed by hand, others by hoes, others again by cultivators. If weeding is not carefully attended to, the crop will be seriously injured, perhaps altogether lost. At the end of the third month, or earlier if the growth has been vigorous, all the young plants should be pulled up except the one which appears to be the strongest, or is nearest to the centre of the hole.

Nurseries.—The seed is sometimes sown in nurseries by which means the attacks of caterpillars are warded off more efficiently, and irrigation in dry weather may be attended to.

As an Annual.—In the United States cotton is cultivated as an annual, and sown every year although in the West Indies in former days it was treated as a perennial. Planters in the United States consider that it yields larger crops as an annual, and if the soil is likely to be of such a nature as to favour luxuriant growth and a perennial form, a crop of corn is first grown.

Pruning.—Even the annual plants may require some pruning if they show any tendency to produce wood and leaves at the expense of flowers and seeds. In such a case the tops should be nipped off when podding commences. If the plant is grown as a perennial, pruning is necessary, and this is done during the next month after the crop is gathered in April. It is usually considered advisable to prune down to about 4 feet, but much depends upon the soil.

The crop of the perennial cotton begins to come in towards the end of September, and lasts till the end of December. A second crop lasts from the end of February until the middle of April.

Manures.—As the cotton-plant is cultivated for the sake of the fibre which envelops the seeds, attention is directed to the chemical analysis of the seed which bears the fibre as well as to the fibre itself, in order to discover what substances these extract from the soil that have to be replaced.

An analysis of the ash of cotton fibre shows that these ingredients are :—

	Percentage.
Potash	31·05
Lime	17·09
Phosphoric acid	12·32
In other words 10,000 lbs of cotton fibre abstract from the soil	
	lbs.
Potash	31
Lime	17
Phosphoric acid	12

An analysis of the ash of cotton-seed gives

	Percentage
Potash	19·40
Lime	29·79
Phosphoric acid	45·35

The seed is thus much more exhausting on the soil than the fibre or "lint," and when its greater proportion is considered, it is probable that while for every bale of cotton, the lint takes 4 lbs of soil-ingredients, the seed takes 38 lbs.

If, therefore, the seed after expression of the oil, is utilised as cattle-food, and returned to the ground in the form of manure, the crop will be one of the least exhausting known. On the contrary, if the seed is permanently removed, heavy manuring will be necessary to preserve the fertility of the soil.

The best manures are superphosphate of lime (containing phosphoric acid and lime) and potash (either wood ashes or potash salts). Salt appears to be peculiarly beneficial, and good cotton lands are often low-lying, subject to the influx of tides, but in such a situation high ridging is necessary.

All refuse from the plant should be returned to the soil, either by being burnt and the ashes ploughed in, or by turning cattle in to feed it down. Burning ensures destruction of eggs of hurtful insects or spores of destructive fungi.

Guano and other nitrogenous manures should be avoided, as causing the plant to run too much to stem and leaf.

Harvesting.—In some varieties the cotton fibre adheres only slightly to the pod, and must be picked within a few days from the bursting of the pod, in those varieties in which the fibre adheres firmly, picking may be deferred longer according to the convenience of the planter. Women and children pick the fibre and seeds from the pod as it hangs on the bush.

To pick cotton carefully and expeditiously requires a good deal of practice. The fingers should grasp lightly the five sections comprising the ball, and withdraw at one pull the whole of the cotton without any particle of leaf or foreign matter adhering to it. Cotton should never be gathered while wet from rain or dew.

The pickers put the cotton into bags tied round the waist, and when these are full, they empty them on a good-sized "cotton-sheet" to dry whilst they refill their bags. When the sheet is full, it is carried to the weighing house. An average picker will collect 100 lbs of seed cotton in a day.

After the pickers have been through the whole field, it will be 4 or 5 days, and possibly 10 days before more pods are ripe, but careful watch must be kept so as to set the pickers to work immediately on the ripening of the pods.

Drying.—As soon as the cotton is gathered, it is exposed to the sun on wooden platforms for 3 days until the fibre is quite dry and the seeds are hardened. It is not put out until the sun is up, and is taken in before sunset. If the weather be wet, it is kept under cover, and spread out in thin layers.

The great object is to get rid of any superfluous moisture it may contain, without drying it too much. When dry, it is carefully picked over to get rid of any foreign matter or discoloured particles of cotton. It is then piled in heaps, 5ft. high, 4 or 5ft broad, and 20ft long, and covered over with cloths. This is to preserve the oiliness, strength and gloss of the fibre, which a lengthened exposure to the air would destroy. The tendency to heat, however, must be guarded against, and whenever the cotton gets too warm, it should be spread out on the clean-swept floor of the cotton house until it cools. If the heating is allowed to go on, the oil oozes from the seeds, and discolours the cotton. But many planters allow the heaps to become very slightly heated, thinking that thereby the fibre extracts a very small portion of the oil from the seeds, becoming stronger, softer, and more silky, and at the same time acquiring a very delicate shade of yellow so much sought after by experienced buyers.

Yield.—In the valley of the Mississippi the average yield of ginned cotton per acre is 400 lbs, whereas in South Carolina, Georgia, etc., 200lbs. is considered a good return, and much of the land yields only 100lbs. In India the average yield from native cultivation is 50 or 60lbs.

Ginning.—The separation of the fibre from the seed is always done on the estate by machinery, called a gin. There are several kinds of gin, the Whitney, Macarthy, &c. A modification of the Macarthy and the double action knife-roller gin has lately been manufactured by Dobson & Barlow. One of these gins is capable of cleaning 300 to 800 lbs of seed cotton in an hour, yielding 75 to 150 lbs of clean cotton.

The "lint", when thoroughly cleaned, is packed in bales by hydraulic pressure for export. The bales are covered with coarse jute or cotton canvas, and bound with ropes or iron bands.

Cotton-seed oil—The expression and utilisation of this oil is a distinct industry, but in India the seed is used rather as a cattle-food direct, than an oil-yielder. Egypt exports very large quantities of this seed to England. The seed requires cleaning before shipping, otherwise it heats and deteriorates on the voyage. In the United States there are a large number of oil-mills for working up cotton seed, and a good deal of the oil is exported. The yield of oil varies with the season and the locality in which the seed is produced. One authority estimates that 100 lbs. of seed yield 2 gallons of oil, 48 lbs. of oil-cake, and 6 lbs. refuse fit for soap-making. The value of the oil in New York is stated to be 18d. to 20d. a gallon.

Cotton Oil-cake—The cake remaining after the expression of the oil is very valuable as a cattle-food and as a manure.

Feeding cattle with the cake on the estate, and using the manure on the fields is the readiest method of returning to the soil the valuable ingredients extracted by the growth of the plant.

But if the cake becomes heated or mildewed, it is not suitable for food, but can be applied direct to the land. In this case the finer the cake is crushed or ground the better.

Munro gives the average quantities of *manurial* ingredients in one ton as below :—

	Phosphoric acid.	Potash.	Nitrogen.
Brown or rough cotton cake	45lbs.	45lbs.	85lbs.
Decorticated cotton cake	70	45	145

"Oil-cakes heat and decay fast and act quickly when ploughed into the soil. They are *organic manures* (more than nine-tenths of their weight consisting of organic matter), and contain no ready-formed ammonia; but soon give rise to this by decomposition."

The value of oil-cake to feed cattle for the purposes of obtaining a rich nitrogenous manure, and also for the distinct purpose of fattening cattle, has been alluded to as follows in the introductory lecture of the Institute of Jamaica *Lectures on Agriculture* :—

"In England cattle are often kept on a farm simply for the sake of the manure they produce, and it may be advantageous or even necessary to purchase food for them over and above what the farm can provide.

"In Jamaica, too, it might be found profitable to stall-feed cattle for the sake of the manure. In that case it would be necessary to carefully consider not only the cost of various kinds of food, but also what kinds would yield, the best manures.

"As nitrogen is the most costly ingredient of purchased manures, it follows that other things being equal, and looking at it from the point of view of manure, the best food is that which contains the most nitrogen.

"Chemical analysis shows that oil-cakes yield the richest manure; next corn, peas and beans, and bran. Clover-hay yields a richer manure than corn, and corn a richer than meadow-hay.

“The subject of manure led to the consideration of the best foods for producing it in the most valuable form.

“And from the inquiry into the best food for manure, it is natural to pass to a reference to investigations into food used for the purposes of nutrition generally.

“The theory of nutrition is of some importance in breeding and rearing stock, and fattening cattle. Food has to be considered in two ways, first as regards its composition, secondly as regards its digestibility.

“In examining the composition of a food, determination is made of the percentage of albuminoids, or nitrogenous constituents which are flesh-formers; of fat; of the carbo-hydrates, such as starch and sugar, serving for the production of heat and mechanical work; and of the ash constituents, such as lime phosphates for the supply of bone-material, &c.

“The composition of food has also to be considered according to the time it is harvested; for instance, when grass is cut for hay, it should be mown as soon as it flowers.—after that, it considerably deteriorates, for the soluble carbo-hydrates are changed into indigestible fibre.

“Again, luxuriant grass produced by irrigation contains more water than ordinary grass; it is therefore less nourishing, and a larger quantity is required.

“The foods that are richest in albuminoids have the highest nourishing value, and therefore for fattening purposes the various descriptions of oil-cakes are the best. Of the ordinary grasses, oats contain the most nitrogen, and corn (or maize) the least. All the grains are rich in an easily digested carbo-hydrate, namely starch. The grains are poor in lime, and corn (or maize) does not even contain sufficient for a rapidly growing animal.

“The digestibility of each kind of food has to be considered, and also the influence of one food on the digestibility of another. The latter point is as important as the former. For instance, foods rich in starch, like mangels, cannot be given in greater proportion than 15 per cent of the fodder without lessening the digestibility of the fodder, whereas, a nitrogenous food like oil-cake may be given without interfering with its digestibility.”

Fream gives the following average percentage of *albuminoids* in the leading nitrogenous food employed in feeding farm animals:—

Decorticated cotton cake	...	...	41
Linseed cake	...	...	25
Linseed	...	...	24
Beans	...	...	22
Undecorticated cotton cake	...	...	19
Oats	...	...	12
Corn (Maize)	...	...	10
Clover hay	...	...	10

The following are average percentages of *fat* in certain food:—

Linseed	...	...	34
Linseed cake	...	...	11
Decorticated cotton cake	...	...	10½
Oats	...	...	6
Undecorticated cotton cake	...	...	5
Corn (Maize)	...	...	5

Composition of average samples of cotton cake :

	Decorticated.	Undecorticated.
Moisture ...	10.64	13.30
Oil ...	10.23	5.24
Albuminous compounds ...	44.19	23.17
Mucilage, sugar, digestible fibre, &c. ...	23.42	32.27
Woody fibre (cellulose) ...	4.88	20.79
Mineral matter (ash) ...	6.64	5.23
	<hr/>	<hr/>
	100.00	100.00
Containing nitrogen ...	7.07	3.71

“Note the high position occupied by oil-cakes, both as nitrogenous and as fatty foods. Inasmuch as albuminoids and fat are the most concentrated of the constituents of animal food, it is evident that small quantities of oil-cake may be made valuable adjuncts to other less nutritious food. In other words, a little oil-cake—particularly decorticated cotton-cake and linseed-cakes goes a long way.”

General Remarks—At the end of last century there were over 100 cotton works in Jamaica, but sugar was paying so well that cotton was gradually given up.

There seems to be some prospect of the cultivation being taken up by small settlers and others in Turks Island, and if it is likely to be a paying crop there, it might also pay to grow it again in Jamaica.

It is interesting to note that the celebrated Sea Island was first grown from seed of the wild cotton imported into the States from Inagua one of the Bahama Islands.

The United States Consul at Turks Island writing to the Director of Public Gardens in August 1892, stated: “About a year ago I noticed that some of the soil here was very much like that at Edisto Island in South Carolina, and fancied that Sea Island cotton would thrive here. About October last I imported some of that seed and planted it, the result was very favourable. In about six months the product was about 200 lbs. of the cleaned lint per acre, equal in quantity to the average produced in South Carolina. There were no heavy rains following so that although the trees were in fairly good condition, there was no second crop during the year. I have no doubt that if there had been the usual rainfall in May, there would have been a second crop before the end of the twelve months nearly, if not quite equal to the first. Samples of this cotton were sent to New York. It was reported that this staple was slightly shorter than that of Sea Island cotton, but that mine was finer and of a better quality.

“ENCLOSURE.—INAGUA COTTON.”

“Regarding the samples sent us we have to say that the No. 2 native cotton looks as though it might be classed with our American cotton. The present value is about 7 to 8 cents.”

SEA ISLAND COTTON.

“The samples of No. 1, Sea Island cotton is not as long as our Sea Island, but it is very fine, the fibre being more silky in nature than ours which is an advantage. Parties here cannot say that the cotton has degenerated any after planting in your soil with the exception of the length. The value of the sample here is from 12c. to 15c. and perhaps more.”

The cultivation of cotton in Egypt has increased rapidly. An interesting report upon the subject has been laid before the French Société Nationale d'Agriculture by M. de Vilmorin. In the report he says:—The regular cultivation of cotton does not date beyond the first half of this century, and a great impulse was given to it by Mehemet Ali when the various inland canals were cut to regulate and equalise the annual overflow of the Nile. In order to show his colleagues how rapidly the growth of cotton had increased, M. de Vilmorin included in his report a table showing that the quantities exported to Liverpool had risen from 15,000 bales (of about $6\frac{1}{2}$ cwt. each) to 79,000 bales in 1850, 109,000 in 1860, to 220,000 in 1870, and to 240,000 in 1880. The cotton crop is, M. de Vilmorin adds, of an average annual value of about £10,000,000, and it extends over an area of more than a million acres, with a tendency to extend each year. Nearly all the cotton grown in Egypt is cultivated as an annual plant, being sown in March, and gathered in from September to December. M. de Vilmorin goes on to point out that careful studies as to the best methods of cultivation, the most desirable varieties to grow, and the most effectual means of destroying the enemies of the cotton plant are being conducted, and that the more enlightened growers are beginning to use plenty of artificial manure. The Egyptian cottons are, in M. de Vilmorin's opinion, merchandise *sui generis*, without any precise equivalent in the world, and likely to be in great request among the manufacturers of cotton goods.

Some of the seed of the best Egyptian cotton was obtained 3 or 4 years ago through the Egyptian Government. Major Pinnock experimented with this seed on his property near Kingston, and has kindly given the following Report on it:

Major Pinnock to Director of Public Gardens.

May, 1896.

Dear Sir,

I think I have some of the Egyptian seed left that you gave me, but I cannot advise anyone growing it, it has a long silky staple but the colour is too yellow. I took samples to England in 1894, of cotton grown by me from this seed, and samples of cotton growing wild on my pen, the latter, although inferior in length, quality and strength of staple, was a very white colour and worth $\frac{3}{4}$ d per lb. more. I had the valuation of two well known Liverpool Cotton brokers, as also the opinions of several manufacturers, and all agreed that the colour of the cotton from the seed you gave me depreciated its value, and rendered it useless in many classes of manufactures.

The following is a copy of the valuations I received on July 30th, 1894.

Lot (a)—wild cotton—very good, colour and staple good but rather weak and brittle: value with seed as it is $1\frac{1}{4}$ d per lb. in Liverpool, value if ginned $4\frac{1}{4}$ d per lb.

[Some of the cotton in this sample I observed had not fully matured in consequence of its having been picked too soon and this would account for its being weak and brittle.]

Lot (e)—colour not good, staple very good: value with seed as it is $1\frac{1}{4}$ d per lb., value if ginned $3\frac{1}{2}$ d per lb.

Yours truly,
A. H. PINNOCK.

His Honour the Commissioner, Turks Island to Hon. Colonial Secretary.

Grand Turk, 29th April, 1896.

Sir,

I have the honour to report that, as a result of my recent inspection of the Caicos Islands, it has struck me that some good may possibly be done for the people by inducing them to cultivate cotton, if only in a small way, in addition to the usual provision fields to which their attention is at present entirely confined.

2. I noticed cotton growing, chiefly in a wild state, at every settlement I visited. At Lorimers, I came across one man who had been taking some little pains with the cultivation, and in his house I found several bags full of cotton, for which he was able to find a market at Cockburn Harbour. Four varieties of cotton were pointed out to me and were described as "white cotton," "brown cotton," "casimere" and "sea-Island" respectively. The first is the ordinary cotton that one sees growing wild in these and other West India Islands; the second appears to be almost the same as the first, with a brownish tinge at the edge; the "casimere" is a brown silky cotton, possibly the Egyptian variety; and the "sea-island" presumably the same as that grown in the Southern States of America. This man told me that he had some couple of "tasks" (a task is 105 feet square) planted out, and that, while the value fetched was small, yet it was sufficient to pay him for the comparatively little trouble he had in growing it.

3. I find that Mr. Stubbs, at Cockburn Harbour, has recently been laying himself out to buy cotton brought to him by the Caicos people on a barter system. Samples that he has forwarded to the States have been valued at 6 to 10 cents a pound; he allows from $2\frac{1}{2}$ to 3 cents with the seed. Mr. Stubbs told me that he contemplates setting up a small gin at Cockburn Harbour, if and so soon as he can find that there is a likelihood of the people bringing him in sufficient cotton to justify the expense.

4. I spoke to the people in the different places, advising them to try cotton and pointing out particularly that it was work in which they could utilise the services of their children. They seemed to doubt the likelihood of their being able to obtain a certain market and quoted an experience of former years when they found the crop left on their hands. However they took in the idea and promised to think about it.

5. It is under these circumstances that I write to ask if you would be so good as to obtain from the Director of Public Gardens and Plantations any information that he thinks might be useful in regard to the times, method of planting and gathering, and as to the quality of cotton that would be most suitable for cultivation in such land as the Caicos affords. I would also ask whether he could obtain for the Government one or two bags of the best and most suitable cotton seed. I would then propose to distribute this seed by means of the Constables in various localities, with a circular giving information as to planting, etc.

6. I know that in parts of the Bahamas cotton is grown and disposed

of on similar lines to those which I have described and to the mutual benefit of producer and purchaser, and it is just possible that a system of the same sort may be built up here.

I have the honour to be,
Sir,

Your most obedient servant,
EDWARD J. CAMERON, Commissioner.

Seed of Sea Island Cotton and other varieties can be obtained from Messrs Peter Henderson, New York.

RAMIE RIBBONS STRIPPED BY THE INDUSTRIAL SCHOOL BOYS AT HOPE GARDENS.

The following is the full statement of the work done by the boys at Hope Gardens in stripping Ramie ribbons mentioned in the Bulletin for last April, according to the method described in the first paragraph quoted of Consul Hosie's Report in Bulletin for March 1894, page 37. The scraping described in the second paragraph was not attempted. The experiment dated 13th Dec. was to ascertain whether they could work quicker, if the stems were cut and brought to them, than if they stripped from the stem actually growing.

The total to the 11th was sent to Messrs. Dunlop with the result stated in April Bulletin. The wet ribbon amounted to 729 lbs. 14oz., and this took the boys 433½ hours to strip, which dried to weigh 132 lbs.

	Week ending 16th Nov., 1895.							
	Wednesday 3 hrs.		Thursday 3 hrs.		Friday 3 hrs.		Total 9 hrs.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Jas. Murray	2	8	3	10	6	7	12	9
Jno. Nathan	1	6	2	6	5	9	9	5
R. Manley	1	14	2	0	3	0	6	14
Jos. Salmon	1	0	2	3	2	9	5	12
S. Roden	1	12	3	4	4	8	9	8
C. U. Good	1	5	1	10	2	6	5	5
Jos. Samuels	1	2	1	7	Weeding		2	9
Rich. Pircher	0	13	Weeding grass		2	12	3	9
Total	11	12	16	8	27	3	55	7

	Ramie stripped during week ending 23rd November, 1895.										
	Monday. 2 hours.		Tuesday. 3 hours.		Wed. 3 hours.		Thurs. 3 hours.		Friday Rain.		Total. 11 hours.
	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	...	lbs.	ozs.
Jas. Murray	4	5	5	15	7	6	9	10	...	27	4
Jno. Nathan	5	12	6	6	5	2	7	11	...	24	15
R. Manley	3	13	4	14	4	12	5	8	...	18	15
Jos. Salmon	3	2	3	5	Weeding		4	3	...	10	10
S. Roden	3	13	5	9	5	7	7	4	...	22	1
Alex. Reid	2	2	Weeding		4	4	4	7	...	10	13
Jos. Samuels	2	6	3	13	5	0	4	12	...	15	15
R. Percher	2	3	3	5	Weeding		1	11	...	7	3
C. N. Good	Weeding		4	5	3	6	Weeding		...	7	11
Total	27	8	37	8	35	5	45	2	...	145	7

Week ending 30th November, 1896.

	Monday. 2½ hours.	Tuesday. 2½ hours.	Wed. 1 hour.	Thurs. 2 hours.	Friday. 2½ hours.	Total. 10½ hours.
	lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.
John Nathan .	5 14	5 10	4 10	5 5	6 3	27 10
R. Manley .	4 15	5 2	3 6	5 4	6 3	24 14
Jos. Salmon .	2 12	2 15	1 0	2 13	3 13	13 5
S. Roden .	5 14	5 10	2 12	4 15	4 8	23 11
A. Reid .	3 15	3 14	1 15	3 15	4 1	17 12
Jos. Samuel .	2 10	2 7	Weeding	2 6	2 12	10 3
C. Good .	2 14	2 12	1 4	2 8	2 10	12 0
Zack Crawford .	1 13	Weeding	1 3	2 3	...	5 3
J. Murray .	...	...	...	6 14	8 8	15 6
	30 11	28 6	16 2	36 3	38 10	150 0

Week ending 7th December, 1895.

	Monday 3 hours.	Tuesday 3 hours.	Wed. 3 hours.	Thurs. 2½ hours.	Friday. 3 hours.	Total. 14½ hours.
	lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.
John Nathan .	7 0	7 10	8 3	5 2	6 5	34 4
J. Murray .	9 5	9 4	9 3	7 13	7 9	43 2
R. Manley .	6 10	7 15	8 7	6 3	5 11	34 14
J. Salmon .	4 8	4 13	4 14	4 10	3 9	22 6
S. Roden .	5 10	7 13	8 9	5 12	5 8	33 4
A. Reid .	3 7	5 6	4 11	4 3	4 3	21 14
J. Samuels .	3 6	4 8	5 11	5 6	4 13	23 12
R. Percher .	3 1	...	4 6	3 10	2 10	13 11
Z. Crawford .	3 13	4 9	5 0	3 13	4 5	21 8
C. Good .	...	5 6	...	3 4	3 14	12 8
	46 12	57 4	59 0	49 12	48 7	261 3

Week ending 14th December, 1895.

	Monday 2½ hrs.	Tuesday 4 hrs.	Wed. 3 hrs.	Total. 9½ hrs.
	lbs. ozs.	lbs. ozs.	lbs. ozs.	lbs. ozs.
James Murray .	6 9	11 4	7 15	25 12
Jno. Nathan .	5 5	9 11	6 7	21 7
R. Manley .	5 0	—	—	5 0
Jos. Salmon .	3 10	7 15	4 14	16 7
S. Roden .	6 11	4 6	8 14	19 15
Jos. Samuels .	1 0	6 0	4 8	11 8
R. Purcher .	2 6	7 8	4 2	14 0
Z. Crawford .	3 12	—	—	3 12
	34 5	46 12	36 12	117 13

	Fibre cut with knife and stripped 2½ hrs.		Stripped from the root in 2½ hrs.	
	lbs.	ozs.	lbs.	ozs.
Jas. Murray .	6	9	7	13
Jno. Nathan .	5	5	5	2
R. Manley .	5	0	6	3
S. Roden .	6	11	5	12
J. Salmon .	3	10	4	10
R. Percher .	2	6	3	10
Z. Crawford .	3	12	3	13
	33	53	36	15

	Stripped from sticks ready cut in 3 hrs.		Fibre stripped from the root in 3 hrs.	
	lbs.	ozs.	lbs.	ozs.
Jas. Murray .	7	15	9	10
J. Nathan .	6	7	6	3
J. Salmon .	4	14	4	14
J. Samuels .	4	8	5	11
R. Percher .	4	2	4	6
	27	14	32	12

DIRECTIONS FOR PLANTING RAMIE.

By WM. CRADWICK, Superintendent of Hope Gardens.

THE plants as sent from the Gardens are ready for planting without further preparation.

If the land is such that ploughs and cultivators can be used, thoroughly plough up the whole of the land, then form beds five feet wide, with walks between the beds eighteen inches wide, the beds can be any reasonable length but intervals should be left for the passage of carts, &c.; raise the beds by taking soil from the space left for the walks and throwing it on the beds. This will increase the depth of soil for the plants to grow in, and by lowering the walks make them serve as drains, the depth of which would be regulated by the rainfall of the district. If manual labour has to be utilised simply fork up the space to be used as the bed, leave the walks hard, but the top soil can be shovelled off and put on the beds in the same way, to form the walks and drains; it must be borne in mind that this is the best of the soil and will enrich the beds.

The soil must be thoroughly pulverised, the plants can then be planted by opening a hole with the hand just deep enough to cover the plant about half-an-inch, not deeper; cover the plants lightly with the hand but do not press the soil or only very slightly, if the weather is dry; do not plant nearer the edge of the beds than six inches, put the plants in nine inches apart, or if on very rich soil a foot apart.

Keep the young plants quite free from weeds by hand weeding. The

plants put out at Hope a year ago treated as above, were weeded three times, and since then the Ramie has kept down the weeds itself except on the paths.

Our reasons for planting in beds, clearing paths and intervals is to obviate the necessity of walking between the plants, and so trampling the soil round the roots, and making it hard and cakey, which from experience has been found to be very detrimental to the growth of the plant. In the beds planted at Hope a year ago the soil is almost as loose and friable as it was on the day the beds were planted; and if the crop were taken off now the only thing requiring to be done is to hoe the paths, and perhaps pull out a few climbing weeds which no plants can keep down without assistance.

By planting as close as above described the plants shoot up very rapidly with little or no tendency to branch.

The above may seem rather troublesome but if the plants are treated in this way the growth will be more than satisfactory, and it will be many years before the plant requires replanting, but if carelessly dealt with, allowed to get weedy when young, trampled on or between, the plant will soon become enfeebled and the whole trouble of replanting will have to be gone through again in a short time.

COFFEE PULPERS FOR SETTLERS.

In the Bulletin for January, 1895, a description was given of two of Gordon's hand coffee pulpers suitable for dealing with small quantities of coffee.

An opportunity has lately presented itself of testing one of these pulpers, viz. the "Colombia" on a Coffee property, and the following report has kindly been furnished by Mr. B. S Gosset, on the capabilities of the machine. An essential point in the working is a constant stream of water flowing into the water box.

Mr. B. S. Gosset to Director of Public Gardens.

Farm Hill, Hagley Gap P.O.

Dear Sir,

I have tried the small Gordon's Iron disc pulper you sent me, over here, and find it works well.

The coffee is pulped very free from pieces of skin, and no Coffee was to be found among the pulp.

I have never seen cleaner work done with so little cutting of the berry.

I have a Walker's disc pulper, a Gordon's patent Breast pulper, B. size, and a Jamaica "Rattle Trap Pulper." The only one which can turn out as clean work as the little Iron disc pulper is the large B. size Gordon's Breast Pulper.

All the English pulpers want to be fed by a constant flow of water from a pipe with a cock to regulate the feed,—a one inch pipe with cock of the same size would be needed for a pulper of this size.

With a regular supply of water I estimate that this pulper would work off about 10 tubs of Coffee an hour weighing about 1,000 lbs., and could be worked by one man.

Yours faithfully,

B. S. GOSSET.

KOLA NUTS.

BY FRED. B. KILMER, Chemist, New Brunswick, U. S. A.*

The kola nuts, as found in the American Market, come mainly from Africa. The bulk of the West India nuts are consumed by the inhabitants of the islands where grown; a very small part of the crop is shipped to Europe. Lately, small supplies have reached our market from this source. No accurate estimate of the extent of the world's supply, nor the possible yield for this drug, can be given. The official reports of the African trade give from 2,500,000 to 3,000,000 pounds per year, which is largely utilised for home consumption. Those who are familiar with tropical products can realise the difficulties and peculiarities of the market in such a commodity. It is carried on mainly through native women. There is a certain amount gathered for home demand. The quantity that will reach the shipping ports must depend upon the caprice of the natives, and especially as to how much they stand in need of rum or tobacco. The crop must all be carried, often hundreds of miles, in head loads, through miasmatic forests, over impassable streams, across pathless mountains, under a tropical sun. The conditions are such that, to gather a ton of nuts and safely land them on a ship that plies along Africa's sunny shores, is a task that one would shrink from after a survey of the field. The native gatherers are shrewd dealers, even if not well-skilled in the arts of civilised commerce. They know how to corner supplies, to create a rise in price, and they also know that, when a European buyer wants the nuts badly, grades that have no value at home will find a ready market. This accounts, in part, for the quite variable nature of market specimens. In the West Indies, the governments encourage the cultivation of the plant, and, before many years, ample supplies from this source will be obtainable. In our own country, some attention and discussion has taken place, looking towards its cultivation on our soil.

The kola plant seems to grow well in any climate where there is plenty of rainfall and a warm, tropical sun. Of course, the hotter and more moist the climate, the better. Wherever bananas, nutmegs or cocoa will grow, it is safe to say that this tree will thrive. The best kind of soil is that which is deep, rich and clayey, although it will grow in a great variety of soils. In some of the West Indian Islands, it may be found as high as 5,000 feet above the sea level, but the best specimens are generally found at about 1,000 to 2,000 feet elevation. If the situation is low and damp, the ground must be well drained. The young plants may be obtained directly from the seed, planted in the field where they are to grow: but the best results seem to come from planting the seeds in nursery beds, transplanting them when plants are from 2 to 3 feet in height. The seeds as usually obtained from growers are packed for shipment in boxes covered with earth, and the whole wet with fresh water. Holes are bored in the boxes for ventilation. The nursery beds in which they are planted are made of loam, peat or leaf mould and kept shaded. In nursery planting the seeds are put in the bamboo pots commonly used in the tropics, and placed from 9 to 12 inches apart. It

* Abstract by the author of a lecture delivered at the Pharmaceutical Meeting of the Philadelphia College of Pharmacy, January, 1896.

takes three to five weeks before the sprouts appear above the ground. When ready for transplanting, they are set a distance of about 25 feet apart. If the soil into which they are transplanted is not rich, the best planters dig holes several feet deep, 5 feet each way around, and fill in with the topsoil. It is necessary for the young plant to have shade. Many intelligent planters, who have lately taken up the planting of kola, use the banana for the purpose. The banana is very rapid-growing. It shelters the young kola plant and makes a profitable crop while the kola is coming into bearing; kola, in turn, will begin to yield by the time the banana has exhausted the soil. The bananas are planted 10, 11 or 12 feet apart, with the kola at every second banana in the direction of the line. Thus, a plot of 20 feet square is enclosed with banana trees with four kola plants at the corners, leaving the kola from 20 to 34 feet apart. In sheltered situations, as in a low valley between hills that have a growth of woods, the banana is omitted in the centre of the square, to give more light and air. The gradual thinning out of the banana is made as the kola acquires increased growth. Kola is usually planted at the beginning of the wet season. Grown wild, it commences to yield fruit about the fifth or sixth year. Well-cultivated specimens often begin to bear considerably earlier. In the wild state they reach full bearing in the ninth or tenth year. When the kola tree attains full size, it is customary with planters to place in the field with them small varieties of coffee, or some vegetable plants such as peas or yams. Kola gives the necessary shade. The stems and leaves of the other plants furnish a good fertiliser. By this method a kola plantation costs nothing except for the first planting. Kola does not appear to exhaust the soil as does the coffee, banana, orange, etc. Upon once attaining its growth it appears to be of permanent value. Specimens that have borne for fifty years and probably longer have been noted. Independent of its value for the nuts, kola is an excellent shade and timber tree, and is utilised for this purpose. A conservative estimate of the yield is 120 pounds of dried nuts, or over 250 pounds of green nuts per tree, or from 8,000 to 10,000 pounds per acre. No such amounts, however, are gathered in any portion of the West India Island sowing to the unsystematic and haphazard measures employed in harvesting the crop.

Taking up that part of the plant probably of the greatest interest, the seed or nut, we may examine the pods, which we will find contain from two to twelve nuts or seeds, so closely pressed together in growing as to be crowded into various shapes. The cellular tissue of the pod before drying is filled with a very slimy, stringy mucilage that is largely observed upon ripening. A singular fact noticed about the seeds is the fact that red and white nuts are found side by side in the same pod. So far as my observation goes, pods may be found that contain all red or all white, but no trees give all white or all red seeds. The native users lay great stress upon the difference between the white and the red kola nuts. Symbolically, the white nuts means peace, happiness, veneration, acquiescence to overtures. The red nuts mean the reverse: war, ill-will, challenge, rejection of overtures, etc. In some instances the white seeds command the higher price, being in repute as giving greater and better effects. In the dried nuts found in our market it is difficult to distinguish between the white and red varieties. Oxidation during the drying of the seeds gives to both about the same

yellow-brown colour. When subjected to the action of solvents, white or red nuts (dried) yield to water, alcohol, acetone or glacial acetic acid, shades of orange and yellow which are so nearly alike that considerable practice is necessary to distinguish between them. The colouring matter of the red nuts is, however, very soluble in dilute mineral acids. The white and red varieties may be distinguished by macerating for twenty-four hours in dilute sulphuric or hydrochloric acid when it will be found that the acid extraction of the red kola is a beautiful red rose, while that of the white seeds is of a light straw colour. Heckel has shown that if the acid extraction is made alkaline with ammonia, that from red nuts assumes a purplish violet; that from white an ochre-like colour.

Several observers have noted that the red nuts give a larger percentage of moisture; Heckel gives 46 per cent for white, 56 per cent for red. The same author claims that the white seeds, contain 5 per cent. more caffeine, 7 per cent. more of the peculiar principle, kolanin, than the red. My own experiments tend to confirm the observation that there is an appreciable difference in the amount of gluco-side found in the white seed as against that found in the red.

RULES AS TO SALE OF LANDS BY THE GOVERNMENT OF JAMAICA TO SMALL SETTLERS.

1. No more than 50 acres will be granted to one purchaser, nor less than 5 acres.

2. The price at which the lands will be sold may be learnt at the office of the Surveyor General, or from the Bailiffs in charge of the different parcels. No land will be sold for less than 5/ per acre and the ruling price will be the same as that at which lands in the neighbourhood are put in the market.

3. The Surveyor General on receipt by him of an application in the form endorsed hereon and on deposit of one-fifth of the price of the lands shall cause a survey to be made of the quantity of land applied for, the applicant receiving notice of the time where the survey is to be made.

4. On the survey being made the applicant shall forthwith be entitled to possession of the land allotted to him on such survey.

5. If the applicant shall be dissatisfied with the situation, or configuration of the land allotted to him on such survey, and shall within one week after the survey give written notice thereof to the Surveyor General or to the Surveyor who made the survey, or to the Bailiff in charge of the land, and shall deliver up possession of the land, he shall be entitled to a refund of one-half of the amount deposited by him as above and his application shall be deemed to be withdrawn.

6. If such notice shall not be given, or possession delivered, the applicant shall at the end of one week after the survey be deemed to be the purchaser of and to be in possession of the land allotted to him on such survey, and as soon thereafter as practicable a certificate shall be delivered to him by the Surveyor General, who shall keep a duplicate of such certificate in his office.

7. Such certificate shall be in the form following :—

SALE OF GOVERNMENT LANDS TO SMALL SETTLERS.

Jamaica ss.

Office of Surveyor General, Kingston.

This is to certify that _____ of the Parish of _____ Yeoman (hereinafter called the purchaser) did on the _____ day of 189 _____, pay the sum of £ _____, being one-fifth of the purchase money of £ _____ 'in respect of _____ acres of land part of _____ in the Parish of _____ and that the situation and configuration of the said _____ acres are as shown by survey thereof made by _____ on the _____ day of 189 _____, which can be seen on application at the office of the Surveyor General in Kingston.

The land comprised in this certificate is held subject to the following conditions :—

- (1.)—The remaining four-fifths of the purchase money and £2 being the cost of survey together amounting to £ _____, are payable in ten years by ten equal yearly instalments of £ _____ each without interest, the first of such instalments being payable on the _____ day of 189 _____, and the subsequent instalments at intervals of one year thereafter, provided that if within such period of ten years the purchaser shall have brought one-fifth of his acreage into good bearing in one of the crops mentioned in clause 4 of these conditions, he shall be released from payment of or be refunded, as the case may require, one-fifth of the purchase money.
- (2.)—Such payments shall be made to the Collector of Taxes for the said Parish of _____, and the receipt for each payment must be endorsed on this certificate which must be produced to the Collector of Taxes at the time of payment.
- (3.)—The balance of the purchase money and costs of survey may however be paid in advance at any time and the Collector of Taxes is authorised to receive such payments whenever tendered.
- (4.) The purchaser shall within six months from the date hereof build a house on the land comprised in this certificate, which house shall be occupied by him or by some person on his behalf. The purchaser shall also within 12 months from the date of his obtaining possession, plant at least one-fifth of the land in Kola, Coffee, Orange or other permanent crop producing plants, to be approved by the Surveyor-General, in the manner in which such permanent crops are usually planted and shall maintain such permanent crops by proper care and cultivation until such time as the purchase money due to the Government has been paid.
- (5.)—If the purchaser shall at any time be in arrear in respect of payment of three yearly instalments on account of purchase money and costs of survey, (or if the purchaser shall fail to satisfy any of the conditions laid down in the preceding paragraph the Surveyor General on behalf of the Government may give a notice calling on the purchaser or person in

possession either to pay the arrears due or to remedy the default complained of, as the case may be.

- (6.)—Such notice shall be served either by being delivered to the purchaser or person in possession of the land, or by being affixed to some tree, or posted on some other conspicuous part of the land.
- (7.)—If at the expiration of one month from the service of such notice the requirements of same have not been complied with, the Surveyor General may by himself, or some person appointed by him, enter into possession of the land and may either before or after such entry sell the same at public auction or private contract as he may deem fit and either on conditions similar to those contained in this certificate or otherwise. The proceeds of such sale after payment of all expenses shall be applied in paying to the Government the balance of purchase money and costs of survey remaining unpaid at the time of such sale, whether the same shall be in arrear or not, any surplus when realised, being payable to the purchaser or other person entitled thereto.
- (8.)—On payment of the purchase money and costs of survey in full (and on fulfilment of the 4th condition hereof) the purchaser or other person entitled thereto will receive from the Crown a conveyance or patent in fee simple in the usual form and with the usual reservations including a reservation to the Government of the right to make new roads or improve existing roads, the Government paying the cost of any damage actually done to fruit trees, growing crops and cultivated ground in making or improving such roads.
- (9.)—No transfer of or dealing with the rights of the purchaser in the land comprised in this certificate shall be effectual until written notice thereof shall have been given to the Surveyor General duly authenticated to his satisfaction.

Dated this day of 189 .

Surveyor General.

8. Condition 4 in the above certificate and the words included in brackets in conditions 5 and 8 may at the option of the Surveyor General be omitted in the case of any lots of land the purchaser of which resides within one-half mile of such lot. Such omission must be certified by the initials of the Surveyor General in the margin of the certificate.

SALE OF GOVERNMENT LANDS TO SETTLERS.

Application.

I, of the Parish of do hereby apply to become the purchaser of acres of land, part of in the Parish of for the sum of £ . And I herewith deposit with the Surveyor General the Sum of £ , being one-fifth of the price of the said land and agree to be bound by and to conform to the within rules in respect of my purchase.

Dated this day of 189 .

The patents of James and George Fullerton and John Pritchard together containing 900 acres in the Parish of Trelawny are offered for

sale on the above terms. These lands are situated in the black grounds of the Parish of Trelawny and front on the Main Road leading from Christiana to Ulster Sping. It is proposed to construct a Cart Road starting from the Main Road, and leading through those lands into the Parish of St. Ann. Each lot offered for sale will front either on the present Main Road or on the new Cart Road. It is proposed to establish a Model Farm either on, or in the immediate vicinity of these lands.

A plan of the Lots and proposed Road may be seen at the Surveyor General's Office. Lots fronting on the present Main Road will be sold at from £3 to £4 per acre. Lots fronting on new Cart Road will be sold at from £1 to £2 per acre. These lands may be seen on application to A. A. Carter, Govt. Bailiff, Troy, Balaclava P.O.

Copies of the Rules may be obtained from the Bailiff or from the Surveyor General's Office.

As soon as not less than 10 applicants come forward and pay their deposit money surveys will be made of their various lots, but no survey will be undertaken for a single applicant.

FERNS: SYNOPTICAL LIST—XXXVII.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Gardens, Demerara.

33. *Nephrodium strigosum*, Jenm.—Rootstock small, scaly, fibrous; stipites very short or membraned to the base, puberulous; fronds freely tufted, 3-15 in., l. $\frac{1}{4}$ - $1\frac{1}{4}$ in. w. tapering downwards to the rootstock, of two kinds, barren and fertile; the latter elongate-lanceolate stiffly erect and viviparous at the retuse apex, the latter ligulate acuminate reduced forming a prostrate spreading rosette at the base of the former, both serrate-lobate, coriaceous, harsh, dark green, under surface on ribs and veins grey puberulous; lobes deltoid or rounded or obtusely pointed shallowly or deeply cut, 1-2½ li. w., 1½-6 or 8 li. d. very close, veins pinnate, raised and obtrusive beneath simple or rarely forked, the opposite ones below the acutely sharp sinus united, those above free; sori medial; involucre distinct, cordate puberulous —Fée. Fil. Ant. tab. 15. fig. 1.

In woods of the lower hill sides, gathered in the western parishes. Fée's figure is a quite exact representation of the erect fertile fronds but does not show the spreading prostrate, rosette-like diminuated barren ones.

34. *N. incisum*, Baker.—Rootstock erect, fibrous; stipites tufted, erect, 1-3 in. l. the base a little scaly; fronds erect, lobed or subpinnatifid, a span to 1 ft. l. $1\frac{1}{4}$ - $1\frac{3}{4}$ in tapering at the base through dwindling decurrent rounded scallop-like lobes, and similarly upwards to the acuminate lobate-entire apex, subcoriaceous, dull green, naked or the rachis puberulous cut $\frac{1}{4}$ - $\frac{1}{2}$ way down to the rachis, the incisions forming a sharp sinus between; lobes 3-4 li. w. and l. obtuse or rounded; veins pinnate, simple or forked, opposite ones below the sinus uniting, those above free; sori medial involucre cordate, fugacious —Pl. Fil. t. 91. *N. stenopteris*, Hook, *Aspidium*, Kze. *Poypodium*, Swartz.

This I have not seen, but it is ascribed to Jamaica by Grisebach on the authority of a specimen gathered by Macfayden, which I suspæct belongs to the next species, though he quotes Plumier's figure, the two

though very distinct being generally confounded in descriptions. Plumier's figure resembles closely some of the forms of *N. scolopendrioides*, Hook, on which perhaps it is based.

35. *N. Wrightii*, Hook.—Rootstock thick as a quill, much elongated densely clothed with dark brown scales; stipites apart but contiguous, erect, 4-8 in. l., strong grayish puberulous; fronds linear-oblong 8-12 in. l. $\frac{3}{4}$ -1 $\frac{1}{2}$ in. b. generally a little narrowed at the base, chartaceous; under surface puberulous on the ribs, upper glabrous, dull green; fully pinnate in the lower half or third, the pinnæ close or apart, the upper part pinnatifid, apex pointed, subentire; pinnæ horizontal, rounded 3-4 li; w. $\frac{1}{2}$ -1 $\frac{1}{4}$ in. l. the lower ones free at the base and somewhat auricled on each side, the rest adnate and entire; rachis stiff densely puberulous pubescent, gray close, at a wide angle; veins free or the lowest meeting at the sinus in the upper pinnatifid portion; sori medial or rather nearer the margin; involucre evident.—Sp. Fil. t. 239.

Infrequent on open mountain banks Nearly allied to *scolopendrioides*, but of a more regular or equal width upwards, and marked particularly by the lower part being uniformly fully pinnate and the upper deeply pinnatifid, so that the veins do not form costal areolæ, and by the different rootstock. The plant cited above is a good figure of it.—Cuba.

36. *N. scolopendrioides*, Hook.—Stipites densely tufted from a small erect or decumbent, scaly fibrous rootstock, 1-6 in. l., puberulous, scaly at the base and after decidedly fibrillose upwards; fronds 6-12 in. l. 1-2 in. w. lanceolate or oblong or linear-lanceolate, acuminate or obtuse at the apex, the base reduced and usually fully pinnate, above this lobed or deeply pinnatifid, subcoriaceous dark green above, paler beneath; upper surface glabrous, rachis costæ and veins beneath densely greyish stellate-puberulous; segments variable, close, or apart with a narrow or broad rounded sinus between 2-4 l. b. $\frac{1}{4}$ - $\frac{3}{4}$ in. l., blunt and rounded or subacute; the reduced lower ones distant, deltoid or oblong and rounded auricled on both sides at the base, quite free, subcordate sessile; margins entire even or crenate; veins pinnate and simple in the outer part of the segments, once or more forked within the branches more or less anastomosing, forming costal areolæ, the lowest pair from opposite ribs uniting and sending a limb to the sinus, where the next pair meet; sori copious uni- or pluri-serial on each side the midrib; involucre small, ciliate—Hook, Fil. Exot. t. 18., *Aspidium*, Mett., *Polypodium*, L. Hook, Sp. t. 239.

a. var. *extensum*.—Stipites 6-10 in. l. slender; fronds 15-20 in. l. 2-2 $\frac{1}{2}$ in. w. cut as in the type; the margins even; sori 1-2-serial.

b. var. *littorale*.—Fronds much broader, 10-15 in. l. 2-3 in. w; segments acute or acuminate, longest 1 $\frac{1}{4}$ -1 $\frac{3}{4}$ in. l. $\frac{1}{4}$ - $\frac{1}{3}$ rd. in. w. even, crenate or lobulate; veins pinnate in the crenatures or lobules, the lowest opposite ones connected; sori in one to several series.

Plentiful on the rocky cliffs of the sea coast along the northern and eastern parts of the island. A highly variable plant, presenting three or more states which look distinct, but run one into the other. The barren fronds are on short stems, are often only slightly lobed, and are prostrate; while the fertile are more erect, much longer, on long stems, with distant reduced free basal pinnæ, which pass upwards into larger and more contiguous confluent ones with a costal wing and narrow or open rounded sinuses, the top of the frond becoming gradually merely lobed. The barren fronds are viviparous near the apex. Forms of this

are often mistaken for forms of *asplenioides*, resembles Plum. Fil. t. 84 very closely but is not winged in the lower half as that is represented.

35. *N. tenebricum*, Jenm.—Stipites 4-8 in. l., erect grayish-puberulous; fronds 1-1½ ft. l. 4-6 in. w., gradually reduced both up and down, the acuminate apex pinnatifid, and passing through blunt lobes into the entire points; chartaceous, pellucid. dull grayish or brownish green, puberulous on the ribs, otherwise glabrous; rachis grayish puberulous; pinnæ numerous, spreading, with an open space between them, the central horizontal, and 2½-3 in. l. by ¼-½ in. oblong lanceolate and acuminate, obtuse pointed, sessile, and hastate with a pair of enlarged horizontal lobes at the base, above this serrulate or slightly lobed the outer part entire, the inferior ones (which dwindle gradually in the lower third or fourth of the frond to mere auricles at the base) being more distant and deflexed; veins 2-4 to a side, the lowest opposite ones uniting in a branch to the sinus, where the next usually join; sori near the base of the veins; involucre minute; soon obliterated. Journ. Bot. 1882, 326.

St. Ann and Clarendon Parishes Well distinguished by the gradual dwindling of the fronds downwards in the lower half the subentire and bluntish, though acuminate pinnæ hastate at the base with a pair of spreading auricles, one on each side, resembling *Polypodium hastæfolium* on an enlarged scale. The lowest pinnæ are only ½ inch long — Endemic.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of July:—

IN FLOWER.

Andira inermis, H. B. & K.
Averrhoa Bilimbi, Linn.
Bassia latifolia, Roxb.
Bauhinia variegata, Linn.
Brownea Rosa-de-monte, Berg.
Calophyllum Calaba, Jacq.
Caryocar nuciferum, Linn.
Cassia siamea, Lam.
Castilloa elastica, Cerv.
Clerodendron macrosiphon, Hook. f.
Coccoloba latifolia, Lam.
Cocos botryophora, Mart.
Cordia alba, Roem et Schult
Cynometra americana, Vog
Dipteryx odorata, Willd.
Heritiera macrophylla, Wall.
Hyophorbe Verschaffelti, H. Wendl.
Lagerstrœmia Flos-reginæ, Retz.
Michelia Champaca, Linn.
Mimusops Elengi, Linn.
Myroxylon toluiferum, H. B. & K.
Nerium Oleander, Linn.
Norantea guianensis, Aubl.
Omphalea triandra, Linn.
Oreodoxa regia, H. B. & K.
Pachira aquatica, Aubl.
Pterocarpus Draco, Linn.
Pterospermum lanceæfolium, Roxb.
Semecarpus Anacardium, Linn. f.
Sterculia carthaginensis, Cav.
Stevensonia grandifolia, F. Dunc.

IN FRUIT.

Cæsalpinia Sappan, Linn.
Carapa guianensis, Aubl.
Cocos botryophora, Mart.
Eugenia caryophyllata, Thunb.
Eugenia malaccensis, Linn.
Gmelina asiatica, Linn.
Heritiera macrophylla, Wall.
Imbricaria maxima, Poir.
Mi helia Champaca, Linn.
Omphalea triandra, Linn.
Pachira aquatica, Aubl.
Pachira Barrigon, Seem.
Pterocarpus indicus, Willd.
Terminalia Arjuna, Bedd.

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

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 Poisonous Principle of Urchites suberecta, by J. J. Bowrey. [Author.]
 Select extra-tropical Plants by Baron Sir F. von Mueller. [Hon. Premier, Victoria]
 Systematic arrangement of Australian Fungi by D. McAlpine. [Hon. Premier Victoria.]

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| " corynocalyx | " brachybotrya |
| " pauciflora | Atriplex nummularium |
| " calophylla | " semibaccatum |
| From Botanic Gardens, Bangalore. | From Royal Botanic Gardens Trinidad. |
| Bauhinia Vahlia | Phoenix rupicola. |
| From Mr. Thomas H. Sharp, Spanish Town. | Logwood. |

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

	PAGE
Reproduction of Oranges by Seed	145
Eucalyptus in California	149
Ramie in Jamaica	149
Ramie in United States	151
Alkaloids of Kola	157
Forestry	159
Tobacco Seed for Distribution	160
Trap for Beetles	161
Lignum Vitæ	161
Premiums for Cultivation	161
Ferns: Synoptical List.—XXXVIII	162
Castleton Gardens	167
Contributions to the Department	167

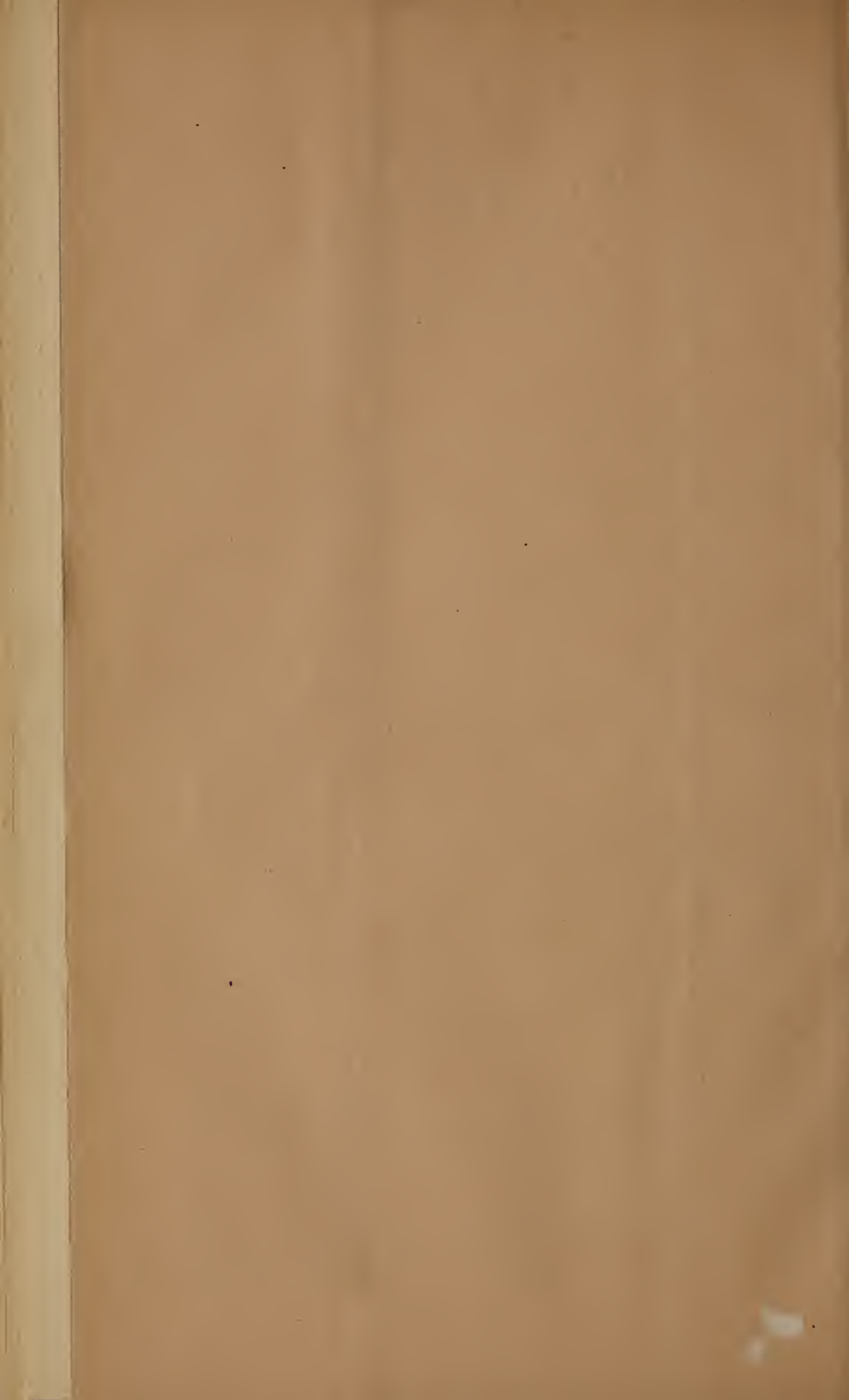
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1896.



JAMAICA.

BULLETIN

OF THE

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THE REPRODUCTION OF THE ORANGE FROM SEED.

BY HERBERT J. WEBBER, Special Agent, United States Department of Agriculture, Subtropical Laboratory, Eustis, Florida.

In the issue of the *Gardeners' Chronicle* of April 25, 1896, I notice Mr. C. Wolley Dod suggests that it is generally believed by gardeners that Orange trees raised from the seed of a sweet Orange produce bitter fruit unless grafted on to the sweet Orange tree. As I am somewhat familiar with Orange-growing in Florida, having spent several years here in studying the industry, it may not be out of place for me to give some notes regarding this.

SWEET ORANGE (*CITRUS AURANTIUM*).

The seed from the fruit of the sweet Orange, I think we may safely conclude, invariably produces sweet Oranges unless they are the results of hybridisation with some other species or variety. The evidence, however, is somewhat conflicting. The experiments of Galesio, published in 1811, seem to show conclusively that the belief that they produce bitter fruit, which Mr. Dod suggests is quite generally held by gardeners, is erroneous. In his *Traité du Citrus*, Galesio says, "I have during a long series of years sown pips of sweet Oranges, taken sometimes from the natural tree, and sometimes from Oranges grafted on bitter Orange trees or Lemon trees. The result has always been trees bearing sweet fruit, and the same has been observed for more than sixty years by all gardeners of Finale. There is no instance of a bitter Orange tree from seed of sweet Oranges, nor of a sweet Orange from the seed of bitter Oranges, . . . In 1709, the Orange trees of Finale, having been killed by frost the practice of raising sweet Orange trees from seed was introduced, and every one of these plants produced the sweet-juiced fruit."

Macfadyen's statement regarding the experience in Jamaica is, however, in opposition to Galesio. Macfadyen says, "It is a well established fact, familiar to everyone who has been any length of time in this island, that the seed of the sweet Orange very frequently grows up into a tree bearing the bitter fruit, numerous well-attested instances of

which have come to my own knowledge I am not aware, however, that the seed of the bitter Orange has ever grown up into the sweet-fruited variety." Duchassaing says that in Guadeloupe the sweet Oranges often yield bitter fruit, while according to Dr. Ernst, at Caracas they sometimes yield sour but not bitter fruit. Brandis, who is considered one of the highest authorities on this subject, relates that at Khasia, in India, so far as he can verify the fact, the extensive plantations of sweet Oranges are from the seed.

It is difficult to harmonise these conflicting statements. The very extensive experience of Orange growers in Florida, California, and Louisiana entirely corroborates Gallezio's statement. In Florida for many years the policy has been extensively followed of growing trees from seeds of sweet Oranges, and in all cases known to the writer, sweet Oranges, usually of a very fair quality, have been produced. Indeed, the fruit of the sweet seedling Orange trees in Florida is of superior quality to the fruit commonly imported into the United States, and is well known in the markets of New York, Philadelphia, &c. Probably one-fourth of the Florida Orange groves, which in the season of 1894-95 yielded over one billion Oranges, are sweet seedling trees. It is so thoroughly understood that seeds from sweet fruit produce sweet Oranges of a fair quality, that no grower has any hesitation to rear extensive groves from sweet seed trees. Since the severe freezes of the winter of 1894-95, which killed to the ground almost all of the trees in the State, many groves which were originally budded on sweet stock are being re-grown by allowing sprouts, which have been thrown up by the sweet seedling stock, to grow into trees without budding. This illustrates how well it is known by Florida growers that sweet seedling Orange trees produce good sweet fruit. In Louisiana and California sweet seedling trees have also been grown to considerable extent, and always, so far as I can learn, with the same results that from seeds of sweet Oranges sweet fruit is produced.

Mr. William Fawcett, Director of the Jamaica Public Gardens, states that, "The evidence goes to show that Macfadyen's experience was exceptional in finding that the seeds of the sweet Orange sometimes produced trees with bitter fruit The danger in planting seedlings of the sweet Orange appears to be small."* Mr. Syme also says,† "The popular opinion in Jamaica that the majority of the seeds of a sweet Orange will produce sour Orange plants is not quite well founded, though there need be little surprise felt if a goodly proportion of the trees are productive of sour fruits. It may be safely asserted that there are a few good sweet Orange trees in this island (Jamaica) so isolated from inferior varieties, sour-fruited Shaddock, Grape-fruit, Citron, Lemon, or Lime trees as to be beyond the influence of the fecundating pollen of the latter. It is inferentially chiefly to this influence, rather than to an inherent tendency in the tissue, that many seedlings, raised from sweet Orange seed, exhibit what may be termed degenerate or unmarketable fruits."

In the reports from the Consuls of the United States on fruit culture in their several districts, in answer to a circular from the Department of

* *Bull. Bot. Department of Jamaica*, No. 4, Nov., 1887.

† *Bull. Bot. Department of Jamaica*, No. 42, April, 1893.

State, sweet Oranges are reported to be grown wholly or largely from seeds in the following places : Morocco, Guerrero (Mexico), Ecuador, Jamaica, Guadeloupe, Porto Rico, Syria, Sidon, Philippine Islands, Naples, Azores Islands, Spain, &c.*

Far the greater portion of the evidence, it will be seen from the above discussion, supports the belief that seeds from sweet Oranges commonly produce sweet fruits. When bitter or sour fruits result from planting sweet Orange seeds it is probable that other seeds have been accidentally mixed with them or that they are the results of accidental hybridisation. Sweet Oranges are almost invariably grown near sour Oranges, Lemons, Limes, Pomelos, &c., and it is not greatly to be wondered at that from seeds formed under such conditions a hybrid occasionally arises. Both Fawcett and Syme think this is what misled Macfadyen. Stubbs and Morgan† also mention this as one of the main causes of the variation in the quantity of seedling Oranges. That perfectly fertile seeds may be obtained by hybridising the different species of Citrus I have incidentally proved in the course of pollination experiments which I have been conducting under the direction of the U.S. Department of Agriculture. The following instances may be cited :—

Parson Navel Orange (a local variety of the common sweet Orange, *Citrus aurantium*), which is commonly seedless, crossed with pollen from the acid Lime (*Citrus limetta*), produced three full seeds, which were planted, and gave four seedlings, two embryos of one seed developing.

St. Michael Blood Orange (*Citrus aurantium*), crossed with pollen of Grape-fruit or Pomelo (*Citrus decumana*), formed fifteen well developed seeds, which were planted, and gave twenty-two seedlings. If seeds thus artificially hybridised are fertile, there is no reason to doubt that seeds accidentally hybridised may be fertile.

In each of the above cases the number of seedlings resulting is in excess of the number of seeds planted. This introduces an interesting feature into experiments of this nature. It is a well-known fact that most species of citrus fruits produce several embryos, some seeds producing as many as twenty-five; only from one to three of these, however, commonly develop. Crüger, Schacht, Hofmeister, Strasburger, and others have carefully studied this interesting polyembryonic development; and it appears, so far as we yet know, that only one of the embryos in each seed is formed by the act of fecundation, the others being what are termed adventive embryos developing from the side of the embryo sac. It is thus probable that only the sexually-developed embryo will be influenced by the hybridisation. As two to three embryos frequently develop from a seed, even in cases of hybridisation some of the seedlings, those from adventive embryos, will probably produce true to the parent bearing the fruit.

While seedlings of the sweet Orange produce sweet fruit similar to those produced by the parent, there is yet much variation in the fruit from such seedlings. Commonly it can hardly be distinguished from the parent, but many are of much inferior quality, and occasionally one

* *Fruit Culture in Foreign Countries*. Special Consular Reports, Washington 1890.

† Stubbs and Morgan, *The Orange and other Citrus Fruits from Seed to Market*. Special Bulletin, Louisiana State Experiment Station, 1883, p. 12.

producing fruit superior to that of the parent tree may be found. This uncertainty in the quality of the fruit is what renders budding or grafting desirable in this industry as in others. There is, however, by no means so great a difference between the fruit of the common seedling and that of the best budded varieties as occurs in certain other fruits, such as the Pear and Apple. If sweet seedlings are to be grown, the seeds should be taken from selected seedling trees, known to produce good fruit, which are isolated from trees of other varieties and species. By such selection one would avoid the probability of obtaining seeds affected by crossing or hybridising with other varieties, and may be quite sure that the trees from such seeds will produce good fruit.

The various improved varieties of the sweet Orange, such as the Hart's Late (Tardive), Jaffa, Majorca, Ruby, &c., cannot be depended upon to reproduce true through the seed. The policy of budding the trees to selected varieties cannot be too strongly recommended.

BITTER OR SOUR ORANGE (CITRUS BIGARADIA).

Whether the bitter or sour Orange be classed specifically with the sweet Orange, or is considered as a distinct species, the fact remains that the varieties in cultivation are totally distinct in foliage, fruit, and character of branching, from the sweet Orange, and that both are reproduced true through the seed. The seed of sour Oranges invariably produce sour fruit of the same general character. It is true the fruit of seedlings vary slightly in shape, size, taste, thickness of rind, &c., as in the case of sweet Oranges, but they are nevertheless distinctly sour Oranges. Gallesio says, "The sour Orange produces many seeds which always reproduce sour Oranges."

The sour Orange was introduced into Florida very early, probably by the Spanish, and escaping from cultivation, spread over the central and southern portions of the State. When comparatively recently—about 1870—interest was awakened here in the Orange industry, extensive wild sour Orange groves were found in many places. One of these, at Citra, Florida, contained some 500 acres. These wild groves have mostly been cut off and budded, so that now but few of the original trees can be found. I have examined a number of these old original trees, and have always found them to produce comparatively the same fruit. The fruit from these old wild trees, furthermore, does not noticeably differ, so far as I have been able to determine, from the fruit of numerous cultivated sour Orange seedlings, one or two of which are found in almost every grove in the State. As these seedlings scattered through the groves of the State are unquestionably descendants from seeds of the wild sour Oranges found here, the identity of the fruit is significant in this connection. I have made some enquiry of pioneer Orange growers who cut off and budded many of the wild sour Orange trees, and have been unable to learn of any marked difference having been observed in the character of the fruit on different wild trees. Orange growers here invariably feel sure of obtaining sour Oranges when sour Orange seed is planted.—*Gardeners' Chronicle*.

THE EUCALYPTUS TREE IN CALIFORNIA.

The Eucalyptus tree promises to become as useful in California as the bamboo is in Japan and China. It has the advantage of requiring little or no attention and of growing with astonishing rapidity, and in the vast timberless regions it has been an important factor in improving the land. The wood has many medicinal qualities. The eucalyptus is also extensively used to form a windbreak about gardens and orchards. It has been found very profitable to raise the tree for fuel. Its remarkably rapid growth makes it possible to raise a crop or forest of these trees to a size suitable for cutting every three years. Within a year from the time the seed has been planted the tree often reaches a height of ten feet, and a height of fifty-three feet in three years. It is customary to cut the tree off about two feet from the ground, at intervals of from three to five years. The trees are then cut into cord wood. It is estimated that a single acre, if left untrimmed for eighteen years, would produce ten thousand dollars' worth of wood. In Australia the wood of the eucalyptus tree is coming to be extensively used for manufacturing purposes, and it is probable that in time new important uses will be found for the wood wherever these trees are cultivated.—*Produce World.*

RAMIE IN JAMAICA.

Several thousand roots of Ramie have been distributed to various parts of the Island from the Public Gardens.

Caution is however still necessary, and the following letter from Messrs. Dunlop shows that the question of machinery is not settled yet.

Requests have occasionally been made that sufficient Ramie stems should be ready at a moment's notice for any machine that may be brought forward to be tested, and a statement made that the stems from 5 to 10 acres would be required. No Government, not even that of India or the United States, has ever undertaken to test a machine whenever produced. The Government of India has on two occasions given notice that they would hold a public trial at a certain time and under certain conditions. The Governments of France and the United States have done the same on former occasions, but the interest is now so general that apparently all these Governments consider that the matter may be left to the inventors of machines to demonstrate their capabilities in the same way as other inventors do. To have from 5 to 10 acres of stems always ready for one machine, would mean that from 250 to 500 acres should be permanently established. All that the Public Gardens can be reasonably expected to do, is to provide a sufficient number of plants to start the cultivation in different parts of the Island, and then leave it to private enterprise. Roots have lately been distributed to more than 60 centres.

Messrs. Dunlop Bros. & Co., to Director of Public Gardens and Plantations, Jamaica.

15th June, 1896.

Dear Sir,

We beg to thank you most sincerely for your kindness in sending to

us a copy of the Bulletin of the Botanical Department in Jamaica for April, 1896. This paper came to hand on the 1st inst., and we have read with great care and interest all that is printed therein with regard to Rhea Fibre.

We take this opportunity of thanking you for the kind way in which you have taken notice of what little we have been able to do in giving you, or the Public in general, what information we could concerning this article, and we now desire to add a little more to the general information. Since we last wrote to you the demand for Rhea Fibre has considerably increased. Not so much in a speculative manner as in a steady strong firm demand brought about by manufacturers in a large way of business who require constant supplies of the article to meet certain demands, which have arisen for a class of material that could really only be made from Rhea Fibre. Nor is it likely that this demand will only be spasmodic because it arises from the efforts of the English manufacturers to compete with cheap artificial silk material, which is being made and sold in this Country from France. The present difficulty in the demand lies in the fact that sufficient Rhea cannot be put on the market at present, because where these large manufacturers come into the market their output would easily consume more than all the supply put together, and the second difficulty is that they cannot pay exorbitant prices, consequently, until a reasonable supply is forthcoming, nothing can be done in the matter.

After careful investigation, the friends with whom we are interested on this side and in Jamaica, have come to the conclusion that it would be a mistake to rush into and plant a large tract of country in Jamaica at present, as owing to the unknown circumstances that might arise, a bad start might be made which would dishearten people on this side and probably on your side, and prejudice in the eyes of all concerned an industry that as far as human observation can see ought to become a large and successful one.

The intention of our friends and ourselves in conjunction with them is to secure a small suitable property in Jamaica and plant it out with plants which we can obtain from the Botanical Gardens, and to send out to Jamaica as early as possible the best description of Machine, or the best system of decorticating the Fibre into a most valuable article for export from Jamaica. With this end in view we have several Machines and more than one system to select from at present, and our efforts are being directed at present to secure the best one.

To give you an idea of what is to be avoided and what is desired, we beg to send you the following samples from which you will see that the efforts made by people in Jamaica without being controlled or conducted, simply result in discouragement or a loss. Mr. Sidney Moxsy made a good effort to prepare in the best way possible a fibre which would sell on this side and sent it over to us in bags. As all the samples are more or less about the same, we send you one of them marked Mr. Moxsy's parcel.

You will at once observe how impossible it is to deal with this article successfully on this side. The Fibre is not only all in a tangle, but is more or less destroyed in strength by not having been properly worked. As compared with this we send you a sample of what is wanted on this side, and what we hope to succeed in producing from

the Fibre in Jamaica. This sample is marked Patterson's Fibre because it comes from the east and has been imported by a firm called Patterson & Co. It does not require an expert to see the difference between these two Fibres, and yet it ought to cost just as little money and as little trouble to produce the fine one as it has cost Mr. Moxsy to produce the tangled mass that he has sent home.

We will be pleased to supply you with further information as soon as we can.

We remain,

Yours faithfully.

DUNLOP BROTHERS & Co.

RAMIE IN THE UNITED STATES.

In the Bulletin for March and April, 1894, information was published on Ramie. During the past year a valuable Report was published on this subject by Mr. C. R. Dodge, the Special Agent in charge of Fibre Investigation for the U. S. Department of Agriculture. The following extracts from this Report enlarge on parts of the notes in the Bulletin, and will be useful to those who are about to experiment in the cultivation in Jamaica:—

SOIL AND CLIMATE.

In general terms it may be said that the ramie plant requires a hot, moist climate, with no extremes of temperature, and a naturally rich, damp, but never a wet, soil, the necessary moisture to be supplied by frequent rains or by irrigation; in other words, such a climate and soil that when the growing season has commenced, the growth will be rapid and continuous. In the United States the best localities, so far as experiment has determined, are portions of Florida, Mississippi, Louisiana, and Texas, on the Gulf, and central California, on the Pacific Coast. The other Gulf States, doubtless, will prove equally favorable to this culture when more extensive experiments have been undertaken than are now recorded. Regarding the northern limit of commercial culture it is difficult to make positive statements. The plant thrives in South Carolina, and it is fair to suppose that two annual crops are possible, though the quality and yield of the fibre can only be ascertained to a certainty by careful tests of the product of both crops.

In the Gulf States Ramie has been grown experimentally in a great variety of soils. from the light sandy uplands to the rich black lands of the Louisiana bottoms, though light, sandy, alluvial soils have always given the best results. In California deep alluvial, sandy or loamy lands which, when well prepared, will hold their moisture through the growing season, or that can be irrigated, are most commonly selected. Any good soil that will produce other crops is recommended, particularly if well prepared, or that holds its moisture through the growing season, or which can be irrigated. . . .

ENRICHING THE SOIL.

In all countries where Ramie has been grown commercially or experimentally the necessity for heavily enriching the soil by the application of the farm manures or chemical fertilizers is emphasized, for successful ramie culture is an impossibility on impoverished land. . . .

In Mr. Favier's admirable treatise on Ramie, a great deal is said upon

this subject, and many interesting tables of analyses are presented. We learn that well-decomposed stable manures and well-ground chemical fertilizers, guano, and oil cake are all used with success upon French Ramie plantations. The practice is to spread these upon the land, the rains or irrigation carrying the nutritive elements where they can be readily assimilated by the plants. Reducing to pounds and acres (as the figures are given in kilograms and hectares) we find that about 7,000 pounds of stable manure, or 525 to 615 pounds of chemical fertilizers or oil cake, are used per acre

The exact proportion of the fertilizing elements to be employed in the composition of chemical fertilizers is certainly difficult to determine, since it varies with the kinds of soil, but we may adopt a formula based upon the average of the analyses of the crops. The chemical fertilizer composed as follows, and applied in the quantities stated above, per cutting, will give satisfactory results: 3 to 4 per cent of soluble phosphoric acid, 8 to 10 per cent of pure potash, 5 to 6 per cent of nitrogen, and 8 to 10 per cent of lime.

It should be particularly noted that the quantities of fertilizers recommended per acre are to be applied per cutting and not annually. Mr. Favier considers stable manure an excellent fertilizer, as it contains very nearly the kind of nutriment that the plant requires. The fertilizer that has given the best results is oil cake, to which has been added carbonate of potash in the proportion of 10 to 15 parts of the latter to 100 parts of the former. The oil cake supplies the necessary nitrogen and phosphoric acid, but lacks the potash. The restoring of the leaves to the soil supplies a portion of the potash needed by the plant, and when this is not done, a larger proportion of potash than is indicated above should be used. The practice is to bury the leaves in trenches immediately after each cutting.

Professor Hilgard, who has treated this subject exhaustively in Bulletin No 94 of the California Agricultural Experiment Station, makes the statement that of all fiber plants ramie stands first as regards the depletion of the soil of plant food. A very interesting comparative table is given, showing amount, in pounds, of soil ingredients withdrawn from one acre by various fiber and other crops. The portion referring to ramie is here reproduced, and may be studied with interest and profit.

Soil ingredients (in pounds) withdrawn from one acre by a crop of ramie.

Soil ingredients.	Leaves (4.25 tons).	Stalks (7.25 tons).	Bark (2.75 tons).	Whole Plant (14.25 tons).
Potash ...	68.13	155.99	27.86	251.98
Soda ...	8.99	33.63	7.52	50.14
Lime ...	566.91	71.77	19.14	657.82
Magnesia ...	114.58	43.68	10.10	168.27
Br. ox. of manganese ..	1.92	1.45	.20	3.57
Iron and alumina ...	38.56	12.16	7.1	51.43
Phosphoric acid ...	77.13	67.71	10.86	155.70
Sulphuric acid ...	30.86	14.53	3.17	48.56
Silica ...	692.71	7.06	4.48	704.25
Chlorine ...	41.56	2.50	7.79	51.85
Total ash constituents ...	1,641.35	410.48	91.74	2,133.57
Nitrogen ...	206.10	105.85	57.75	369.70

The total amount of mineral ingredients withdrawn by a single crop (four cuts) is 2,143 pounds, which must be considered as permanently removed when neither the leaves nor the stalks are used as fertilizing materials. The draft per acre made on lime is about 658 pounds; on potash, 252 pounds; phosphoric acid, 156 pounds, and on nitrogen to the extent of 370 pounds. Of the potash about three-fifths, or 156 pounds, is contained in the stalks, more than one-quarter or 68 pounds, in the leaves, while the bark and fiber, the only production aimed at, contains a little above one tenth, or 28 pounds, of the total amount.

The leaves contain nearly 87 per cent of the total lime taken from the soil, that found in the stalks being about 10 per cent, and that in the bark 3 per cent. Of the total phosphoric acid withdrawn, the leaves absorb almost 50 per cent, or 77 pounds; the stalks 43 per cent, or about 68 pounds, while only 7 per cent, or 10.86 pounds, is found in the bark. The depletion of the soil in nitrogen is greatest through the leaves, which have more than 55 per cent of the total, or 206 pounds; about 29 per cent, or 106 pounds, is found in the stalks, while in the bark there is only 15 per cent or about 58 pounds. It will thus be seen how very small is the proportion of plant food withdrawn by the bark and fiber as compared with that by the leaves and stalks.

If the leaves and stalks are returned to the soil, the amount of mineral matter withdrawn per acre is, comparatively speaking, very small, being only about 28 pounds of potash, 19 of lime, 11 of phosphoric acid, and 58 pounds of nitrogen. A strong soil could withstand such a small demand for a considerable length of time without showing an appreciable diminution of crops; and whenever fertilizing becomes necessary, it will probably be found that, in California, phosphoric acid and nitrogen are the substances to be supplied.

Should the stalks not be used as fertilizer, the amount of potash permanently removed from the soil would be increased by 156 pounds, that of lime 72, phosphoric acid by 68, and that of nitrogen by 106 pounds; quantities forming, with exception of lime, a large percentage of the total mineral matter withdrawn.

Mr. S. B. Allison recommends as a good fertilizer for ramie 300 pounds of cotton-seed meal and 300 pounds of kainit, and suggests mixing with an equal weight of charcoal dust; the special advantage in the use of the last-named substance, however is not clear. The kainit supplies the needed potash, while the necessary nitrogen and phosphoric acid is supplied by the cotton-seed meal. Professor Stubbs recommends two parts of cotton-seed meal and one part of acid phosphate, at the rate of 400 to 450 pounds per acre, though he states that the results of his operations the past season lead him to believe that the fertilizer was not applied in just the right combination for the best success. In Florida the natural phosphate of the State may be used with good results, though the necessary potash will need to be supplied, Frederick Natho, in his Texas experiments, has only used "potash salts at the rate of one ton per acre per year." He supplies it, proportionately, after each cutting. But enough has been written to enable any planter or experimenter to properly enrich his land for this crop. That the plant cannot be grown successfully without bringing the soil up to the proper fertility is satisfactorily proved by the evidence set forth, and those who try to cheat the land by halfway measures, in

the matter of applying fertilizers and in returning the trash to the soil, will in the end only cheat themselves.

SOIL PREPARATION.

In preparing the land for a plantation, thorough tith—that is, deep plowing and cross harrowing—is essential, which should be done in the fall. The ground is frequently broken to a depth of 15 inches or more, but never less than a depth of 12 inches to secure good results; and lumpy land is rolled. Before planting, the ground is again cross-plowed, harrowed and rolled.

The plant is propagated by seeds, by cuttings, or by layers, and by division of the roots. When produced from seed, the greatest care is taken with the planting, as the seed is very small. For this reason open-air planting can hardly be relied upon, plants started in the hot-bed giving the best results. After planting, the seeds are covered thinly with sifted earth and kept shaded from the sun until the young plants are 2 or 3 inches high, when sunlight is gradually admitted to them. In five or six weeks they will be strong enough to transplant to the field. Layering is little practiced in this country (see remarks on the subject of planting, p. 155). By far the most practical method and the one which will give the best results is propagation by a division of the roots of old or fully matured plants. The old plants are better than young ones for the purpose, as the root mass is larger and the roots stronger.

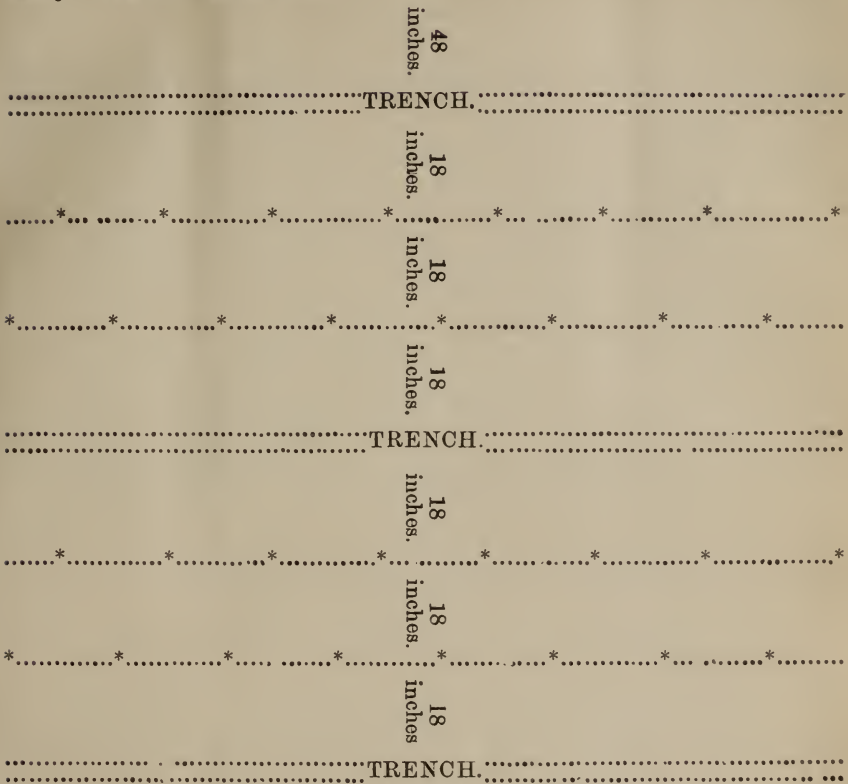
The planting roots are usually sub-divided into lengths of 3 to 5 inches, each piece showing several eyes. Five inches is the better length to plant, although shorter pieces are often used.

PLANTING THE ROOTS

There is the widest difference of opinion as to the distances apart the plants should be set. Professor Stubbs formerly advocated planting in rows 4 or 5 feet apart and 1 foot in the row, but in his recent experiment the plants were set out in the row much more closely. While this will give good results in the first year, it will prove a drawback in the end, as in two or three years the mass of roots will have become solid, and require resetting to produce suitable stalks for the machine. Mr. Allison plants in rows $4\frac{1}{2}$ feet apart and 1 foot in the row. Mr. Natho, a Texas grower, prefers the rows to be 4 feet apart, the plants to be set 15 inches in the row. In California the rows are often set closer than 4 feet.

Mr. Allison's practice has been to prepare the land in the fall by using a subsoil plow. About the 1st February it is cross plowed and well harrowed. A month later it is laid up in flat beds $4\frac{1}{2}$ feet from centers, leaving about 6 inches elevation in center of bed. The ground is then barred off and opened to the depth of 4 inches with a scooter plow, the roots being placed about a foot apart in the row and then covered with two furrows. A week later, when the roots are sprouting nicely, a harrow with a board at the back of it is run over the ground, which allows the young plants to come up in clean mellow soil. The Perseverance Fibre Company advocate setting the roots diagonally, as represented by * in the accompanying plan. Plow in the trenches, pulverising the soil and loosening the spreading roots. The roots should not be cut off until fall or spring, unless too prolific. Irrigate in the trenches.

Plant 8,000 roots to the acre. A 4-foot passageway should be left in every block of 2 acres or so :



Texas method of setting Ramie roots.

Reference has been made to layering. This is usually resorted to when a supply of roots is difficult to be obtained, and it is desired to reproduce plants as rapidly as possible. It is always practised in connection with established plantations. In California layering is practised as follows :

The roots are planted in the first year for the special purpose of propagation, 3 or 4 feet apart, set slantingly, 2 or 3 inches of earth covering the tops. Careful cultivation is given, the ground being kept clean and loose. When the first stalks have attained the height of about 3 feet they are ready for layering. The ground should then be thoroughly moistened and the stalks bent gently down, fastened with small crotchets, and covered with 3 or 4 inches of earth, leaving the top of the layered branch uncovered. Care should be taken to avoid detaching the stalks from the parent root. In the course of three or four weeks the layers will have made stalks which can again be layered for the same purpose, and quite a number of plants can be dug out for transplanting in order to increase the plantation.

It is also suggested to plant cuttings. These are prepared by dividing the stalk into lengths of 5 to 6 inches. They are set out obliquely, and nearly covered, and if the work is done before hot weather begins they will require neither watering nor shading, but must be kept clean of weeds. In two weeks they may be transplanted.

In time the entire space between rows will have become so filled with roots that replanting will be necessary. Some have advocated the plow-

ing up of a field of ramie when the roots become overcrowded, leveling off the ground and removing all exposed roots, leaving the field to start up anew from the roots that remain buried in the soil. This is a shiftless method at best, as it is impossible under such conditions to secure an even stand over the field, and an even growth of stalks is equally impossible. A course recommended both in California and in Louisiana is to run between the rows with a plow having a sharp rolling cutter, by means of which the superfluous roots are removed, and the rows or beds trimmed to a given width. The method advocated is to turn from one side only, allowing the roots to spread on the other side. This removes annually all old growth, and keeps the stand of plants hardy and vigorous. The course recommended in India, on the contrary, is to replant the entire field every four or five years in order to keep up a vigorous growth that will give a profitable field.

The matter of securing an even growth of stalks is a very important consideration; and by even growth not only is meant even length and size of stalks, but uniformity of growth in the individual stalk. A stem of ramie either grows rapidly and rankly, when there is an excess of moisture, or it is stunted and of slow growth when opposite conditions prevail. When one of these conditions follows the other in the same growing crop, the fiber is adversely affected, for in the after processes to fit it for spinning, treatment necessary to reduce the hard or stunted growth to the condition of spinnable fiber may wholly disintegrate the structure of the fiber in the softer or free grown portion of the stalk, and great wastage and loss ensue. Or, the stalks in one part of the field may produce one grade of fibre and those on another portion a different grade; or the crops from two cuttings may differ in the same way. It will readily be seen, therefore, that when the cultivation has been carelessly conducted, and the stalks are not only uneven in quality in themselves but uneven in different parts of the field (owing to different conditions of moisture and soil fertility), that the loss in value may be sufficient to consume the farmer's profits. The only after-cultivation necessary is to plow, or hoe between the rows, as may be necessary to keep the soil free from weeds or in good condition. This work is usually performed in the spring or early summer months.

As to the operations in the second year, the detailed account of Mr. Allison's experience will give a hint as to the practice that should be followed. Early in April, when the danger of frost had passed, all young growth was cut off but not saved. Fertilizers were applied, and the soil between the rows plowed and hoed. About the 1st of July the first crop was cut, followed by another plowing and hoeing. The stalks were then allowed to grow until about November 1, the time of the second cutting. It would be better, however, not to delay the last cut too late, in order to avoid a "second growth," which takes the form of clusters of leaves, eventually producing branches, and which appear at the point of juncture of the leaf and stalk after the old leaves have fallen.

IRRIGATION.

In portions of Texas and California the practice of irrigation will be necessary to secure any results. But there is no doubt that in other States there are localities, not known as irrigation districts, where water must be used to produce a proper growth of stalks. While the roots

cannot live in a wet, cold soil, they do require a sufficiency of moisture to insure continuous and rapid growth, and this will necessitate the practice of irrigation on any lands that may, in a dry season, or in the dryer portions of every season, lack the proper degree of moisture to make satisfactory growth. On the other hand, continued cold, rainy weather, giving an excess of moisture, may injure the crop by stunting the growth.

In an official report made in 1881 by Dr. King, Superintendent of the Botanical Gardens of Calcutta, artificial irrigation is considered essential to obviate the natural effects of a dry climate. And it is pointed out that the plants need moist air—no long dry, hot months—a naturally rich soil, plenty of rain, and no extremes of temperature. The conclusions drawn are that in localities where these conditions are not found, or where the existing conditions cannot be modified to approach them, it is useless to try to grow ramie. In the Kangra district of India the plant cannot be successfully cultivated without irrigation, and the facilities for obtaining an ample supply of water at all seasons (the dry particularly) render this district particularly favorable to the culture. Mr. Favier, in his account of French culture, has a special chapter on irrigation, urging the practice as essential to success when the proper conditions of moisture do not exist naturally.

THE ALKALOIDS OF KOLA.

By FRED. B. KILMER, Chemist, New Brunswick, N.J., U.S.A.*

The alkaloids so far identified as belonging to this plant are to the chemists very familiar substances. Worthy of note is the fact of their close relationship to each other in chemical formula and structure. Also, that they are analogous and apparently identical with the alkaloids found in all the caffeic group of plants; that they are closely related chemically and physiologically with the xanthine bodies, which are found normally in the muscular and other tissues, such as the liver, spleen, brain substances, etc., of the animal body. These xanthine bodies are typical products of the downward destructive metabolism of proteids. Similarly, the alkaloids of this plant seem to form when the seed is on its way toward removal from the tree.

Xanthine $C_5 H_4 N_4 O_2$.

Para-xanthine $(C_7 H_8 N_4 O_2)$.

(Dimethyl-xanthine.)

Theobromine $C_7 H_8 N_4 O_2$.

(Dimethyl-xanthine.)

Caffeine $C_8 H_{10} N_4 O_2$.

(Trimethyl-xanthine.)

The experiments made by the writer in the habitat of the plant seem to show that the alkaloids are found chiefly in the ripe or nearly ripe seeds (except that, in a very few instances, the pods have given faint alkaloidal reaction). The wood, bark and leaves give entirely negative results. Experiments are now being made to determine more accurately at just what stage in the life history of the plant these bodies are first manifest. In the limited number of experiments made, the results indicate that, in the green nuts, only traces of the free alkaloids are present, and that the quantity increases materially as the nuts ripen.

* Abstract by the author of a lecture delivered at the Pharmaceutical Meeting of the Philadelphia College of Pharmacy, January, 1896.

KOLANIN, THE GLUCOSIDAL PRINCIPLE OF KOLA.

Heckel and Schlagdenhauffen have set us an illustrious example in the study of drugs by devoting twelve years to the investigation of this plant. Very early in their researches, after exhausting the alkaloids, they separated a body which seemed to them to present an analogy to cinchona red. They found it to contain an active principle which they were at first unable to separate, but which they found to be capable of giving striking physiological results.

Ernst Knebel, of Steeg, in 1891, also a notable name in the history of this drug, in a long and laborious examination, demonstrated that a glucosidal body was present, to which he gave the name kolanin. Knebel demonstrated that this glucoside upon decomposition, gave caffeine, glucose and a third non-nitrogenous body. (Knebel's kola roth).

The work of both Heckel and Knebel heretofore referred to upon kolanin was conducted mainly upon the dried drug. It is quite evident from the results obtained by a number of other observers, that, in the undried seed, especially before ripening, little or no caffeine exists as a free alkaloid.

The kolanin itself is a brown-red, amorphous, bitter powder, insoluble in cold water, partly soluble in boiling water, in hot water forming a resinous, greasy ball, cooling to a shiny, hard mass. A purified form of kolanin is soluble in boiling water, alcoholic solution of potassium hydrate and ammonia. Its alkaline solution is red-brown when cold, but becomes red on warming. Its alcohol solutions do not act upon salts of iron, but are precipitated by plumbic acetate. Upon sublimation, this product gives out an empyreumatic oil and traces of caffeine. Upon boiling with dilute hydrochloric acid it is not dissolved, but partly decomposed into glucose and caffeine. Knebel, in his article, demonstrates that the glucoside, kept at a temperature of 60 deg—70 deg. C. for twenty-four hours, is decomposed into its components, viz.: caffeine, glucose and a third product, non-nitrogenous coloring matter, which he names kola roth.

Kolanin is also decomposed by the action of the ferment of the kola, kolazym by the action of the ferments of the saliva and of the gastric juice.

FERMENTS OF THE KOLA.

It has been proven that there is present in this nut an unorganized ferment, to which the name kolazym has been applied. This body appears to possess manifold powers (possibly there is more than one ferment present). Kolazym is a glucosidal enzyme, having the power to split up the glucoside kolanin into glucose, caffeine, and a tannin-like body. It is also a carbohydrate enzyme, giving quite active diastasic action upon starch. It seems to be active in faintly acid solutions, but will act in neutral and feebly alkaline media, acting best at a temperature of about 54 deg. to 65 deg. C. Extreme cold as well as boiling, seems to destroy its powers. This ferment will convert soluble starch into dextrine bodies and sugar. It will decompose kolanin into its constituents, glucose, caffeine and kola red.

The exact nature and office of plant ferments are somewhat obscure. Prof. J. R. Green, London, gives as an explanation the fact that, in constructive processes of plant life, an excess of material is formed over and above that immediately utilized; that this excess is temporarily

deposited in the tissues, nutritive material of various kinds being found in different regions of the plant. When the constructive process is at rest the action of the ferment is called forth, and the reserve food is made ready for assimilation by a process of digestion, in which the ferments are active factors. Under this view, kolazym may be said to act upon the reserve food stored in the seed. During the resting stage of the seed, it starts the digestion of food for the future plant. In the kola nut, some of the products of this metabolism are the alkaloids caffeine and theobromine; similarly a product of the metabolism of meat are the closely related xanthine bodies. We find in the ripened seed glucose, which shows the ferment has been at work.

FORESTRY.

Abstract of DR. J. T. ROTHROCK'S Lecture on Relations of Forests to the Surface of the Country, at the Twenty-third Annual Meeting of the State Board of Agriculture in Trenton, U.S.A.

We are apt to suppose that the most important relations of the forests to the Commonwealth, to the landowner, and to the general interests of the country, are summed up in the lumber produced. It is, however, quite certain that if all the lumber we or our children could need, were sawed up in proper form and stored away at convenient points, if all the fuel which the forests furnish now or will furnish hereafter, were cut and placed on our backyards, that the least important uses of the forest would have been fulfilled. Climatic conditions, such as are necessary for the protection and maturing of our crops, depend upon trees or their aggregate forests as a living thing. The maintenance of an even flow of water, guarding against freshets on the one hand, and low stages on the other, is closely related to the condition of the high water sheds of a region. On the authority of our best engineers it may be stated that on a timbered area, not less than four-fifths of the water which falls as rain or snow, finds its way to depths beneath the surface, and is, therefore, safe for future use, whereas, on the other hand, of the water which falls on clear ground four-fifths run out of the country. It would have been of vast importance, for example, to the business interests along the upper Ohio river, if last year the quantity of water flowing into that stream could have been doubled in the interests of navigation. It must also be remembered that the severe freshets resulting from treeless highlands, not only carried the water out of the country, but they score the the channel at one point and fill it up at another to such an extent that navigation is rendered more difficult and dangerous. It may be remarked here, that so far as the lumbering interests are concerned, there never will come a time when wood will cease to be used, or to rank as an article of almost prime necessity. It is true that substitutes for timber are constantly being found; iron has largely taken its place in constructing the frames of heavy buildings, and our modern navy and mercantile marine force is represented almost wholly by iron instead of wooden hulls, but on the other hand, new and large uses are constantly being discovered for wood. Our country does not, to-day, furnish the lumber required by the pulp interests, though they have by no means

reached their fullest development. There is, furthermore, an important relation of the forests to agriculture: every particle of soil upon our highlands is slowly moving toward the tide water. It is merely a matter of time before the productive fertility of our hillsides will have taken its place in some stream, and be on its way to the ocean. This tendency we counteract by constant use of fertilizers. The forests on higher grounds may be regarded as important factors in breaking up rock and furnishing decaying vegetable matter to restore the fertility which has been washed out of our fields, and whilst they do this, they themselves are seldom much gullied or washed.

In the near future water will figure much more conspicuously than it does now as a source of power. The time will come when the use of coal will be limited because of an increasing scarcity, and we shall then be driven to utilise the weight and velocity of our flowing water, as a source of power, either directly or through the electricity which it may be made to generate and transmit, it may be, to a distant point, for use. Looked at in this light the value of the forest to the future can hardly be overestimated. But associated with this fact is the other fact that to produce these forests, which are necessary to gather and hoard the water required for the production of power, hardly less than half of a century will be required. Every hour of delay now is a mortgage with which the present is to burden the developments of the future.

Thoughtful persons who have noted the trend of agricultural thought cannot fail to recognize that the climatic vicissitudes of recent years have caused the problem of irrigation for crops, even in this country, to be warmly discussed. An abundant supply of water at the proper times means not only a more certain crop, but a larger and more perfect crop from the same acreage, and as our population doubles and our tillable areas decrease, the necessity for some method of increasing the yield on a given area will be more and more apparent and pressing.

In fact, it may be stated boldly at once, that the interests of the State at large demand that not less than twenty-five per cent. of the area of an average state should be under its own control. Water is an article of prime necessity, and no private interest should be allowed to control or hinder or interfere with its proper distribution to every citizen of the Commonwealth, whether it be for drinking, for production of power, for farming or for navigation. It would be a wise piece of legislation by which a state should become the possessor of every acre within its limits sold for taxes, and either retain it for the purpose of maintaining the timber growth or, if better suited for some other purpose, then to sell it under such restrictions as would never allow the purchaser to use it to the injury of the Commonwealth.—*The Forester.*

TOBACCO SEED FOR DISTRIBUTION.

Havana Tobacco Seed of the best quality has been obtained from Cuba, from the Vuelta Abajo district, for distribution.

Those who wish to have a small quantity of this seed, are requested to apply at once to the Director of Public Gardens, Gordon Town P.O., stating how much land they are prepared to plant out.

TRAP FOR BEETLES.

[*Extract from Proceedings and Journal of the Agricultural and Horticultural Society of India, for October-December, 1895. Vol. X. p. 329.*]

Beetles injurious to Palms, Trap for.—Read following letter from Mrs. C. H. Pope. Maricha. “Having accidentally discovered an excellent trap for the big black shiny beetle that plays such havoc with all palms, I hasten to let you know, as you may have lost valuable species by these beetles eating away the heart and destroying the young leaves before shooting out. Have an old kerosine tin cut in two the long way, then mix a little fresh cow manure with water to the consistency of cream, and put it about 3 inches deep in each tin, placing them in the evening some where near or under your high palms, and by morning you will probably find half a dozen in each tin, when destroy, and repeat again until you are rid of the plagues.”

LIGNUM VITÆ.

As this year has been unusually favourable to the production of good seed of Lignum Vitæ, sufficient will be sown to supply all applications for plants sent to the Director of Public Gardens before the end of August. The seedlings will probably be ready for distribution some time next year. No charge will be made for these plants.

PREMIUMS FOR THE CULTIVATION OF STAPLE PRODUCTS.

Jamaica Agricultural Society, 3 King Street,
Kingston, July 1st, 1896.

The following are the conditions on which this Society is prepared to encourage the Establishment of “Staple Products,” viz. :—

1. That premiums be awarded for the Cultivation and Reclamation of Land by tillage, and the establishment of permanent or staple Crops.
2. That the premiums to be offered are intended to denote certain degrees of excellence, and the Judges shall in no case award a premium where in their opinion the cultivation does not show sufficient merit.
3. That premiums shall not be awarded for cultivations already in existence.
4. That competition shall be opened to Proprietors of 100 acres of land, and under, and to Tenants of similar holdings having a lease of not less than 5 years duration.
5. That proof of the size of the holdings shall be the production of the Tax Receipts.
6. That the Products for which premiums are available shall be Oranges, Shaddocks, Grape Fruit and all Citrus Fruits, Rubber, Gums, Nutmegs, Vanilla, Coffee (Arabica and Liberian), Cocoa, Kola, or Bissie, Ramie, and Tobacco.
7. That one acre of land shall be the minimum of cultivation of any one product, available for a premium.
8. That premiums shall be awarded in one Collectorate District, in

each of the thirteen Agricultural Parishes. These Districts to be balloted for by the President of the Society.

9. That these local competitions shall be superintended by the Members of the Society, resident in or connected with the District, who are named by the Board of Management.

10. That a sum of seventy-six pounds be allotted to each of these 13 Districts and that of this sum £60 be awarded in 20 premiums of £3 each leaving £16 towards the expense of judging.

11. That one or more Judges may be appointed for each District.

12. That crops for which premiums are awarded need not necessarily have reached maturity, and premiums may be given for cultivations in progress, providing these are, in the opinion of the Judges, sufficiently advanced to admit of their being judged.

13. That Judges shall consider the circumstances of each cultivation, as well as the cultivation itself, including the implements used, fencing, draining, roads, &c.

14. That during the month of July, 1896, these competitions be advertised in each District, that all entries shall date from 1st August, 1896, although entries may be received up to the 1st October next, when the lists shall be closed.

15. That the judging shall take place within 15 months from 1st August, 1896.

16. That should 40 or more competitors enter in each District, 20 premiums of £3 each be awarded, but should not more than 30 enter, 15 premiums only be awarded, and if not more than 20 enter, that 10 premiums only be awarded, that should less than 20 competitors enter that no premiums be awarded.

17. That all intending competitors must give notice to the Secretary of the Society, (or to the Superintending District Member named by the Board of Management), of their intention to compete, and the Secretary or Member shall furnish a Schedule of particulars to be filled up by competitors, and returned to him for registration.

For further information apply to

GEORGE A. DOUET, Secretary.

FERNS: SYNOPTICAL LIST—XXXVIII.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Garden, Demerara.

38. *Nephrodium calcareum*, Jenm.—Rootstock stoutish, erect, the crown scaly; stipites cæspitose; erect, brown, dark at the base, which is clothed with deciduous dark brown paleæ, channelled, $\frac{1}{2}$ -1 ft. or more l.; fronds erect, lanceolate or ovale-lanceolate, $1\frac{1}{2}$ -to 2 ft. l., 6-8 in. w. pinnate or sub-bipinnatifid, dark green, chartaceous, rachis and costæ puberulous, other surfaces naked, equally reduced both ways; pinnæ spreading, contiguous or apart, $3\frac{1}{2}$ - $4\frac{1}{2}$ in. l. $\frac{1}{2}$ in. w. more or less, sessile and free at the base uniformly lobed on both sides, the point $\frac{3}{4}$ -1 in. l. entire and bluntish, the lower ones more distant and gradually reduced to $\frac{1}{4}$ in. l. the upper passing through lobes to the bluntish quite entire point; cut $\frac{1}{3}$ rd. or more of the depth to the costæ; lobes $1\frac{1}{2}$ -2 li. w., hardly as deep, the lowest pair uniformly en-

larged, obliquely sub-deltoid, the margin even; veins simple, curved, 4-6 to a side, the lowest opposite ones united, sending a single branch to the sharp sinus, near which the next pair enter; sori nearer the mid-vein, involucre small, fugacious.—Journ. Bot. 1886 by 271.

Ocho Rios gully, St. Ann, discovered by Mr. Sherring growing in moist forests on wet calcareous rocks. It is a smaller plant than *usitatum*, its nearest ally, with the under surface similarly microscopically warted, but with, as a rule, narrower pinnæ, less acuminate at the entire points, and with enlarged basal lobes, the inferior ones being gradually reduced till the lowest are only $\frac{1}{2}$ -1 in. long. The latter is an unmistakable determining character. The upper pinnæ are subentire throughout, more or less free, and auricled on both sides at the base. Endemic.

39. *N. jamaicense* Baker.—Stipites cæspitose from a strong, wiry-rooted, erect rootstock, slightly scaly at the base, 3-6 in. l., grayish-puberulous; fronds oblong lanceolate or lanceolate, 1-1 $\frac{3}{4}$ ft. l. 4-6 in. w., shortly reduced at the base, hard and subcoriaceous, grayish-green, puberulous on the costæ and slightly also often on the general surface; rachis grayish with dense stellate puberulæ, and channelled; pinnæ contiguous or subdistant, spreading, stipitate or nearly sessile, 2-4 in. l. $\frac{1}{2}$ - $\frac{7}{8}$ ths in. w., oblong-lanceolate, the point subentire bluntish or acute, lower 1-3 pairs more or less reduced and deflexed; cut $\frac{1}{2}$ - $\frac{3}{4}$ ths to the costæ into oblong blunt segments, which are widest within and open at the apices with a crenulate-undulate subreflexed margin, (appearing on the upper side as if thickened,) basal pair reduced in the lower pinnæ, veins 8-10 to a side, simple, or the lower ones openly forked near the margins, raised beneath but evanescent at the sori, branches of the costal pair often forming with the vein that runs from the inferior limb to the sinus a pair of areolæ between the forks; sori small, nearer the margin below, but the midrib above; involucre small clothed with stellate puberulæ.—Journ. Bot. 1877. 264.

Infrequent on half-open banks and in forests from 3,000-5,500 ft. altitude; St. Andrew and Portland parishes; Old England and the region of the Government Cinchona Plantation. Midway in general aspect between *deltoideum* and *Polypodium asplenioides*. The general gray colour, pale and prominent costæ ribs and veins of the underside, crimped edge, that seems as if thickened on the upperside, the branched veins, and the areolæ which are often formed within the forks of the costal pair, well distinguish the species. The segments are somewhat unequal occasionally. *N. Bermudianum*, Baker, is nearly identical with this. Endemic.

40. *N. deltoideum*, Desv.—Stipites cæspitose from a decumbent elongating rootstock, channelled, 3-6 in. l. below the merely auricled portion of the fronds, scaly and slightly muricate at the base; fronds 1 $\frac{1}{2}$ -2 ft. l. 6-9 in. w., the apex pinnatifid with blunt lobes, suddenly reduced in the lower half or third to small auricles, which line the stem on each side, decreasing in size to the base, hard and subcoriaceous in texture, dark green paler beneath; pinnæ spreading, contiguous or subdistant, 3-5 in. l. $\frac{3}{4}$ -1 in. w., truncate and sessile at the base, the acuminate or bluntish apex subentire; cut $\frac{2}{3}$ ds to the costæ into close, flat oblong, obliquely rounded, straight or subfalcate segments 2-2 $\frac{1}{2}$ li. w. and 3-4 li. deep to the sharp sinus; margins entire, rather convex

when dry : rachis channelled, and with the costæ more or less pubescent on the face, puberulous beneath and on the ribs ; surfaces otherwise naked ; veins conspicuous, close, simple, 10-12 to a side, lowest pair running together to the sinus, a medial pellucid streak from the costæ passing between them sori nearly medial, dark purplish-brown, deciduous ; involucre small, fugacious.—*Polypodium*, Swartz.

Common in most forests from 2,000-4,000 ft. altitude. The lower 1-2 pair of the normal pinnæ are usually a little shortened and deflexed. The segments are close together at the ends, not divergent there, as is more or less generally the rule in other cases. It is a very peculiar plant in several of its features. The auricles which constitute the lower half of the frond, and dwindle from $\frac{1}{2}$ or $\frac{3}{4}$ in. l. at the top to less than a $\frac{1}{4}$ in. at the base, exceed the normal pinnæ in number, usually considerably. The pellucid medial streak which runs from the costæ between the lowest pair of veins to the sinus is also an exceptional character. The veins are raised on both sides.

41. *N. Serra*, Desv.—Rootstock free-creeping, subterraneous ; stipites apart, strong, erect, stramineous, 2-3 $\frac{1}{2}$ ft. l. ; fronds 2-4 ft. l. 1-1 $\frac{3}{4}$ ft. w. hard, and rather rigid when dry, light green, naked above, beneath grayish and rather puberulous ; pinnæ very numerous, spreading, linear, and finely serrato-acuminate, 8-12 in. l. $\frac{1}{4}$ - $\frac{1}{2}$ in. w., sessile, the lower ones (in part) narrowed at the base, 1-1 $\frac{1}{2}$ in. apart, the terminal conform but wider ; cut $\frac{1}{2}$ - $\frac{2}{3}$ rds to the costæ into close, sharply-acute, subdeltoid or subfalcate segments ; rachis subangular, channelled, and with costæ and ribs stramineous and coated with stellate puberulæ ; veins very close, simple, 8-12 to a side, 3-4 lowest pairs terminating at the sinus ; sori medial ; involucre as large, pale, puberulous. *Aspidium*, Swartz. Sl. t. 48 fig. 1.

a var. *angescens*.—Pinnæ 2-4 li. w. narrowed at the base, less deeply incised ; teeth subdeltoid, or acute, broader and more shallow than in the type.—*Aspidium angescens*, Sk.

Common and gregarious on road side banks or in wet ground near rivers or streams up to 2,000 or 3,000 ft. altitude. The two varieties are well marked. Var. *a* has very narrow pinnæ, which are narrowed to the base, and cut, not so deeply as in the other, into short, deltoid, or sometimes, roundish segments. This is Wright n. 923, gathered in Cuba, and by Purdie in Jamaica at Lapland, St. James, but it is common, and I have gathered it in several places elsewhere in Jamaica. It is well figured in Sloane tab. 48. fig. 1. vol. 1. The other has wider pinnæ, not reduced toward the base, and narrow falcate segments as in *N. Sloanei*, Baker, but the pinnæ are narrower. This is exactly identical with the Polynesian *N. unvisum*, Carr. Both have a distinct terminal pinna similar to the lateral, but broader, and have more or less puberulæ on the under surface. The rhizome is long and spreads diffusely subterraneously.

42. *N. Sloanei*, Baker.—Root-stock horizontal, subterraneous, free-creeping, strong, scurfy ; stipites apart or distant, erect, strong, subangular, dark and little scurfy-scaly at the base, above stramineous, 2-4 ft. l. fronds ample 3-4 $\frac{1}{2}$ ft. l. 1-2 ft. w., firm and rather stiffish, naked on the ribs, slightly puberulous beneath, rather light green ; pinnæ numerous, spreading 1 $\frac{1}{2}$ -2 $\frac{1}{2}$ in. apart, very finely serrate-acuminate, the upper ones broadest at the base and sessile lower ones narrowed

there and stipitate, the lowest pair hardly reduced, and often deflexed, 9-15 in. l. $\frac{3}{4}$ - $1\frac{1}{4}$ in. w., pinnatifid to the narrowly winged costæ; segments narrow, subfalcate, point subacute, $\frac{1}{2}$ - $\frac{3}{4}$ in. l. $\frac{1}{8}$ th. in. b., close or with as much as their own width between them; margins cartilaginous-edged, even; rachis strong, and with the costæ stramineous and nearly or quite glabrous; veins 15-20 to a side, simple, close, pellucid, lowest pair curved and running together to the sinus; sori medial; involucre as large, pale, or fresh-coloured, naked or puberulous. Sl. t. 50. fig. 1; Herb. Pl. Fil. t. 22; *Aspidium invisum*, Swartz.

Common among the lower hills and widely spread through the country, ascending to 5,500 ft. altitude, on banks and other open places. A very fine species, the fronds however not erect but arching from the base outwards. A much wider pinnæd plant than *Serra*, to which it is closely allied. The texture is rather thin but hard, becoming rigid when dry. The rootstock is very wide-creeping under the surface of the ground, with the stipites scattered along it. Frequently the fructification does not reach the outer part of the pinnæ. *N. paucifugum*, Jenm. of Jamaica may be a young state of this. The specimen on which it is founded, has a creeping rootstock, naked stramineous glossy petioles and rachises, pale green naked, bipinnatifid fronds, truncate at the base, simple oblique veins, several to a side, which run into the serratures of the segments.

43. *N. patens*, Desv.—Stipites biserial along a subterraneous strong horizontal creeping rootstock, erect, 1-2 ft. l. not channelled, with a few deciduous scales at the base; fronds erect, $1\frac{1}{2}$ -3 ft. l. 8-12 in. w. papyraceous, rather flaccid, more or less pubescent throughout, paler beneath tinged gray by the light coloured pubescence; pinnæ numerous, spreading, distant or subdistant below, sessile, lowest 1-2 pair little reduced usually and deflexed, acuminate, with a serrato-entire point, 4-6 in. l. $\frac{2}{3}$ rds.— $\frac{3}{4}$ ths. in. w., widest at the base and tapering outwards, or the lower ones of a uniform width along the inner half or two-thirds, cut $\frac{2}{3}$ rds. or $\frac{3}{4}$ ths. to the costæ into entire close oblong, bluntish segments, 2-3 li. l. from the acute sinus, and nearly 2 l. b. a little dilated or not at the confluent bases; rachis strong, not, or only faintly, channelled, subangular, more or less pubescent and grayish; veins simple 7-9 to a side lowest pair meeting at or below the sinus; sori medial; involucre as large, pale, freely ciliate. *Aspidium*, Swartz; Eat. Fern. N. America pl. 70; Sl. t. 62, fig. 1.

Common in open and bushy places and by way-sides ascending in Jamaica to 5,000 ft. altitude. This is distinguished absolutely from all its allies possessing the same aspect of frond, by its creeping horizontal under-ground rootstock, upon which the fronds are arranged in a bi-linear series. It is probably common all through the West Indies, but in the absence of the rootstock other species are often mistaken for it in herbaria. The plant figured by Eaton in his Ferns of N. America is true and the figure well illustrates the species.

44. *N. molle*, Desv.—Rootstock erect, an inch or less thick; stipites erect, 1-2 ft. l., not or very slightly channelled, with a few deciduous scales at the base; fronds oblong, or ovate-lanceolate, $1\frac{1}{2}$ - $2\frac{1}{2}$ ft. l. 6-10 in. w., pellucid, papyraceo-herbaceous and flaccid; pubescent, light-green; pinnæ spreading horizontally, 4-6 in. l. $\frac{3}{4}$ in. w., sessile, close or more or less distant, especially below, oblong-lanceolate with a

serrato-acuminate point, 1-3 lowest pair more or less (often little) reduced and deflexed, pinnatifid $\frac{3}{4}$ ths. or 4-5ths. to the costæ; segments close, oblong, often subfalcate, flat and bluntish, $\frac{1}{4}$ in. l. from the acute sinus, $1\frac{1}{2}$ li. b., basal pair largest; margins even or subcrenulate; rachis stramineous, grayish-pubescent; veins simple, 7-9 to a side, the lowest pairs forming narrow arched areolæ and sending a distinct branch to the sinus, above which the next pair terminate; sori medial; involucre as large, pale, pubescent. Sl. t. 50, fig. 2. Herb. Aspidium, Swartz.

Common in open and half over-grown places up to 3,000 ft. altitude, or higher, and generally diffused throughout the island. As in *stipulare* the basal pinnules of the lower pinnæ are often enlarged and pinnatifid. I have under those species pointed out that from *stipulare* this is distinguished by the lowest veins sending a simple branch to the sinus from their anastomosis, (not running together thereto), and from *patens* its other ally, by the same character, and the erect rootstock. The texture of this is perhaps softest of the group.

45. *N. guadalupense*, Fée.—Stipites numerous, cæspitose from a stout, upright rootstock 15-21 in. l, not, or faintly, channelled, grayish-puberulous, and sparsely deciduously scaly at the base; fronds spreading, ovate-lanceolate, the acuminate apex pinnatifid, 2-3 ft. l. 10-15 in. w., thinly chartaceous, pellucid, grayish-green, especially beneath, and clothed with minute scattered stellate puberulæ, as are the rachis and ribs also; pinnæ numerous, spreading, 1- $1\frac{1}{2}$ in. apart, 6-8 in. l., $\frac{3}{4}$ -1 in. b., upper ones truncate and broadest at the base, lower shortly narrowed there and more distinctly stipitate, lowest pair not, or little, reduced, and deflexed or horizontal; cut $\frac{1}{2}$ - $\frac{2}{3}$ rds. to the costæ into flat obliquely rounded subfalcate entire segments, 2 li. b. and 3 li. d. to the narrow sinus, passing gradually outwards into the finely acuminate subentire point; veins simple, 10-12 to a side, 1-3 lowest pairs uniting at, or the inferior pair running together to the sinus; sori medial; involucre small, pale, puberulous.—Fée. Fil. Ant. t. 24. fig. 3.

Common in forests and shady waysides from 1,500-4,000 ft. altitude. The terminal pinna is hardly distinct, though in cutting it more or less resembles the lateral but is generally broader, the upper pinnæ being gradually reduced till they pass into it. Marked by its gray stellate puberulous vestiture, which is very dense on the rachis, costæ and ribs, broad lobed pinnæ, the lower ones of which are narrowed cuneate-form at the base. The fronds are broadest in the lowest third or half, from whence they narrow gradually to the apex. The rachis relatively, slender.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of August:—

IN FLOWER.

Acacia cyanophylla, Lindl.
 Baphia nitida, Afz.
 Bauhinia variegata, Linn.
 Bignonia magnifica, Bull.
 Brexia madagascariensis, Thou.
 Brownea Rosa-de-Monte, Berg.
 Calophyllum Calaba, Jacq.
 Caryocar nuciferum, Linn.
 Cordia alba, Roem. & Schult.
 Eugenia malaccensis, Linn.
 Erythrina umbrosa, H. B. & K.
 Erythroxylon Coca, Lam.
 Gelonium multiflorum, A Juss.
 Gmelina asiatica, Linn.
 Hevea brasiliensis, Muell. Arg.
 Lonchocarpus cyanescens, Benth.
 Manihot Glaziovii, Muell. Arg.
 Mesua ferrea, Linn.
 Musa coccinea, Andr.
 Myroxylum toluiferum, H. B. & K.
 Napoleona inperialis Beauv.
 Norantea guianensis, Aubl.
 Noronhia emarginata, Thou.
 Omphalea triandra, Linn.
 Oreodoxa regia, H. B. & K.
 Russelia sarmentosa, Jacq.
 Pterocarpus Draco, Linn.
 Sanchezia nobilis, Hook. f.
 Sarcocephalus esculentus, Afzl.
 Semecarpus Anacardium, Linn. f.
 Stevensonia grandifolia, Duncan.
 Swartzia grandiflora, Willd.
 Tabernæmontana longiflora, Benth.
 T. Wallichiana, Steud.
 Terminalia Arjuna, Bedd.

IN FRUIT.

Chrysalidocarpus lutescens, H. Wendl.
 Couroupita guianensis, Aubl.
 Copernicia cerifera, Mart.
 Dillenia indica, Linn.
 Diospyros discolor, Willd.
 Hevea brasiliensis, Muell. Arg.
 Imbricaria maxima, Poir.
 Michelia Champaca, Linn.
 Omphalea triandra, Linn.
 Oreodoxa regia, H. B. & K.
 Pachira Barrigon, Seem.
 Samadera indica, Gærtm.
 Sarcocephalus esculentus, Afzl.
 Terminalia Arjuna, Bedd.

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

Agricultural Leger, Nos. 16 & 23 & other Pamphlets. [Kew.]
 Bulletin de L'Herbier, Nos. 4 & 5, April & May 1896. [Conservateur.]
 Bulletin Torrey Botanical Club, No. 5 & 6. May & June 1896. [Editor.]
 Bulletin New York Botanical Garden, No. 1. April 1896. [Secy.]
 Bulletin Central Experiment Station, Ottawa. No. 95. May 1896. [Director.]
 Report Experimental Farm, Canada. 1895. [State Botanist.]
 Report Bot. Garden Ceylon. 1895. [Director.]
 Report Bot. Station, Lagos. 1895. [Curator.]
 Report Govt. Gardens & Parks, Mysore. 1894-5. [Supt.]
 Agri. Gazette of N. S. Wales. Parts 3 & 4. March & April 1896. [Dep. of Agri.]
 Agri. Journal, Cape Colony. Nos. 9-11. April & May 1896. [Dep of Agri.]
 Agri. Gazette & Planter's Journal, Barbados. No. 1. May 1896. [Editor.]
 Hawaiian Planter's Monthly. Nos. 5 & 6 May & June 1896. [Editor.]
 Central African Planter. Nos. 87-88. April 1896. [Editor.]
 The Forester. No. 4. July. 1896. [Editor.]
 Sugar. No. 7. May 1896. [Editor.]
 Sugar-Cane. No. 323. June 1896. [Editor.]

- Sugar Journal. Nos. 3 & 4. April & May 1896. [Editor.]
 Sucrerie Indigène et Coloniale. Nos. 21-26 May-June. [Editor.]
 W. I. and Commercial Advertiser, May and June, 1896. [Editor.]
 W. I. Home Builder. May 1896. [Editor.]
 Produce World. Nos. 33-38. May-June 1896. [Editor.]
 British Trade Journal. No. 42. June 1896. [Editor.]
 American Journal of Pharmacy. No. 7. July 1896. [Editor.]
 Montreal Pharmaceutical Journal. No. 4. July 1896. [Editor.]
 Chemist & Druggist. Nos. 840-843. May & June 1896. [Editor.]
 Times of Ceylon. Nos. 18-21. May 1896. [Editor.]
 Science Gossip. No. 25. June 1896. [Editor.]
 Botanical Gazette. No. 6. June 1896. [Editor.]

SEEDS.

- From Royal Gardens, Kew.*
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 Kickxia africana
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 Corchorus capsularis
 Pseudophœnix Sargentii
From Agri. Horticultural Society, Madras.
 Corypha umbraculifera
From Botanic Gardens, Bangalore.
 Mimusops Elengi
From Botanic Gardens, Saharanpur.
 Urena lobata
 Hyptianthera stricta
 Embelia Gamblii
 Rhus semialata
 Callicarpa arborea
 Mallotus philippinensis
 Capsicum cernuum
 Ainsleæa pteropoda
- Grewia lævigata
 Osbeckia stellata
 Strobilanthes capitatus
 Solanum crassipetalum
 Nyssa sessiliflora
 Erodia fraxinifolia
 Cassia sp.
 Celastrus monosperma
 C. paniculata
 Rhus Griffithii
 Acacia rubicaulis
 Daphne papyracea
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 Epidendrum venosum
- Lælia albida
 L. autumnalis
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 Nerium splendens variegatum
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 Vepris lanceolata
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 Naseberry Bullet.
- From W. Jekyll, Esq.—*
 Eccremocarpus scaber.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

Salt Bushes of Australia	—	PAGE 169
Ornamental Plant in Gardens	—	171
A useful Jamaica Weed	—	172
Reproduction of the Orange from seed	—	173
Teak	—	175
Logwood	—	179
Cane Varieties	—	183
Ferns : Synoptical List.—XXXIX	—	188
Contributions to the Department	—	190
Castleton Gardens	—	192

P R I C E—Threepence.

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

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1896.

JAMAICA.

BULLETIN

OF THE

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New Series.]

AUGUST, 1896.

Vol. III

Part 8.

THE SALT BUSHES OF AUSTRALIA.

Baron Sir F. Von Mueller, Government Botanist of Victoria, has in the following letter called attention to the value of different kinds of "Salt Bushes" as food for sheep and cattle in parts of the warmer regions of the world where other vegetation is scanty, and the soil is impregnated with saline particles. These plants are well worthy of trial in such districts in Jamaica, and seed will be procured from Australia for those who wish to make the experiment.

Although they are desert plants, they require some care before they become established. It is recommended that the seed be sown in nursery beds, or in bamboo pots, and after three or four months they may be transplanted to their permanent position. It is best to plant them out after the "seasons" rains are over. When once they are established they require no more care, and will then seed and spread.

*Baron Sir F. Von Mueller to Director Public Gardens and Plantations,
Jamaica.*

Melbourne, 23rd June, 1896.

By this mail, dear Mr. Fawcett, I send you fresh seeds (or rather fruits) of four *Atriplices* of the best rural Australian species. You may perhaps do as much wonder with them on your salt plains as Professor Hilgard did with *Atriplex semibaccatum* and several other species, which on my own thoughts and impulses I introduced for the Alkali country of California and the adjoining states, and for which boon he gives my Department some acknowledgement in his reports. These alkali lands have suddenly, through these "Salt Bushes" of mine, risen enormously in value; indeed, though California was discovered and sparingly colonized soon after Columbus' time, they were till these last years forbidden ground, as not even indigenous plants would grow on them. The *A. semibaccatum* is relished most by cattle, and all sorts by sheep.

Always ready to serve you,

F. VON MUELLER.

In Von Mueller's valuable treatise "Select Extra-Tropical Plants," he describes several of the species of *Atriplex* as follows:—

ATRIPLEX HALIMOIDES, Lindley.

Gregarious over the greater part of the saline desert-interior of Australia, reaching the south and west coasts. One of the best dwarf species for salt-bush pastures. More saline and thus less agreeable to sheep also less copiously seeding than *A. nummularia*. All such plants are readily raised from seeds. Should even in its native places, with other valuable species, be re-disseminated methodically. About 20,000 dried seeds (fruits) go to a pound. A covering of prickly branches will effect protection to the young seedlings against sheep and other pasture-animals. The gregarious occurrence of *A. halimoides* and *A. vesicaria* in some wide subsaline tracts of the Australian interior is indicative of the facility with which these two kinds of salt-bushes get even spontaneously disseminated. Where these plants are to be grown permanently, the soil must of course contain a fair proportion of saline particles, especially chloride, either naturally or artificially.

ATRIPLEX LEPTOCARPA, F. v. Mueller.

East-Australia. This is another of the perennial salt-plants, though not a large one, which render many of our dry and sterile tracts valuable for sheep pastures. It will bear a great amount of drought, and if not too closely fed down, produce seeds in abundance.

ATRIPLEX MUELLERI, Bentham.

Interior of Australia, reaching the south and west coasts. Cattle, and especially sheep, are so fond of it that they often browse it to the root.

ATRIPLEX NUMMULARIA, Lindley.

From Queensland through the desert-tracts to Victoria and South Australia. One of the tallest, most fattening and wholesome of Australian pastoral salt-bushes, but not so much relished by grazing animals, as some of the smaller species. Sheep and cattle, pastured on salt-bush country, are said to remain not only free from fluke, but to recover from this *Distoma*-disease and other allied ailments. Mr. Edward Garwood Alston, of Van Wyks Vlei estate in Carnarvon, aided by Mr. Henry Sandford, of Graaff-Reinet, and President Reitz, of the Orange Free State, has had immense success with *A. nummularia* and *A. halimoides* in South Africa, as far as the Transvaal, the origin of the introduction also there having been through Von Mueller. Even pigs and fowls are fond of these salt-bushes. The withered leaves and seeds afford a natural mulching.

ATRIPLEX SEMIBACCATA, R. Brown.

Extra-tropic Australia. A perennial herb, very much liked by sheep, thus considered among the best of saline herbage of the salt-bush country. Mr. Will Farrar pronounces this herb as wonderful for its productiveness and its drought-resisting power. Professor Hilgard writes that in the Tulare district, California, where the soil contains 2 per cent alkali, this plant grew to a height of 8 feet. He knows no other plant that does so well on the same soil.

ATRIPLEX SPONGIOSA, F. v. Mueller.

Through a great part of Central Australia, extending to the south and west coast. Available, like the preceding and several other species, for salt-bush culture of particular nutritiveness as pasture-fodder, but herbaceous.

ATRIPLEX VESICARIA, Howard.

In the interior of south eastern and in central Australia. One of the most fattening and most relished of all dwarf pastoral salt-bushes of Australia, holding out in the utmost extremes of drought, and not scorched even by sirocco-like blasts. Its vast abundance over extensive salt-bush plains of the Australian interior, to the exclusion of almost every other bush, except *A. halimoides*, indicates the facility with which this species gets disseminated of its own accord. Splendid wool is produced in regions where *A. vesicaria* and *A. halimoides* almost monopolize the ground for enormous stretches. With other woody species easily multiplied from cuttings also; but, as remarked by Naudin, producing thousands of fruits in less than three months after sowing, and, as stated by Millardet, has become the marvel of the Delta of the Rhone.

ORNAMENTAL PLANT IN THE GARDENS.

CEROPEGIA SANDERSONI, *Decne.* This interesting plant was lately in flower at Hope Gardens. The flowers are pale green, mottled and veined with darker green, with a peculiar translucent appearance. The corolla $2\frac{1}{2}$ inches long, is tubular below, expanding upwards like a salver with five points which open out and unite again, in a most curious manner into an umbrella-like covering. It doubtless serves as an attraction for flies to creep into and effect fertilisation, but the umbrella-like covering is not, strictly speaking, a fly trap. This species was discovered by Mr. John Sanderson, in Natal, who sent living plants in a Ward Case to Kew, in 1868. The plant at Hope was received from Kew last August. Other species are natives of the East Indies, and Southern Africa.

A JAMAICA WEED.

(DESMODIUM TORTUOSUM, Sw.)

USEFUL FOR FODDER & GREEN DRESSING.

The following letter contains valuable information on a plant which is a weed in many parts of the island. Being one of the Leguminosæ it collects nitrogen from the air, one of the most valuable ingredients of plant food. The best way to renew worn out lands is to sow some such plant as this, and as soon as it has reached the flowering stage to turn in cattle to feed it down; or it may be then ploughed into the soil on flat land, or simply cut down and left on the ground on very steep land. A specimen may be seen in the Museum of the Institute.

Prof. F. Lamson Scribner to the Director of Public Gardens and Plantations.

United States Department of Agriculture, Division of Agrostology,
Washington, D.C., August, 1st, 1896.

DEAR SIR,

I forward you to-day, enclosed in separate wrapper, a small package of seed of the Florida beggar weed (*Desmodium tortuosum*, Sw.), a wild forage plant highly esteemed in the subtropical portions of the United States. It produces fodder of fine quality in large quantities, and grows best on sandy soils containing lime. On cultivated lands it grows often 8 to 10 feet high. The haulms, though rather woody, are eaten by cattle and working stock of all kinds. Beggar weed makes an excellent manure. In Florida it is extensively used as a renewer of worn lands. It promises to be a plant of much agricultural value in the warmer countries.

Respectfully,
F. LAMSON-SCRIBNER, Agrostologist.

The genus *Desmodium* belongs to the Leguminosæ, or Pea Family, having the same form of flower as the pea. The pod, instead of being all in one, like a pea-pod, is divided up into several joints which do not usually open. The leaves have generally 3 leaflets, and there are numerous small flowers. In *Desmodium tortuosum*, D.C., the pod is somewhat twisted, divided deeply from both edges into from 2 to 6 round, flat joints; the flowers are small, purplish, with stalks which are longer than the flowers themselves; the plant is 2 to 3 feet high, covered with hooked hairs.

Desmodium triflorum, D.C. is also a common weed in Jamaica and the tropics. Roxburgh says that in India it is very common on pasture ground, helping to form the most beautiful turf, and that cattle are very fond of it. Von Mueller recommends it as fodder for places too hot for ordinary clover, which it somewhat resembles in its mode of growth, keeping close to the ground. There are 2 or 3 small flowers growing together at each leaf, the crimson corolla being enclosed in the calyx; the leaflets are not more than $\frac{1}{4}$ inch long, and are nearly as broad, the upper part being the broadest. In India the plant is used medicinally being valued as a cure for dysentery; the fresh leaves are applied to wounds and abscesses that do not heal well.

Desmodium uncinatum, Dc., called "Chili Clover", is said by Dr. W. Hillebrand to be valuable for forage. This is a larger plant as compared with the last; its 3-cornered stem is covered with stiff, hooked hairs by means of which it clings to and climbs over bushes; the flowers are purplish-blue, larger than in other species, being $\frac{1}{2}$ inch long and more.

Desmodium gangeticum, Dc. is regarded in India as a febrifuge and anti-catarrhal. This plant grows 3 or 4 feet high; the leaves instead of having 3 leaflets as usual in the genus, have only one leaflet 3-6 inches long; the pod is notched only on one edge.

Desmodium gyrans, Dc., which is a native of the East Indies, is also found in Jamaica. It has attracted a great deal of interest from the fact that the two small lateral leaflets make in the course of a few minutes periodic oscillations which are quite independent of the sleep-movement of the large terminal leaflet due to variations in the light.

THE REPRODUCTION OF THE ORANGE FROM SEED.

By HERBERT J. WEBBER, Special Agent, United States Department of Agriculture, Subtropical Laboratory, Eustis, Florida.

(Concluded from July Bulletin.)

GRAPE FRUIT AND SHADDOCK (CITRUS DECUMANA).

The fruit commonly known in the United States as the Grape-fruit, or Pomelo* a smooth, round fruit, is always reproduced true to the seed. This is so well known to growers of this State, that they never have any hesitation to allow the trees to grow to maturity as seedlings. I have tested the fruit of many seedling trees in all portions of the State, and have almost uniformly found it of good quality. Only a very slight variation can be found commonly between the fruit of such seedlings. The Shaddock, so far as I have been able to learn from growers, also reproduces true, through the seed.

THE CITRON (CITRUS MEDICA).

Florida growers have had but little experience with this species, and I have been unable to learn anything regarding its reproduction through the seed. Of this species Galesio says, "We have seen the Citron tree of the Jews (*Citrus medica cedra*) reproduced constantly from the seed. It has many seeds, the greater part of which always give Citron trees having constantly the same characteristics in aspect, form, and properties."

LEMON (CITRUS LIMONUM OR C. MEDICA LIMONUM).

This species, while not extensively grown in Florida for commercial purposes, is yet cultivated to a considerable extent. Many growers may be found who have grown lemons from the seed and almost invariably, the testimony is that the fruit from the seedling is comparatively the same as the fruit from which the seed was taken. No other result has,

*Said by Dr. Morris (*Garden and Forest*, 1896, p. 164) to be the Forbidden Fruit of the West Indies—*Citrus Paradisi maliformis* of Macfadyen's classification.

so far, come to my knowledge. Of the common Lemon, Gallesio says, "It is reproduced constantly from the seed, and its peculiarities are perpetuated to its descendants." When Lemons are grown in Florida for commercial purposes they are almost invariably budded to improved varieties. In Ecuador and Haifa (Asia) they are reported as commonly propagated from seeds.*

LIME (CITRUS LIMETTA OR C. MEDICA ACIDA).

The common Lime also is reproduced constantly from the seed, commonly, if not invariably, transmitting its peculiarities to its descendants. In the extreme southern part of Florida and on the Florida Keys, thickets of seedling Limes escaped from cultivation have sprung up in waste places, and these, so far as I have been able to learn from inquiry and personal examination, invariably produce fruit of about the same character. In this section, where Limes are grown quite commonly, they are mostly propagated from the seed. Professor Lelong says: "The Lime comes true from the seed, the seed 'sport' only in exceptional cases."†

MANDARIN ORANGES (CITRUS NOBILIS).

The principal varieties or sub-species of the Mandarin Oranges cultivated in Florida are those known as the China (commonly called "Mandarin"), Tangierine, King, and Satsuma. Of these the China and Tangierine varieties are not unfrequently propagated from the seed, and usually produce fruit true to the parent variety with but slight variation. In all cases, so far as I can learn, fruit of a characteristic Mandarin type is produced. Seeds of the China ("Mandarin") reproduce the China variety with slight variation, but are said by some growers not to be so desirable for market, owing to a tendency to form an elongation of the rind at the calyx, which makes them awkward to pack. They also do not average equal in flavour to the selected budded fruit. One very intelligent and critical grower tells me that seeds from the China frequently produce Tangierines. I have had no opportunity to verify this statement. Tangierine seedlings reproduce fruit the same or but slightly different from the parent. The Tangierine most commonly propagated here is a selected seedling known as the Dancy Tangierine. The Satsuma and King are also reproduced true by the seed.

KUMQUAT (CITRUS JAPONICA).

Two varieties of this species, one with elliptical fruit and the other with round fruit, have been introduced into Florida, and are grown to some extent. I have eaten the fruit from several seedling trees, and find it to be the same comparatively as that from the budded trees. The owner of these assured me that they produced fruit the same as that from which the seed was taken.

TRIFOLIATE ORANGE (CITRUS TRIFOLIATA).

This Orange, the fruit of which is not used, has not been changed materially by cultivation and selection. It invariably reproduces seedlings having the same characteristics, so far as can be observed. I have

*"Fruit Culture in Foreign Countries," in Special Consular Reports, Washington, 1890.

†Lelong, B. M., "Propagation, Budding, Grafting, and Appliances." *Ann. Rep. Cal. State Board of Horticulture for 1891*, p. 148.

observed hundreds of seedlings from one trifoliate tree, which stands in the midst of a large Orange grove, isolated from all other trees of this species. It is surrounded by sweet Orange, sour Orange, Lemon, Grapefruit, and Mandarin trees, all bearing, and yet every seedling observed had the characteristic foliage and twigs of the trifoliate Orange. The seedlings have not yet fruited, so I can only speak as to the foliage and twig characters; but if hybridisation had occurred in any instance, it could not be observed in these. As many of the surrounding Citrus trees are always in bloom at the time this tree blooms, there would seem to be every possible chance for hybridisation to occur.

VARIEGATED ORANGES.

While the reproduction of variegation through seeds introduces an entirely different question, it will yet be interesting in this connection to state that variegation is apparently invariably reproduced through the seed. I have twice sown a quantity of seeds from fruits of variegated Oranges taken from two different trees of *Citrus bigaradia*, and every seedling produced, about twenty in each case, was entirely white throughout. With the utmost care I was unable to rear any of these. The majority of them formed three leaves, reaching a height of from 2 to 3 inches, but all finally died. A few formed a fourth leaf. The variegated sour Orange trees, from which the seeds were taken, had the leaves beautifully mottled with white, about half of the leaf usually being discoloured. The rind of the fruit and the branches also showed the variegation very plainly.—(*Gardener's Chronicle*.)

TEAK.

THE PRODUCE OF INDIA, SIAM, AND BURMAH.

Of all the timber trees of the Indian Peninsula, teak is, perhaps, the most useful. Its strength and durability is well known. For house-building it is the best of woods, owing to its resisting the attacks of white ants from the oily nature of the wood. It is, however, an expensive kind of timber, and, except in those countries where it is plentiful, the price is too high to allow of its being used for ordinary purposes. Great quantities are employed on the western coast for shipbuilding, for which it is superior to any other kind of wood.

The Teak tree is the *Tectona grandis* of Linnæus, belonging to the natural order Verbenacæ, and to the class of hard, leafy, non-resinous and non-coniferous woods. It is a deciduous tree, found principally in India, stretching across Hindustan and through Burmah, almost to the frontier of China. Extensive forests of teak are found in Pegu and on the banks of the Irrawaddy. The most extensive, and probably the best, forests of teak at present existing are those of Burmah, where they extend along the banks of the Salween and other rivers, as such positions favour its growth; here it is found in detached clumps, rather than scattered among other trees. In India the tree is of great value. It produces a good oil, which is used with paint as a substitute for linseed; it also makes a good varnish for paint and wood, and is known generally by the name of wood oil. The leaf of the tree is large and round, somewhat resembling in shape a cabbage leaf, and is about ten inches in diameter, but very thin, although its fibres are strong. These

leaves contain a red colour, which in Malabar was formerly used to dye silk and cotton. Natives of Burmah use the leaves as plates, also to wrap up parcels and for thatching. The blossoms and berries are produced in large numbers; when in bloom they resemble hops, and the clusters of seed have the appearance of a bunch of grapes. The seed or nut is of a dark russet brown colour and very hard; when ripe it falls to the ground and plants itself, but its spread in this way is impeded by the numerous forest fires of the dry season, which generally occur in March and April, after the seeds have ripened and fallen down. Of the seeds which escape, numbers are washed down the hills by the first heavy rains of the monsoon. These collect in the valleys, and it is here that groups of seedlings and young trees are generally found. The value of teak for the purposes of shipbuilding does not consist merely in its durability; a still greater advantage is, that the ship is at all times ready for service, while those of European wood—constructed of oak and fir—are constantly warping, and in about forty-eight hours after caulking of the top sides are as leaky as before, and the health of the crew suffers. But the teak ship, when well caulked, remains dry and comfortable for those on board and what is more is always fit for service.

In Burmah the two principal ports for the shipment of teak are Moulmein and Rangoon. In the Moulmein markets at least five kinds are sold, and at Rangoon large quantities are brought down the Irrawaddy and sold under the name of Irrawaddy teak. Siam has also contributed a considerable quantity to the British markets. The two kinds best known for trade purposes are the Malabar and the Burmah. The former grows in the forests along the western side of the Ghauts and the adjoining mountains, where numerous streams afford water carriage for the timber, and the largest forests are upon the Anamally Hills, fifteen to thirty hundred feet above the sea level. The tree requires sixty to eighty years to reach a proper age and maturity to fit it for shipbuilding. After the best straight timber has been taken, the crooked pieces, called shin logs are used for other purposes.

Teak does not injure iron, and is not liable to shrink in width. In colour and lustre the wood resembles oak; it is light, easily worked and, though porous, is strong and durable; but the quality of the timber depends very much upon the locality in which it is grown, and that is exceedingly variable. The differences in the quality of Malabar and Burmah teak arises from the kind of soil, exposure, and humidity of the climate. A tree in Burmah, ten years old, has a girth of 18 inches at six feet from the ground, while one in Bombay will require 20 years to reach this size. Quality depends much on this comparative rate of growth; and the slower this is, as a general rule, the denser and finer grained is the timber. Thus, teak grown in Burmah weighs generally 42 pounds to the cubic foot, while that grown on the western coast of India rises as high as 55 pounds, and the difference in strength varies as from 190 to 289. The durability of the wood under favourable circumstances is simply marvellous. In the museum at Kew, there is a specimen of perfectly sound teak, received from Salsette, in Bombay, said to be 2,000 years old. Teak wood rib lining of the arches in the caves of Karli is said to be co-eval with their construction about 2,000 years ago. This durability is supposed to be due to the aromatic oil contained in the wood, and almost all the authorities concur in this

view. At to the ravages of wood destroying animals, it bears a favourable comparison with most other woods. It is one of the few kinds that the white ants will generally leave unmolested. The essential oil with which it is impregnated probably checks their ravages, as they have been known to eat it when old and after prolonged exposure to air. Teak and greenheart are the only known woods used in shipbuilding that are said to be proof against the attack of the *Limnoria terebrans*, a marine insect, which resembles very much in appearance a very small woodlouse, and causes much damage to many timbers, which in course of time, assume the appearance of honeycomb. Sometimes, however, teak is attacked by marine worms—probably the *Teredo navalis*, the most common enemy of wood used in submarine work. Notwithstanding this, one of the greatest advantages of teak for shipbuilding is its unshrinkable nature. When once seasoned, it does not crack or alter its shape, and this quality is of the greatest value, considering the various conditions of exposure to which a ship is often subjected during her voyages from one part of the globe to another; perhaps, within a comparatively short period, enduring the heat of a tropical sun and the coldness of a northern region. Another very valuable property possessed by teak is its preservability, as metal fastenings are prevented from corroding by reason of its oily nature. There are but few other timbers known possessing this quality, though many otherwise useful woods contain acids which directly assist corrosion.

It has been long and often said that the supplies of teak are running short, and we have been told that the forests will soon be exhausted; yet the supply has been continued, owing to the discovery and working of previously unknown or neglected forests, and by the admirable administration of the India Forest Department, by which the valuable woods have been conserved and protected. It is a matter of great regret, considering the importance of teak timber to England as a maritime nation, that the preservation of the teak forests was so long disregarded. The whole of British India, south of the Himalayan mountains is unrivalled for its trees and other plants, and there can be no doubt when the anticipated timber famine takes place in Europe and America, the enormous supplies of splendid timber which can be obtained from the forests of India and Burmah will prove of immense financial value to the government of India, and of vast utility to the inhabitants of western countries. It is said that timber is like other articles of commerce, it requires to be well introduced to notice. But just as "good wine needs no bush," so do the woods of India require only to be known to rise at once in demand. In noticing new districts, special mention must be made of Siam, Java, and the islands of the Indian seas, in some of which the teak forests are comparatively little known. In Upper Siam, about the district known as Koman, on the left side of the Mekong, and extending to the borders of Tonking, lie a series of hills and valleys clothed with magnificent forests of teak and endless varieties of gum-yielding trees, which would, if properly worked, be a source of enormous wealth. Not only should the conservation, working and improvement of teak forests be considered, but the raising of artificial plantations be undertaken and there is much to be learnt in regard to the sowing and selection of the seed. This subject also has received the attention of the authorities, and the results so far have been satisfactory.

It has been found in some districts that the most suitable soil for the growth of tall straight teak trees is the alluvial, except when it is low lying and wet; in such it is said to produce a lighter, coarser-grained wood, containing an acid oil which affects iron very materially. The tree will also grow on a moderately stiff loam with free subsoil drainage; the teak takes up from the soil a quantity of silica, hence sandstone and granite will serve, for it is to this large secretion of silica must be attributed the strength and durability of the timber. In Burmah, the upper mixed forests, which are the principal seat of teak in that district, occupy exclusively the soft sandstone formations of the Pegu Roma, and also the older strata of the hills to the eastward. Forests occurring on the latter formation differ a good deal from those found on sandstone, not only in their general growth, but also by an admixture of trees, which do not occur on the sandstone; while on the Pegu Roma the trees attain an average height of about 120 feet. Those found on schistose substrata seldom exceed 80 or 90 feet, showing that soft sandstone produces lofty trees, and metamorphic rocks yield big trees. The position best suited for their growth is that on the southern and western slopes of the hills, where they are exposed to a strong sun, and they require an annual rainfall of about 30 inches. These several points should be considered in choosing sites for new plantations. Then as to the seed, this should be gathered and sown when it is ripe, as then, the juices, not having dried up, the germination will be more speedy, and further, the seed should be always taken from young and healthy trees. A few years after planting an income may be derived from thinning, which will pay the expenses of management. These thinnings are readily purchased, as they are admirably suited for fencing, scaffoldings, and many economic purposes, poles for carts, yokes, &c, &c., The preparing of the timber is interesting. At the opening of the season, the tree is sawn partly through above the roots, and left in that state for a time to absorb the sap, then it is felled to the ground and trimmed into shape. It may now be left for one or two seasons, or may be at once dragged by elephants to the banks of the rivers and floated down to the sea on the first rise of the waters. In Malabar, the timber merchants who purchase the trees have them felled and conveyed to the adjacent streams, down which they are taken to the markets on the Coast, where an inland duty of five per cent. is levied. From this depôt, the Bombay or foreign merchants export them, at an enormous profit, to the Coast dealer, who then pays an additional three per cent. or, in all a duty of eight per cent. per candy on its leaving the Coast. The working of the teak forests is, to a very large extent in the hands of British subjects; but this is not the case with the purchase of the timber. From statistics just to hand from private sources, it is known that British buyers represent about 42 per cent. of the business, natives 48 per cent., and Chinamen 10 per cent. The British purchasing trade is almost entirely in the hands of the Borneo Company Limited, and the Bombay-Burmah Trading Corporation, of which two firms the former is the longest-established, and has the largest interest.—*Produce World.*

LOGWOOD.

The decrease in the price of logwood has led to questions being raised as the reason for differences in the value of woods from Honduras and Jamaica, and in the value of woods growing close together on the same estate.

Two letters on this subject are given below, one from a merchant, the other from Dr. E. Bucher of the Dye Works, Spanish Town.

Dr. Bucher's suggestion that there has been degeneration owing to the mature trees having been cut down and the majority of the living trees being the offspring of young immature trees, may very probably be the true explanation. In the science of Forestry this is a point which is carefully attended to Prof. Schlich in his *Manual of Forestry* says "The source whence seeds has been obtained is of importance. Although trees of all ages can yield excellent seed, as a general rule it may be said that, the best seed is derived from trees which are in the prime of life, namely, healthy trees with a full crown, which have just completed their principal height-growth. At the same time, soil and climate, and especially the latter, are of greater importance than the age of the trees."

It is important therefore that on every logwood property a few mature trees should be retained for the purpose of obtaining seeds from them, that nursery beds should be formed for the purpose of growing seedlings from selected seed of mature trees, and that these seedlings be regularly planted out at proper distances apart.

Prof. Schlich points out that the trees from which seed is obtained should not only be mature, but should be vigorous from good soil and suitable climate.

As the soil and climate of Honduras appear to be productive of good wood, steps will be taken to obtain seed from thence for general distribution here.

There may be conditions in the life-history of the tree which favour the deposit of the dye-material which makes logwood so valuable, and it is advisable that those interested should be constantly on the watch to discover whether such conditions exist.

In most trees there is a decided difference between the sap-wood and the heart-wood, the sap-wood is that portion only of the wood which is actually living. The water absorbed by the roots, containing the mineral food from the soil, passes up through it alone, and starch and other reserve materials are deposited in its pith-rays and are not found in the heart-wood. In some trees, for instance in Box-wood and in some Maples, the whole of the wood is sap-wood, and there is no portion of the wood which is different in character. In some trees again, several kinds of Willows, etc., the heart-wood which is practically dead always, shows here a tendency to decomposition. But generally the heart-wood owing to changes in chemical and physical character becomes harder, of a darker colour, and more resistant to destruction; the incipient process of degradation has taken place, but owing to this part of the stem becoming a place of deposit of excretionary substances, it has become endued with a lasting character which directly benefits the plant in acting as a mechanical support.

It is a curious fact that injury to the stem of a tree often induces changes in the sap-wood, similar to those characterising the formation of heart-wood: for instance, in the East Indian Ebony the sap wood becomes black and hard like the heart-wood,—the injury excites and hastens a process which usually takes place slowly.

The so-called “Bastard Wood” may be a case where, for some reason or other, the wood has not yet commenced the process of transformation, and it may be possible by some means to set up a change which would convert a worthless into a valuable tree.

————— *Esq., to J. Allwood, Esq.*

Kingston, 14th July, 1896.

DEAR MR. ALLWOOD,

I feel obliged for your kind note of even date, and I gladly submit to you my opinion as to the cause of the rather unexpectedly heavy fall of the market value of logwood

The cause I think, is chiefly to be attributed to over production, not so much in Jamaica, but in other West India and Central American Logwood Countries.

Until very recently Jamaica used to be the only country exporting the roots of the Logwood Tree, as in the other countries the want of good roads and the rather difficult labour of digging prevented any material competition.

This monopoly appears to have been removed by Monte Christo (St. Domingo) where the supplies of Logwood got exhausted, and the attention had to be turned to the export of the roots. This export has gradually and considerably increased affecting the value of Jamaica Roots.

The Government of Hayti has recently reduced the export duty on Roots, and since that, the exports of Roots from Hayti are constantly increasing.

In Yucatan new districts have recently been opened at the west coast of that country with enormous wealth of Logwood of a very fine and rich quality.

Campeche has also exported much more than hitherto and these latter two countries supply a wood with such magnificent and rich dye, that none of the Jamaica wood can favourably compete with it.

This over production, together with a temporary smaller demand at home, has overstocked the markets, and as the expenses on Logwood (unlike Coffee or other produce) render it an immovable merchandise it always means a heavy loss, to be forced to land a cargo unsold as had to be done recently for want of any demand

The owner of the cargo as a rule, remains at the mercy of the 2 or 3 buyers, that may be at that particular port, where the cargo was landed.

Several exceptionally cheap sales were easily enforced in that way, which helped not only to bring down the market quotation, but to create an anxiety to sell at any price, before the lay days for waiting of the ships in the British Channel had expired and necessitated the landing of the cargo.

With the stocks that have now accumulated in Europe there seems to be little chance of any improvement of the market during this pre-

sent year, as the other logwood countries appear to go on exporting exceptionally heavily still.

The logwood growers in Jamaica forget however, that the prices during the last years were run up too high and a sudden reaction was not altogether unforeseen.

Even to-day (being 35/—below the highest point) we are still 10/ to 15/ higher than in the year 1886, and at that time every grower in Jamaica seemed to be satisfied with the prices then ruling.

During next year there may be an improvement in the value, but I doubt, that we shall see prices again as high as we had them in 1894, and at that time there was a fear that Aniline colours might interfere with the sale of logwood, but there is no such chance with the present prices of logwood.

I may be wrong in my above opinions, but nevertheless I gladly submit the same, at your request, and remain

Very sincerely, yours,

Dr. Emile Bucher, to J. Allwood, Esq.

Spanish Town, 16th July, 1896.

DEAR MR. ALLWOOD,

I have to acknowledge the receipt of your letter dated 14th inst., asking me to give my opinion as to the cause or causes for the present drop in price of logwood and as to the future prospects of the trade.

From facts ascertained by the latest statistics showing that Logwood as a dye is yet as much in demand as ever, and also from the fact that the better classes of Logwood continue to be bought at their former high prices, it is to be inferred that the main reason of the fall of Jamaica Logwood is to be sought in the bad quality of a portion of Jamaica Logwood lately exported. At the same time, those countries that produce a quality of Logwood superior to the Jamaica product appear to be able by increased exports to supply the immediate wants of the market. From information lately received, I understand that Haiti and San Domingo have begun exporting Logwood Roots, whilst Honduras and Mexico are said to make ever increasing shipments. Under these conditions, it is natural enough that consumers keep shy of the comparatively poor Jamaica Logwood.

If it is considered that one ton of Honduras or Mexican Logwood will do the same work as one and a half tons of Haiti Logwood and two tons of Jamaica Logwood, it is evident that for an increase in the export of each ton of Mexican Logwood the wants of the market will be lessened by a quantity equal to two tons of Jamaica Logwood. Taking the average exporting capacity of Jamaica at 90,000 tons per annum, it would be sufficient for Mexico and Honduras to exceed their exports by 45,000 tons annually to enable the market to do without Jamaica Logwood. If Haiti and San Domingo contribute to this end, as seems to be the case, the necessary result must be a depreciation of the Jamaica Logwood. In my opinion, such a depreciation will continue as long as our competitors are able to keep up the present rate of their shipments.

It is not unlikely that the supply of Roots from Haiti and San

Domingo will be practically exhausted in a few years time, as Roots will be gathered in these countries probably only in places easily accessible, *i.e.*, in the immediate vicinity of roads and of ports.

This assumption of mine is, however, by no means certain as it is possible that by a continuance of political peace and by internal developments, Haiti and San Domingo may continue to affect the Jamaica trade very considerably.

The safest remedy for Jamaica would, in my opinion, be to improve the quality of the wood and that without losing time.

The geological, agricultural and climatic conditions of Jamaica are favourable enough in comparison to those prevailing in the countries competing with us, and there is, in my opinion, no reason why we should not be able to produce quite as good logwood as they do.

In my travels through the principal Logwood producing countries, particularly Haiti, Honduras and Yucatan, I was able to ascertain that there are several varieties of Logwood as distinct from each other as one apple tree might be from another.

The Logwood cutters in Yucatan are well aware of this fact, and at least four distinct varieties are known to them in Yucatan and those are :—

1. Tinta Negra
2. Tinta Maria
3. Tinta Catzim
4. Tinta Amarilla Catzim

the first having most and the best dye, the last having least.

I had lately occasion to state at a public lecture given by Mr. T. H. Sharp at Spanish Town under the auspices of the Jamaica Agricultural Society that I knew of at least three distinct varieties of Logwood grown in the Parish of St. Catherine in this Island, and that I knew of one property that produced on the same soil all the three varieties, the best of which I called Red Logwood on account of its showing an uniformly red colour throughout when freshly split. It was as good as the best Honduras, and more than twice as good as the ordinary average Jamaica Logwood which shows a yellowish white colour when freshly split. The third kind of Logwood, commonly called "Bastard Wood," is, as a dye, quite worthless.

It is important to know that the Red Logwood which gave such good results, was not by any means of trees more mature than the other two kinds, and as I could on the other hand see no difference in the soil, I was inclined to think that by some accident, different varieties of Logwood were growing on the same soil.

It is said that Logwood was originally imported into Jamaica from Campeche. There are two ways of explaining the present inferiority of this dyewood :

Either the Logwood originally imported was of an inferior variety, or the Logwood has been allowed to go through a slow process of degeneration. Of the two alternatives, I prefer believing in the last. Indeed, just as animals would degenerate if the reproduction of the species were, through a succession of generations, confined solely to individuals before those individuals had reached maturity, thus plants placed in similar conditions must degenerate.

It is a regrettable fact that, for a number of years past, the bulk of

Jamaica wood exported was immature, and no provision was made to keep a sound, mature, parent stock from which sound seed could be gathered for future generations. If this theory is correct, there must still be places in Jamaica that, through their difficulty of access or their great distance from the sea, must have preserved Logwood of the original high quality, as in those places Logwood would not have been ruthlessly destroyed, as it was scarcely if ever, exported. That this is the case I have no doubt, as the analysis of certain Logwood at Endeavour, a property of the Hon. George McGrath at Moneague, showed. This Logwood had every appearance of Mexican Logwood, and was quite as good.

I admit that a favourable soil will accelerate the growth of Logwood, and will allow its growing to a fuller size; but I, personally, do not believe that a rich soil will necessarily develop rich dye, and until I am contradicted by the facts, I believe that the quality of the Logwood in Jamaica can be improved by the importation of sound seeds from the best procurable foreign Logwood. This step is the more advisable seeing that there is no indication that the importance of Logwood as a dye, in face of the developments of the science of Chemistry, is declining.

In the latest manual of dying by Edmund Knecht and Christopher Rawson, 1893, it is said, page 342: "Logwood is, perhaps, the most important of all dyestuffs."

The world's annual production of artificial dye stuffs from Coal Tar amounts to £6,000,000. The present consumption of Logwood alone amounts to £2,000,000 per annum. There is probably no other single dye reaching that figure.

From the following statistics compiled by Messrs. Benekendorff, Berger & Co., of 4, Cullum Street, London, it would appear that the consumption of Logwood is increasing. They state that the importations of Logwood to Europe were:

in 1892,	Tons	180,958
" 1893,	"	188,664
" 1894,	"	208,185
" 1895,	"	225,779

To this may be added for the United States 75,000 tons annually.

On the 1st June, 1896, the price at Havre was £5 per ton for Jamaican Roots, and £12 per ton for Mexican Laguna Prima.

I am yours sincerely,

EMILE BUCHER.

CANE VARIETIES.

Barbados Agricultural Gazette and Planters' Journal.

There is no subject which is now exercising the mind of the planter to a greater extent than that of the comparative value of cane varieties. During the past year many of them have been grown on a large scale, and while the results shewn by the majority still leave us in uncertainty, there can be no doubt that upon the whole we are already in possession of valuable conclusions. The Old Crop is now being brought to a close, and within the next few months land will be under preparation for the planting of a new one, and while in the next issue of this journal we hope to see some numerical results with regard to varieties, it is not inappropriate at this time to review the recent his-

tory of varieties in this island, and to point out the general conclusions above referred to.

Some six years ago, excepting one or two estates, the entire island, or all that was cultivable, was practically covered with the Bourbon cane, rich in juice and saccharine content, a cane that had yielded as much as four tons to the acre, not in virgin, but in long cultivated, fields. In 1890 the 'large crop' was reaped and in the same year from April onwards occurred a rather severe drought, followed in 1891 by a milder and shorter one. It was in the beginning of 1891 that the shot borer made its appearance in the Bourbon cane, throughout the West Indian Islands; not for the first time as several scientists can testify, but the fact was remarkable on account of the large quantity, and the damage done, and led to a careful study of the insect and its habits, with the result that it was concluded that the Shot Borer only attacked canes previously diseased from some other cause. Attention was accordingly directed to that other cause which was in 1892 and 1893 shewn to be the well known rind fungus (*Trichosphaeria sacchari*); while in the same years in the parish of St. John what is now known as the root form of the disease rapidly developed until it assumed alarming proportions and in the case of one or two estates practically annihilated the entire crop. The Shot Borer and rind fungus were first noticed in their epidemic and parasitical form in S. Philip, the "root fungus" in S. John; but from 1892, onwards the rind fungus has spread until there is no part of the island that has not suffered from it. The Root fungus has however until quite recently, for the most part, been confined to S. John and the neighbouring red soil districts.

The bearing of this upon the question of cane varieties is of course, well known, for in 1891 it was found that many varieties were not attacked by Shot Borer, and when the real evil was shewn to be fungus, then it was similarly found that these same varieties were not attacked by the fungus; consequently those planters who were amongst the earlier ones to suffer loss due to fungus, eagerly directed attention to varieties and seedling varieties as the means by which they were to combat the disease. So that whereas cane varieties up to 1890 were mostly confined to Dodds and regarded by Planters in this Island as more or less of a scientific curiosity, from 1891 onwards they began to enjoy a practical value.

It must not be supposed that varieties other than Bourbon were unknown outside Dodds, for some of the Dodds varieties were obtained in the island, as specimens of canes that had been long cultivated there; still for the most part they had been cultivated recently only by accident, which could be seen by a scattered Ribbon, or Transparent cane occurring here and there in Bourbon fields. The fact is that the Bourbon cane was the result of careful trial and careful selection in the earlier days of cane cultivation in Barbados, and it is no wonder therefore, after all the care and trouble and time expended in its selection that it should be so hard to beat, and after all the centuries of agricultural experience acquired by the cultivation and observation of this cane, that its habits and requirements should be very much better known than that of the varieties. We have little or no evidence of what varieties were rejected in those old days, and consequently we have to start over again to get experience with them. The varieties at Dodds

cultivated from 1887 onwards may be divided into, varieties long growing in the Island, imported varieties, and varieties reared from seed, or Seedling varieties. As many as one hundred or more different varieties have been reaped in plots, analysed and reported upon in one year, and as is well known, results have shown that they differ greatly in value, some being worthless, others giving high results. The results however, from various causes have differed from year to year, in recent year several varieties have given better results than Bourbon, but those varieties have not always been the same. Nevertheless there has been sufficient uniformity to shew under the conditions existing at Dodds and the treatment there adopted that there are certain varieties and seedling varieties which in crop, gallons of juice and in richness of juice give, in particular instances, very high results indeed, which give good results year after year exceeding that of the diseased Bourbon, and that with similar conditions and treatment these varieties may be safely adopted to take the place of Bourbon wherever the cane is diseased.

It is within the memory of every reader that with the spread of disease, a demand arose for varieties, and their cultivation spread gradually to all parts of the island, so that the crop of 1896 may be said to have in some respects been an experimental variety crop, and the crop of 1897 will be still more so, because every one feels—even the most ardent devotee of the Bourbon—that the time has come when the Bourbon must be—at all events temporarily—abandoned. Even though the yield from varieties were unequal to that of Bourbon, yet it would be better to reap a moderate quantity of sugar from a healthy variety, than none at all from diseased Bourbon. Notwithstanding the fact however, that the great majority of estates are now growing trial fields of different varieties, opinion is by no means unanimous as to the result, in fact there can be no doubt that practical results have differed even with the same varieties; and certain causes may be suggested to account for these differences.

In the first place, in the rush for varieties, the young plants have necessarily been obtained from every conceivable source, and we all know that in the case of—say the Bourbon variety or any other—obtained from different places where they have been cultivated under different conditions, do not give the same quality or quantity of growth. Consequently we have good and bad cases of every variety, and opinions of planters will vary according to their good or bad fortune in this respect.

There has been a great deal of necessary hap-hazard in the choice of plants, and this alone would account for great difference in results.

Planters recognised that they must try “varieties” and in the rush, so long as it was a “variety” that they got, it had to be enough. What is now required is a weeding out of varieties, until none but good ones are cultivated. Let planters carefully ascertain the results that different varieties give in their own district and in soils similar to their own, let them ascertain how they were treated, and let them obtain plants from the best varieties so ascertained from estates where they grow to the best advantage and in the healthiest manner.

Another cause for diversity of results lies in the fact that while some varieties give good results in the hilly districts and in red soils, they

will not necessarily do so in the lower lands or black soils and *vice versa* with regard to varieties that grow well in black soils. It will consequently be necessary for planters to carefully record the results of a variety in different places, and to select for their own plantations those which thrive best under the conditions of soil and climate there obtaining.

A third and important factor determining the yield of different varieties is the quality of soil they are grown in and the treatment they receive.

The Bourbon has been studied agriculturally for a very long period and the treatment most conducive to its welfare is well known. This, in Barbados, cannot be said to be the case with varieties, and we have doubtless much to learn as to the best time to plant, the best age to choose the plants, whether to plant tops or cane, which variety likes a low lying field, liable to swamp, and which a porous well drained soil; the time to manure; the best composition of manure and so on for each. Of course the knowledge acquired by study of Bourbon will form a basis from which to work on the variety, and there can be no doubt in the light of recent results that when we thoroughly know how to treat the best varieties, and where to grow each, that results equalling or exceeding those given by the Bourbon will be obtained.

Results obtained by successful and experienced planters have shewn, that where an appropriate variety has been grown on equal terms with the Bourbon, it has at all events given equal results. White Transparent and Caledonian Queen have yielded as much as 3 tons to the acre this year, and in one estate an average of $2\frac{1}{4}$ to $2\frac{1}{2}$ tons over the whole estate and that when last year Bourbon cane in consequence of disease gave only $\frac{3}{4}$ hogshead per acre. In no estate in the Island has the Bourbon cane this year done better than that, and after a drought like that of 1895, and with a reaping season like that of 1896, it is exceedingly improbable that the Bourbon would have yielded on the present crop area any greater average yield than that obtained this year.

It has been the custom the last two years to grow varieties in fields where Bourbon would not grow at all, to select for them the poorest field of the estate. "That is one of my thinnest fields, I am going to plant that in Caledonian Queen" a planter will tell you and so on. Of course the result has not been favourable to the variety.

We are told that the yield of some varieties is not up to its appearance, that the yield is disappointing. A planter will tell you "if I had a stand of Bourbon equal to that of my White Transparent or Burke, I should make three or four hogsheads to the acre" and is disappointed to get only two. This surely is not a strong contention: for as a rule, either Bourbon would not grow in those fields at all, or if they did they would be so small and diseased that the yield would be three quarters or one ton per acre as against 2 tons yielded by the variety: and moreover if a variety cane despite it being planted in a poor field, despite its suffering from months of drought and despite its being left almost unsupplied with artificial manure and sparingly with pen manure, still maintains a vigorous growth and green colour and yields a moderate return of sugar surely it is not to be condemned, for what in such circumstances would the Bourbon have looked like and have yielded?

In choosing variety canes, we should aim at one which will give on the average the highest tonnage of sugar of good quality, at the smallest cost of cultivation and manufacture. Therefore we want a cane which is vigorous in growth, resisting the fungoid diseases, and which with a moderate tonnage of canes per acre yields a high percentage of juice of high saccharine content. This will probably be got only after long and careful work in raising and improving seedling varieties, and it is to them that we must look for a cane with qualities approaching to these. Judging from recent results with seedlings both at Demerara and at Dodds, and arguing from what has been done by careful work in the improvement of other valuable agricultural plants, there is every reason to believe that much may be done for the sugar cane.

It is only in recent years, subsequent to the discovery of seedlings at Dodds, that the matter has been thoroughly taken up; seedlings are being raised for the West Indies at Dodds and at the Demerara Experimental Station and are being experimentally cultivated in several islands. Cane seedlings are also being raised and studied in various parts of the tropical world: and I believe it is in this direction that some of the best work of the future lies, by which we shall be able to combat disease, raise yield, and cheapen agricultural production.

With regard to resistance to fungoid attack, amongst old varieties, "Transparent Canes" such as Caledonian Queen, and White Transparent, the Striped Cane, the Queensland Creole and Rappoe have all shown a high resisting power. Several seedlings also shew the same high degree of immunity: and amongst these the best known and most widely cultivated is the Burke. The Burke however has not succeeded everywhere, in some places it is succumbing to root fungus and it is possible that this variety will ultimately prove a success in certain localities only. The Burke however has shewn how much even at this stage a seedling can accomplish, and there are other seedlings which, up to the present known only on a small scale, appear to be more hardy and point distinctly to the conclusion that in time seedlings will be obtained of high disease-resisting power.

With regard to sugar-producing qualities all the above named varieties have given good yields of sugar per acre at one place or another; but like the power of resistance to disease the results have differed on different estates. The Caledonian Queen and White Transparent on the whole appear to have done better than any others.

Amongst seedlings the Burke (of those that have been cultivated on a large scale) has done best, but has not done so well as far as I can judge in the hill districts. It is characterised by a vigorous growth, a high tonnage of canes, and high yield of juice, and it is to the number of gallons of juice per acre that it owes its yield of sugar which is high: one or two individual instances only as far as I know, have shown more than a moderate saccharine content, general experience uniting in the opinion that the juice is not a very rich one. The objection to a cane which owes its yield to a large tonnage of cane and a large number of gallons of juice of moderate strength, is the heavy soil exhaustion, the cost of cartage and labour and the large amount of evaporation in proportion to fuel supplied by the megass. The Queensland Creole, Caledonian Queen and White Transparent all yield rich juices where favourably cultivated. The former two however, inclined

to be of "dry" cane. The recent Dodds reports and the last Demerara report record seedling plots with remarkably high yields of sugar per acre due to a high saccharine richness as well as high tonnage. These seedling varieties shew high promise of solving the problem before us.

The most planters now can do is to aid in disseminating information as to the results of this and next year's reaping, and to make use of the broad conclusions already arrived at until our knowledge is more complete.

FERNS: SYNOPTICAL LIST—XXXIX.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent, Botanical Garden, Demerara.

46. *Nephrodium usitatum*, Jenm.—Rootstock stout, erect, often a span or more high, densely paleaceous with dark dull brown scales; stipites caespitose, numerous, erect, 9-15 in. l., channelled, dark and clothed below like the caudex; fronds erecto-spreading, $1\frac{1}{3}$ - $2\frac{1}{2}$ ft. l. 9-12 in. w., the apex pinnatifid and passing through mere lobes to the acuminate serrato-attenuated point; thinly chartaceous, pellucid, dark green and glossy above and naked, pale beneath and slightly ciliate on the ribs and somewhat grayish from copious scattered minute tuberculae; pinnae numerous, distinct, spreading nearly or quite horizontally, 4-7 in. l. $\frac{3}{8}$ ths-1 in. w., the lower 1-2 pair little or hardly reduced and sometimes narrowed at the base, upper ones truncate and sessile, widest rather at the base, or more often uniform in width the greater part of their length, passing into the finely acuminate serrato-entire point; cut a third or rather more to the costae into shallow broadly rounded lobes 2-3 li. w.; margins scariose, crenulate-entire; veins pellucid, simple, 4-8 to a side, the lowest pair uniting and sending a branch to the sinus where the next pair meet; sori medial or nearer the midrib; involucre minute and early obliterated. Sl. Cat. p. 20. Hist. p. 90. t. 48. fig. 2. Herb.

Common in the damp woods among the lower hills, gathered in St. Andrew, St. Mary and Clarendon parishes. The pinnae of barren fronds are twice as wide as those of fertile, and closer together. The sori are often confined to the outer part of the pinnae, and to the lobes, as in the preceding species, to which it has nearest affinity, but from which the different scales of the caudex and stipes, narrow pinnae, shallower lobes, obscure involucre and other characters, abundantly mark it. The involucre is only observable in a young state of the sori. In the narrow pinnated fronds the lobes are twice as wide as deep; in the wider they are about equal each way. The texture is often membranous. Generally found near streams.

47. *N. venustum*, J. Sm.—Rootstock stout erect, often several inches high, the crown densely clothed with large chestnut ovate-acuminate scales; stipites erect, $1\frac{1}{4}$ -2 ft. l., clothed at the base like the rootstock, not or slightly channelled, brown; fronds 2-3 ft. l. $1\frac{1}{3}$ rd ft. w., the apex pinnatifid; chartaceous, pellucid; naked or slightly ciliate on the ribs and edges, dark-green above and glossy, paler beneath; brown, puberulous, as are the paler costae: pinnae numerous, spreading or erect-spreading, 5-9 in. l. $1\frac{1}{2}$ in. w., the lowest as large, or 1-3 pairs reduced, and stipitate or not, distant or subdistant, broadest at

the base and thence narrowed outwards or uniform along the inner half or two-thirds, the acuminate point subentire; cut down halfway or rather more to the costæ into close flat broad lobes 3-6 li. d. and $2\frac{1}{2}$ -3 li b., 1-2 basal lobes reduced or not in the lower pinnæ; margins entire or subcrenulate; veins simple, 8-12 to a side, lowest pair uniting below, with an excurrent branch, or at the sinus to which the next pair are contiguous; sori medial, or nearer the edge, the latter in the broader pinnæ; involucre as large, dark or cinnamon brown, naked. *N. Fendleri*, Hook., *Aspidium*, Heward in *Mag. Nat. His.* Sept. 1808, p. 464.

Common in the forests of the central Parishes at 2,000 ft. altitude, gathered near Mt. Olivet, Manchester and on Mt. Diablo, St. Ann, variable in the breadth of the pinnæ and position of the sori. The fronds present two states.—A broad and a narrow pinnæd; in the former the pinnæ are 1 in. w. and in the latter $1\frac{1}{2}$. Scattered on the underside, sparsely or more plentifully, are minute microscopic pale blistered points. In the large state the fructification is confined to the lobes, while in the smaller in which it is generally medial it descends to the lower veins at or below the sinus. *N. Fendleri*, Hook. was based on Nicaraguan specimens.

48. *N. unitum*, R. Br.—Rootstock wide-creeping, in water, as thick as a quill, cylindric, dark-coloured, eventually naked; stipites erect, distant, 1-3 ft. l., naked, dark-brown, channelled; fronds oblong-lanceolate, $1\frac{1}{2}$ -3 ft. l., 5-10 in. w., not narrowed at the base; dark-green, naked or ciliate, with a few small brown scales beneath, coriaceous and stiff pinnæ erecto-spreading or horizontal, numerous, 1-2 or more in, apart below, 4-6 in., l. 4-5 li. w., rounded at the base, and the lower ones substipitate and a little narrowed there, acuminate or bluntish and crenate-entire at the apex, below this cut $\frac{1}{2}$ or $\frac{1}{3}$ rd to the costæ into confluent broad deltoid or rounded lobes; rachis stiff dark-brown, puberulous or naked; veins fine and close, pellucid, deeply curved, 6-9 to a side, the lowest pair sending a branch to the sinus where the next pair meet; sori copious, medial; involucres naked, at length dark-brown. *Polypodium*, L.

Plentiful in Salt Pond, near Guava ridge, St. Andrew, between 3,000 4,000 ft., alt., often common in unused trenches, wet savannahs and the sides of open sun exposed rivers. This is a purely aquatic species with slender wide diffused branched rhizomes, which spread widely but densely through the other herbage of shallow weed covered water. It is well marked by these characters, its coriaceous texture, generally dark colour (*N. gongyloides*, Schk., is a pale thinner form found on the continent) and narrow pinnæ with broad shallow deltoid or round scallop-like lobes. The upper pinnæ are merely serrulate and the apex of the frond is either pinnatifid or terminates in a distinct lobed pinnæ. The under surface is often slightly pubescent.

49. *N. serrulatum*, Jenm.—Rootstock more or less stout, erect, a few inches to often a foot or more high; stipites tufted, numerous, erect, a span to $1\frac{1}{2}$ ft. l., grayish-puberulous, scaly only at the base; fronds 1- $2\frac{1}{2}$ ft. l. $\frac{1}{2}$ -1 ft. w., usually somewhat narrowed (sometimes much) at the base, chartaceous, pellucid, glabrous, or the costæ slightly puberulous or ciliate beneath, varying from light to dark green; pinnæ spreading, sub-distant or distant, contiguous above, numerous in

the larger fronds, oblong or linear-lanceolate, acuminate, the base truncate or somewhat rounded and sessile, 4-7 in. l., $\frac{1}{2}$ -1 in. b., subentire or with broad appressed lobules or cut to $\frac{1}{4}$ th or less to the axis into rounded, even or crenate close, lobes, which are $2\frac{1}{2}$ -3 li. w., rachis strong, channelled, grayish-puberulous; veins 3-6 to a side, the opposite inferior pair uniting at a broad angle and sending a long branch to the sinus, at or below which, usually, 1-2 others join; sori nearer to the mid vein on the inferior, other, or all the veins; involucre small and soon obliterated — *Polypodium serrulatum*, Sw.

Polypodium Lunanianum, Heward in Mag. Nat. Hist. Sept., 1838, p. 460. *Aspidium*, Mett.

a. var. *paucipinnatum*.—Fronds relatively small and pinnæ relatively few, the margins subentire with appressed shallow lobes, colour light, sori usually sparse.

b. var. *angustum*.—Fronds medium sized or large; pinnæ narrow, subentire or with shallow appressed lobes; puberulous, dark-green; sori usually occupying all the veins from costæ to margin.

Abundant on limestone rocks wherever they crop to the surface all through the island. There is much variation in the size of the fronds, number of pinnæ (from $\frac{1}{2}$ - $2\frac{1}{2}$ dozen) their degree of, or absence of any, cutting, the colour (which passes from pale to dark-green), and the paucity or abundance of the sori, the latter varying from a single row along each side of the costæ to as many rows as there are veins to bear it. There is no doubt of the presence of the involucre, but it is small and displaced or concealed very early by the ripening sori. There is no absolute and definite line between the forms described. The largest and most lobate state resembles a good deal *Polypodium flavopunctatum*, to which it has often been assigned, but from which the venation and other characters at sight distinguish it. This and its forms are the western analogues of N., *amboinense* Presl. and N., *arbuscula*, Desv.

CONTRIBUTIONS TO THE DEPARTMENT.

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 Coffee, its History, Classification and Description by J. M. Walsh. [Author]
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 Fertilization of the soil as affecting the Orange in health and disease by H. J. Webber. [Author.]
 The two Freezes of 1894-95 in Florida and what they teach, by H. J. Webber [Author]
 The Pineapple Industry in the United States by H. J. Webber. [Author.]

PLANTS.

- From T. Astwood Smith, Esq.—
 Begonia rubra, var.
 From W. G. Thompson, Esq.—
 Grape Fruit buds
 From Dr. Ogilvie—
 Shaddock buds
 From J. C. Farquharson, Esq.—
 Shaddock buds
 From B. S. Gosset, Esq.—
 Grape Fruit buds
 From Hon. Lt. Col. Ward.—
 Navel Orange buds
 Citron buds

SEEDS.

- From Baron Sir. F. von Mueller, Melbourne
 Atriplex leptocarpum
 " halimoides
 Kennedya monophylla
 Acacia microbotrys
 " pycnantha
 Trivella robusta
 Eucalyptus calophylla
 " paniculata
 " Muelleriana
 " corymbosa
 " miniata
 " resinifera
 " tereticornis
 " hæmastoma
 From Public Gardens, Nagpur, India
 Hardwickia binata
 From Botanic Gardens, Trinidad
 Saraca indica
 Martinezia caryotæfolia
 From Hon. T. Capper
 Stephanotis floribunda
 From Hon. J. T. Palache
 Dutch Runner Beans
 From Dr. Plaxton
 Lignum Vitæ (second lot).

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of September :—

IN FLOWER.

Acacia cyanophylla, Lindl.
Allamanda nerifolia, Hook.
Ardisia tinifolia, Sw.
Artocarpus Lakoocha, Roxb.
Cassia baccilaris, Linn.
 C. glauca, Lam.
 C. siamea, Lam.
Colvillea racemosa, Boij.
Dillenia indica, Linn.
Eriobotrya japonica, Lindl.
Erythrina umbrosa, H. B. & K.
Mesua ferrea, Linn.
Mimusops Elengi, Linn.
Musa coccinea, Andr.
Myroxylon toluiferum, H. B. & K.
Napoleona imperialis Beauv.
Norantea guianensis, Aubl.
Pachira aquatica, Aubl.
Phyllanthus nivosus, Bull.
Pterocarpus Draco, Linn.
Quassia amara, Linn.
Ravenala madagascariensis, J. F.
 Gmel.
Sanchezia nobilis, Hook. f.
Stevensonia grandifolia, F. Dunc.

IN FRUIT.

Averrhoa Carambola, Linn.
Cananga odorata, Hook. f. & Thoms.
Couroupita guianensis, Aubl.
Dillenia indica, Linn.
Diospyros discolor, Willd.
Erythroxyton Coca, Lam.
Garcinia Mangostana, Linn.
Manihot Glaziovii, Muell. Arg.
Michelia Champaca, Linn.
Noronhia emarginata, Thou.
Omphalea triandra, Linn.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

C O N T E N T S :

Orange Cultivation in Sicily	—	PAGE 193
Report on Sugar Canes	—	206
Pharmacological Notes on Kola	—	208
Ferns : Synoptical List.—XL	—	211
Contributions to the Department	—	213
Castleton Gardens	—	216

P R I C E—Threepence.

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ORANGE CULTIVATION IN SICILY.

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(Extract from the "Foreign Office Report for the year 1895, on the Consular District of Palermo.")

REPORT ON THE CULTIVATION OF ORANGES, LEMONS, CITRONS, AND BERGAMOTS, AS PRACTISED IN SICILY AND THE "CALABRIE," WITH A BRIEF ACCOUNT OF THEIR CHIEF PRODUCTS.

Cultivation.

The culture of all plants belonging to the citrus group undergoes three distinct phases with reference to the different periods of the life of the plants, and corresponding to these three very well marked, though very unequal periods of existence.

The first phase comprises all those agricultural operations which are needful to bring into existence the future tree, and to protect its existence during the first year of its life—at least, that is from the sowing of the seed up to the transfer of the seedling to the nursery. The second commences with the transfer of the seedling to the nursery, and refers to the early growth of the young plant up to its fifth or sixth year, extending sometimes longer, during which the operation of grafting is always performed. The second epoch closes with the second and final removal of the young tree to its permanent abode. The third period of cultivation embraces all the remaining life of the adult tree.

Seed Plot.

The soil for the reception of the seed should be of a rich loamy nature, a character in the soil which is indeed needed by the plant throughout all the subsequent stages of its existence, and which, if not spontaneous, must be imparted through copious dressings. The ground must, moreover, in all cases be preliminarily cleared of weeds and stones ere it be dressed, and be ready for the planting of the seed.

The ground having thus been duly prepared, is parcelled out into quadrilateral spaces, bounded severally by raised borders, and provided with small lateral channels serving to convey and distribute the water for irrigation over all the surface of the seedplot.

Although in some instances the Sicilian gardeners have preferred to stock their nurseries with young slips, or with layers, the general inferiority of these two methods to the now prevailing system of raising trees from seeds is so universally acknowledged that they are only adopted at present by those *laudatores temporis acti*, who through prejudice, or in the hopes of earlier returns, sacrifice the permanent and sure advantages of raising from seed. The long and vigorous lease of life enjoyed by plants generated from seed, their consequent relative exemption from those numerous ailments and diseases which have of late years afflicted the orange and lemon trees of Sicily and of the Calabrias, are so many circumstances which explain the persistently abundant and valuable crops yielded by the offspring of seed, as contrasted with those produced by trees derived from slips, and this constant superiority in yield of the seed-grown trees over the slip-grown ones far outweighs the precarious advantages of a rapid but often rank growth of a precocious but usually sickly crop, ending always in a premature decay.

The best seed is considered to be that derived from the "citrus bigaradia," or bitter orange, whose exceptional vigour will always afford the fairest hopes of a fine and healthy progeny. Even a 4-year sapling will endure repeated graftings and other operations, which it would be most dangerous to attempt on plants born of other seed, or derived from slips. The bud or scion engrafted on the citrus bigaradia imparts, I am told, all the flavour inherent to the particular variety whence the graft is taken to the stock without impairing its native vigour.

The most favourable season for putting the seed into the ground is spring, particularly the two months of March and April. The seeds are often previously soaked in water ere they be consigned to the soil, which process, in the opinion of many cultivators, produces a turgidity favourable to the greater development of the plumules. The seeds are sown broadcast, and then covered over to the depth of about 1 inch. The earth in immediate contact with the seeds, whether underlaying or overlaying them, should be finely divided and then mixed with pulverised manure; moreover should the soil be of clayey nature, it will be necessary to import some loose, friable earth to lay between the tenacious, impermeable clay, and the seeds which might otherwise suffer from the excessive moisture stored up in the marl or clay, and generally retained by all argillaceous earths. As soon as the seed-plot is sown, it is plentifully and frequently watered during the whole summer—that is for Sicily—often up to the middle of October, when the weekly irrigations are only interrupted by the advent of the first autumnal rains.

Nurseries.

The spot selected for a nursery should lie when practicable, in a sunny situation, a condition hardly less important to the prosperity of the tender plants than are the good quality and richness of the soil. The ground is prepared for the reception of the seedlings by a first

delving in the month of November, followed by a second a month later, crosswise to the former; subsequently, and as soon as the rains have sufficiently softened the soil, the surface is laid out into separate beds or divisions, isolated from each other by small enclosing mounds. Where the ground is uneven, the channel through which the water is conducted for distribution must need follow the highest level, in which case, however, the sub-divisions cannot be either equal or regular, being subordinate to the course traced by the conduit.

Another very necessary precaution is the avoidance of over-crowding the young seedlings, an object attained by dibbling the ground at certain definite and uniform distances, such as experience has taught us to be necessary to the free development of the young plants. The space allowed between each is from 30 to 35 centims., [12 to 14 inches,] these figures, like most others given here, being founded on general data, are of course only approximately correct, serving to guide the grower, with reference to the average number of seedlings which it will be proper to transplant on a given area, and in fairly good soil.

The fittest season for the removal of the seedlings to the nursery appears to be that period of cold weather following Christmas, and lasting all through February, during which the stagnation of the sap will allow of the removal of the young plant to its new abode, without any material injury accruing from those slight mutilations to the radicles or stem from the spade or hoe, which are inevitable in all removals of plants. In all cases, however, the greatest care should be taken to minimise, as far as possible, the extent of these hurts to the underground fibres, and above all to that vital chord of the plant, the taproot, which ought never to be touched, unless under very special circumstances, when the talta is over long, or attenuated, when the former show a decided tendency to spread in one direction, or when, from the correspondence observed between the underground and overground vegetation, this one-sided tendency of the roots, by producing a similar inclination in the branches, would endanger the stability of the tree. As, however, great judgment and greater experience are needed in order to distinguish when and how to operate in such cases, no inexperienced grower should venture to deal with doubtful ones, relying on his unassisted judgment without consulting an old hand. No theoretical teaching can supply, under the circumstances, those lessons of practical gardening which are only learned, slowly but certainly, by a personal attendance and supervision. The young plants must be copiously watered every week during the long summer droughts, which last in Sicily from May to October inclusively.

Grafting.

The important operation of grafting is one without which no scientific cultivation can be carried on, without which the choicest fruit would be absent from foreign markets, and very rare at home. This indispensable agent of prosperity enables the Sicilian to reap the full advantages offered by soil and climate, and thus to compete successfully in distant lands with the home produce of the same, or with that of neighbouring regions, and even in some cases to oust these. This valuable process has been both theoretically and practically studied by the Italians, who have acquired a proficiency in this respect no where excelled. There are several points which must be attended to in order to achieve success,

both with reference to the patient as well as to the agent. In the former we must study the age, season, strength and mode of operating; in the second we must consider besides the species and robustness of the individual.

The plant is usually able to support a graft after the completion of its fourth year, and the probabilities of success are further increased by the selection of the citrus bigaradia, whose seed produces at once the most vigorous and earliest fruiting plant in this respect—indeed it precedes its congeners by over three years, commencing to yield on the completion of its eighth year. It is therefore a favourite subject for grafting. Independently, however, of the undeniable benefits derived from the association of the good qualities of this wild, vigorous variety, and of the ordinary sweet specimen through the process of grafting, the question mooted by several cultivators in Sicily as to the propriety of according an exclusive preference to the one over the other should be answered negatively, the pros and cons with regard to such a preference in favour of the one species to the exclusion of the other being pretty equally balanced. For if the citrus bigaradia gives earlier crops, the second yields more luscious and finer fruit. But if opinions differ as to the absolute superiority of the one over the other, there can be but one opinion with respect to the advantages of engrafting the wild variety a scion of the sweet domestic species.

In our selection of a fitting individual, we should rely on the long-tried experience of a veteran gardener, who will be able to discern at a glance those plants which, from their appearance, will furnish the best specimens of scions, and certain well known kinds, such as the Calabrian orange, commonly called “a bicchiere,” on account of its oval shape; or where lemon slips are required, the lumaria are highly prized.

Where bergamots are concerned, I have been assured that they can be budded freely and successfully on the orange stock, provided the patient is derived from seed, which seems, indeed, to be a condition precedent of vigour among trees of the citrus family. These remarks apply with equal force to the flaccid and short-lived citron trees, whose brief span of existence is somewhat extended in those cases in which they derive their origin from strong individuals of the orange variety, budded with scions of the citron.

With regard to the system of grafting, that mostly in use among Sicilians and Calabrians is the scutcheon method of grafting, and the month selected for the purpose is April, although when a first graft has either not been undertaken in time or has failed, it is customary to test the efficacy of grafting by approach, or “a occhio dormente”; the first may be attempted immediately during the great heats of summer, and seems to be the safer of the two, while the second can only be practised in autumn, and its result known in the following spring. It is merely a repetition of the spring scutcheon-graft, the bud of which can only germinate at the close of winter, whence it is so termed, in contradistinction to the spring graft, which is also “a occhio,” but “germinante.”

The trees are considered to have attained a sufficient development when they present a stem of about 3 inches in girth. The ground, if at all dry, must be well watered 2 days at least before that fixed for the operation, a measure considered conducive to the freer flow of the sap, and hence to the easier separation of the cortical substance from the sap-

wood required for the insertion of the scutcheon. Should, however a heavy rainfall coincide with the date prefixed for the operation it will be advisable to defer it until the superabundant moisture be absorbed by the soil, or has evaporated, the existence of which during the period of the first adhesion of the scutcheon might induce an overflow of humour, which would imperil the success of the operation, and even the health of the plant itself; in short, a moderate moisture is as conducive to success as a want or excess of it is injurious. The scutcheon should be taken from a young and pliant limb so that the scutcheon be easily adapted to the convexity of the stem on which it is to be applied.

Respecting the nature of the ligatures to be adopted, those fibrous substances are to be preferred which are least subject to hygrometric influences. These are apt, when they affect the ligature, to cause either undue pressure or relaxation. The success or failure of the graft becomes evident on the eighth day, in the former case through the greenness and fulness of the bud, which, together with the full of the pedicle, are evidences of success; while the contrary signs are similarly a proof of failure.

A few words, however, may not be amiss on the *modus operandi* of grafting by "approach." The plants must be, of course, in juxtaposition, so close that one or both are usually planted in pots for the purpose, the subject whence the graft is to be derived must offer all those requisities for success which are required by the scutcheon-graft. A wedge-like or pyramidal incision is practised on that limb of the patient which is to be operated on, and a corresponding pyramidal projection is cut out of the bough of the operating plant which will dovetail, as it were, into the first incision; the two limbs are then firmly tied together and luted and left for about 3 months when the scion or graft will have become united to the stem or bough of the patient, and may be severed safely from its parent. The long period which is needed ere the graft can be considered to have taken, together with the necessity of bringing the plants into close proximity are insuperable obstacles to the generalisation of this particular method, although it may be resorted to in special cases with undoubtedly good results.

Plantation.

Some skill and care are requisite in the selection of a suitable situation and proper soil, on which the young trees extracted from the nursery are to take up their definite abode. In our choice we should be guided not only by general rules but also by those local features of the ground which may render an otherwise less suitable site preferable; moreover we must not omit from our consideration the space of ground required for the unhampered development of each individual plant consistent with that economy of room which no small grower can afford to overlook, and no wealthy landowner willingly neglects in a country where well-irrigated sites are naturally much restricted.

With regard to the quality of the soil, and the lie of the land, the conditions required by the seedlings are more or less suitable to the adult individual, that is, the former should be rich by nature or art, and the second as far as possible have a bearing due north and south, in all cases the site fixed on should have a southern aspect.

In the hot months of July and August the "formelle" or holes for planting are dug, cleared out, and weeded after the first rains of autumn.

The saplings are conveyed from the nursery to the plantation usually during the months of December and January, the most suitable time between these limits will depend almost exclusively on relative medium temperature of the site, and must be regulated accordingly. Thus on heights between 820 and 1,640 feet the removal of the sapling from the nursery should never be deferred beyond the first decade of December, whereas on low-lying plantations the removal may be safely undertaken even as late as the end of January. As these dates refer exclusively to the warm and sunny clime of Sicily they are quoted as embodying certain principles accepted by experience as regulating the proper season for the installation of the young trees when conveyed from their nurseries to their definite abode; the dates, however, as stated would only be approximately exact under similar climatic conditions. It will be seen from these few remarks that excess of heat as well as extremes of cold must be avoided, the first by over-stimulating and accelerating the circulation of the sap even to those slight inevitable injuries cause by the hoe or spade in the removal, and, moreover, renders the plant, I should think, more susceptible to external influences, and requiring instant and copious nutrition which can only be supplied through the roots after the tree has fully taken; on the other hand extreme cold, when it penetrates and pervades the subsoil, may paralyse the underground ramifications ere they have taken root.

In addition to these casual precautions employed in behalf of the young trees on their removal to the plantation, the Sicilian gardeners are in the habit of submitting their trees to an ordeal of darkness before committing them to the soil. This ordeal consists in first placing the young trees within a darkened enclosure to which they are conveyed in roughly-made wicker baskets filled with loam, while they are always kept moist during a period of about 15 days, after which they are exposed to a half-light for a further space of 5 days, whence they are conveyed to some well-shaded spot where they are left for a month before they are considered ready and fit to be planted, should any tree show any symptom of sickliness it must be re-conveyed to the dark recess and kept there during a further period of 8 days or more. It is said that trees which have been subjected to this long preliminary probation rarely, if ever, fail to take speedy root and to thrive.

The cavities dug for the reception of the saplings in Sicily average about 40 inches in depth, and are dipped at distances averaging between $4\frac{1}{2}$ to 5 yards, the former being the medium distance between each plant on an incline, and the second on a level, many cultivators, however, prefer to adopt the perhaps more practical system based on actual measurement instead of assuming as correct a mean distance, which may prove defective on trial. This is performed by a very simple method as described by an excellent authority on the question.

There being a certain correlation between the underground and aerial ramifications, 'twixt the spread of the roots under the soil and the expansion of the branches above ground, the actual circle required for each adult individual can then be ascertained easily enough by dropping a plumb-line from the extremity of the long horizontal limb of some well grown and full grown tree, measuring the distance thus intercepted between the end of the plumb-line and the foot of the trunk of the tree,

which being doubled gives the diameter of the circular space whose circumference will mark the limits needed by each tree, moreover, this operation repeated on several individuals of average growth will give a mean area of the several measured spaces, and hence the average room required by each plant under the same or similar conditions. The next object of the grower or proprietor is to encompass that economy of space which is compatible with the unimpeded development of the tree. These two objects are more or less conciliated and obtained by the adoption of the lozenge or rhomboid system instead of the square.

The lie or direction of the base-line, whence the planting-holes are marked off with pegs, ought to be, as far as possible, north and south, that is in the direction of the meridian of the place, which is easily ascertained by Sicilian proprietors by the simple and primitive but sufficiently accurate method of planting a stake in the ground upright, and laying out the base-line in the direction of the shadow projected at noon by the upright stake. The object of this arrangement is, as I have already stated, to ensure an equable distribution of sunshine for all the trees of the orange or lemon grove, and hence the timely and synchronous maturation of the fruit. In exposed situations the sapling requires propping during the first year, and are then, or should, be cultivated "a basso fusto," that is, their upward growth is restricted by judicious pollarding, which compels the trees to develop laterally, in an inverse ratio to the height; this forced deviation of the tree from its natural tendency, should only be permitted on those occasions when the proprietor having only the choice between two evils, naturally prefers the lesser of the two, viz., when he has to choose between the perchance total loss of the crops of a plantation situated on a bleak exposed spot, or its partial preservation by reducing the height of the tree, and proportionately increasing its expansion in width. The stability of the trees is moreover secured with barriers of thickly-planted canes or quickest hedges. Apart, however, from the dangerous effects of violent winds on trees in exceptionally exposed situations, effects which only in these rare cases can neutralise the benefits accruing from the free development of the plant, these are so well known and of such importance, that growers should prefer always in doubtful cases to let their trees attain their proper height, which alone can procure them that continuous sunshine and relative exemption from disease, which attacks far more readily the lower limbs than it does the upper.

After the plantation has been laid out, the soil dug and sufficiently dressed, and well irrigated, the chief labours cease until the ensuing spring, when, during the months of March and April, according to the more or less dryness of the season, the ground is broken afresh, and disposed in furrows for the reception of the water of the coming summer irrigations. The nascent plantation may be, however, augmented during the winter months, either by the addition of new saplings, or even through the adjunction of the stumps of full grown old trees, which have either been torn up and carried away by floods, or finally uprooted purposely on account of some premature and progressive decay. These stumps are first of all deprived of their branches, after which they are besides well pared and buried to the depth of from six to eight feet; on the advent of spring the interred stumps give forth

fresh shoots which reach the surface, when they are also shod with fine mould, and the process is renewed so long as the upward growth of these new shoots require it, which is until the old branch system has been, so to speak, reconstituted. In some cases, of course when the uprooted tree has been very seriously injured, or is succumbing to senile decay, it will be, of course, a fruitless task to attempt to regenerate it by this method, which can, however, always be advantageously applied to those cases in which the tree has either suffered through neglect, or through a violent separation from the soil. Should any of the young trees perish their places should be filled by plants of the hardier type, which will best resist the adverse condition to which they are subjected when planted amidst half-adult individuals whose overhanging boughs prevent the sun's rays from reaching the new arrivals.

Association of Fruit and Vegetables or Cereals, with the Young Standels of a New Plantation.

The custom of sowing various kinds of pulse cereals and vegetables, generally of inter-planting slips of other trees or vine shoots among the saplings of the nascent plantation, is very widely spread, and within proper limits will contribute to utilise those vacant spaces, which are at first left unoccupied by the young trees, and thus render productive at an earlier date the ground which would otherwise only render after the lapse of several years.

As to the most suitable plant to cultivate, no cut and dried rules can be laid down, every one must use his own judgment, his own experience, or lacking this, the experience of other landowners, on the advisability of giving the preference to any particular plant. It may, however, be admitted that under ordinary conditions of soil and situation, the cotton plant and vine will always give good results, and are wont to be highly valued by most cultivators from the rich, constant, and in the case of cotton, early yield they afford, on the other hand it will be easily understood how in the neighbourhood of large populous centres, orange-growers are often tempted to sow vegetable seed, or how again in situations of close proximity to seaports and cities, medlar and mandarins are often raised, both on account of the large markets these circumstances are wont to offer, and of the rapid growth and fruition of these trees.

Subsequent Labours.

As soon as the development of the trees renders the contemporaneous produce of other plants unadvisable, a certain regular round of labours is initiated which continues with little intermission or change during all the remaining life of the plant. The course of regular labours opens with the late spring and early summer, periodical irrigations which are assiduously carried on until the autumn rains render them unnecessary. The soil is then hoed or even ploughed, with the object of burying all those noxious weeds which shoot up so speedily and so abundantly after these same first rains, and secondly, in order to lay bare the base of the holes. Later on, towards the end of the cold wet season, and when the soil is of a clayey nature, which is wont to retain the superabundant moisture, it is usual to open trenches to draw off the

water which might otherwise stagnate round the roots, these are about one yard in depth, and are opened at distances varying between 25 and 30 yards from each other. Finally in April the ground is once more broken and laid out for irrigation.

In addition to these ordinary and regular labours, in some districts of Sicily, and especially of the two Calabrias, an extra agricultural operation is often practised by the richer landowners or landholders, who alone are able to afford the outlay which this involves, and which is unquestionably beneficial to those plantations on which trees are reared "a secco," in which case, however, the proprietor is able to set off the economy derived from the non-irrigation of the ground against the cost of some extra digging.

With regard to the all important question of irrigation, although theories are, as usual, at variance, practice is pretty uniform. The rules followed by Palermitan, Reggian and Messinese gardeners and growers are very similar, the intervals of irrigation allowed by all are approximately the same; thus, the interval between each irrigation during the first year is 7 days, during the next two years about 12 days, from the completion of the third year of the plant's life to the seventh, about 15 days, and finally the intervals after this period are of three weeks, and they may be accepted as indicating fairly the relative amount of moisture required by the tree at different stages in its growth, and the average absolute quantity of liquid needed by trees under similar conditions, in order to minimise as much as possible the amount of water needful to the prosperity of the plant in those barren districts, and through those long droughts which sometimes afflict Scilian and Calabrian plantations. The following ingenious method is resorted to by those cultivators who are often compelled to convey the water in carts from distant springs to the site to be irrigated:—a pipe of clay of a little over 1 yard in length and 4 inches in diameter, is sunk close to the stem or trunk of the tree, the water is then poured through this conduit, impregnating the subsoil surrounding the roots, undiminished by evaporation.

Trimming and pruning of orange, lemon, and citron trees.

These two arboricultural operations although quite distinct, both in nature and in application, are frequently confounded in Sicily, although their indiscriminate use is often productive of harm to the trees, besides always involving additional labour.

Thus in those cases in which a timely recourse to the clipping scissors or pruning knife would be sufficient to obviate the need of the hatchet or to limit its employ, a neglect of the landowner will compel him later on to apply the pruning instrument, to the greivous detriment of his purse, and as pruning is practised in Sicily to the equally grave detriment of the tree, whose limbs are mercilessly lopped until the bulging mutilated trunk shows clearly that the normal development of the tree having been frustrated, the sap is forced to flow laterally.

The rules suggested by a very well informed writer on the subject, are briefly to trim the trees every winter towards its latter end, and to follow by pruning, when the well-grown plant is either seriously affected with one or other of the numerous ailments to which trees of the citrus

tribe are so subject, or when from special causes it becomes expedient to lower the height of the tree or otherwise to strengthen it radically. The first and less drastic operation of trimming "Rimondamento" is merely the elimination of the dry twigs, suckers, stunted or rank vegetation, which have shot up or sprouted during the preceding spring, summer, or autumn. The Sicilians, however, as I have said, appear to be insensible to the advantages of preserving the leafy covering of the plant in a climate in which shade is such a desideratum during three-fourths of the year, and mutilate all their ornamental trees such as acacias, whose scant foliage and unsightly bulging boles are so many evidences of the injudicious and unsparing use of the hatchet in which the Sicilian delights. In the case of fruit trees we have in addition to the disfigurement, to deplore a decline in the amount of fruit.

When, therefore, the pruning knife or hatchet are resorted to, they should only be on emergencies warranting their employ. Such occasions present themselves most frequently in those exposed tracts of land over which the furious winter sciroccos blow so persistently, and on which, consequently, the trees need cultivating a basso-fusto, or, in the contrary case, when the site is sheltered from the wind, but is also somewhat shut in and excluded from the beneficial influence of the sun's rays, in which case the upward growth of the tree should be encouraged by the severance of one of the two bifurcations into which the parent stem splits. Outside these extreme cases, growers should only have recourse to the pruning knife at long intervals, and even then every care should be taken to avoid over-logging.

However this may be, and whatever method the practical arboriculturist selects as the fittest, the trimmer and pruner, and more especially the latter, should never attempt to operate ere the fruit be gathered. Thus, orange trees planted on the sea-board or at the level of the sea, can be pruned without material inconvenience even as early as January, provided the season be of average mildness, extreme of heat and cold being equally dangerous to the health of the plant during and after the operation. The expediency of operating on trees whose fruit has been already picked, is so universally recognised, and is indeed so evident that lemon-trees which often continue to produce up to June, are never trimmed or pruned until July.

Manuring.

The trees are dressed triennially in most parts of Sicily, unless the extreme poorness of the soil should require more frequent and more copious applications of the fertilising compound. The same average periods for recurrent dressing are, I believe, observed on the mainland, although less generally, on account, in part, of the greater extent of the cultivation of certain varieties of the citrus species, which require more manuring. At whatever recurrent periods the fertilising substance should always be applied during winter.

Gathering of the Fruit.

The proper season for collecting the various and successive crops depend, of course, on the greater or less maturity of the fruits, their kind and the ports or countries for which they are destined, and subject to these conditions, of the successive gatherings and garnerings of the fruit

which commence with November and continue up to March inclusively, are prolonged in the case of lemons up to the end of June.

The first crop, which is gathered during the later end of October, comprising unripe or half-ripe fruit is usually shipped forthwith, although they can be and are occasionally warehoused, but the high prices their early appearance commands on the market do not allow of their being kept for any considerable period of time; they mellow, moreover, on the voyage out, or in the warehouses in which they are stored on arrival: The second crop consists of fruit which is picked during the months November and December, which can be preserved for the most part, with proper precautions, up to April, until then it is stored in special warehouses and sorted carefully.

The next gathering takes place in January, February, and the earliest part of March, and the fruit under this category is immediately shipped for exportation, and it can in no wise be housed or kept for any considerable length of time.

The fruit in whatever season collected should never be under-weight, viz., under $3\frac{1}{2}$ oz. in weight, which is average limit assigned by experienced hands to good marketable fruit, and should be carefully packed in cases made of beech-wood or other light, dry wood of a similar texture. Each case is divided by a thin partition into two parts, and are of various sizes. Those containing from 300 to 360 lemons each are the smallest, and are mostly destined for the United States, a few being expedited to Hamburg and Trieste, those containing between 400 and 420 are mostly shipped to French ports, those containing from 420 to 490 are usually destined for the United Kingdom. In every case the lemons should be carefully packed in tissue paper, and the fruit sorted previously; the mouldy or otherwise damaged fruit set aside, the pedicle cut off, but not torn away.

These observations anent the picking and packing of lemons, apply generally to the gathering and housing of oranges. With regard, however, to the proper season for orange picking, it must be observed that all the fruit growing on the same site ripens about the same time and is all gathered at once and not in successive pickings, although, of course the crop may be ripe for collecting early or late, according to the altitude of the plantation above the sea-level, the greater or less dryness of the soil, and the more or less southern and sunny aspect. Thus the fruit on the lowlands is ripe for picking towards the end of November, that on the highlands in December and January. Finally, the fruit on the mountains only mature sufficiently for the purpose towards the middle of March, but sometimes as early as February, and on very high and exposed sites the fruit only partially ripens in April. Thus it will be seen that there are three distinct seasons or epochs for cutting oranges, but not three successive pickings of the same tree, and therefore the seasons for the trimming and pruning of the orange tree differ widely from that of its congener, the lemon tree.

The cases in which the fruit is laid contain each from 160 to 300 oranges, which are exported to all quarters of the globe, and thanks to their experienced packing and sorting, generally reach their destination in a good condition.

The need of great care and experience in the sorting, storing and packing of oranges cannot be too strongly urged on all growers and ex-

porters, and the Sicilian peasants are unrivalled in the dexterity and deftness they always display in selecting the good fruit among a heap of apparently uninjured although really worthless or inferior oranges or lemons, for in many cases the lesions are so slight, or their outward marks on the rind so seemingly trifling, that they would be admitted as good fruit by all but the most experienced hands. It is almost exclusively to the practised skill of the Sicilian packers that the shipment and conveyance of the fruit in good condition, and its preservation during long sea voyages, are to be attributed, and their reputation is so fully recognised even in other orange and lemon-producing countries, that the Sicilians are sometimes employed in Greece and elsewhere in preference to the native in matters connected with the cultivation and commerce of the citrus species.

It is said that the best oranges can be safely stored for some months—in the case of a late crop even up to July—provided the place in which they are housed be cool, airy, and dry, the fruit be disposed in single layers, and overhauled frequently in order that the diseased or bruised ones be thrown aside. The least preservable varieties of the citrus family are considered the blood oranges, mandarins, and ordinary citrons.

Defects and Disease of Oranges and Lemons.

The distinction between defects and diseases of the fruit is a very well marked and natural one, comprehending under the first head all those fruits which outward blemishes rather than internal lesions render unsaleable, or saleable at relatively low prices: and under the second all fruit in which outward blemishes indicate some corresponding internal disorganisation of the pulp, which render the fruit thus affected utterly valueless. The fruit under both categories yields little essential oil, as the rind is almost always more or less impaired.

Oranges.—Diseases affecting rather the rind, and which may be appropriately termed skin diseases, for they usually leave the internal structure of the plant unimpaired, are the following:—

1. Unpedicled oranges, *senza rosette*, the absence of which may or may not bring about the deterioration and even destruction of the endocarp; in the former case the fruit is utterly unmarketable, in the latter it is vendable but at a loss.

2. Hail-pitted, *colpiti di grandine*. The same remarks applying to the previous category apply to these also.

3. Stained, *stampateo chiazzate*, are those whose rind is only slightly discoloured, a circumstance which would be of little importance as it does not really impair the flavour or juiciness of the fruit, were it not from the blemish diminishing its price on the market.

4. Afflicted by earth sickness, *male di terra*, which obliterates the oil-cells, and disfigures the fruit, so as to render it worthless in trade.

5. Tailed, *codati* or *caudati*. are those oranges whose atrophied pistils are apt to cause laceration when torn away or snapped off, whence the fruit is valueless on the market.

The second class comprises all those fruit whose structural disorganisations have made them utterly unvendable and intrinsically worthless. Such are the oranges called:—

1. Puffed, *enfiati*, whose attenuated rind, bursts on the slightest impact, and cannot bear the lightest weight.

2. Spungy, spugnosi, are those whose rind is completely detached from the shrunken pulp.

3. Fetiferous, or double-fruit, are also of very little value from their deficiency of oil-cells and of juice.

4. Pitted, petecchiate, are those oranges which are marked with yellow-greenish spots, having a dry centre. They soon lose all their value from their atrophied condition.

Lemons.—Although the main conditions under which lemon trees thrive generally are very similar to those required by their congeners, there are differences between the manner and seasons of collecting the fruits, of these two great varieties of the citrus, which are connected with the nature of the different fruit.

There are certain peculiarities of growth among the lemon plants, which deserve to be mentioned as regulating the proper picking seasons.

These peculiarities consist chiefly in the abnormal crops of many trees, and which may be conveniently ranged under three heads.

Under that of March lemons, or marzainoli, are meant the fruit produced by March blossoms; they are not much esteemed on the market, and fetch very low prices on account of the many blemishes and defects they present, although they are sufficiently rich in juice to repay the expense of extraction or condensation.

Under the head of May fruit, or maggiarnoli, are included those lemons which are born of the May and June flowers, more particularly of the latter, during the first two decades of June, and ought, therefore, rather to be termed June flowers or June lemons, instead of May fruit, a term perhaps originating in and relating back to the sixteenth century, ere the introduction of the reformed Gregorian style, when the first decade of June, according to the new style then affirmed, had previously belonged to May, and thus the so-called Maggiarnoli did then really belong to flowers of that month for the most part. The fruit derived from these late blossoms is of the finest quality, and highly prized, both on account of their intrinsic superiority and of the season during which they can be sold; this, from the long period they are borne on the trees, comprises the hottest summer months.

Under the name of bastard lemons, bastardonì, which are sometimes left hanging on the trees for over a year, are comprised all those irregular crops of lemons which are picked between the months of April and November, and which do not belong to the two classes just mentioned. They are commonly rich in juice, but lacking in essential oil, and are mostly consumed at home, where they command fair prices from their seasonable appearance during the long hot summer.

(To be continued.)

REPORT ON SUGAR CANES.

By THOMAS KEMP.

Cane Tops received from Government Public Gardens, February 1895, planted on Greenock Estate, and cut August, 1896.

Name of Cane.	No. of Canes to Stool.	Length of Canes in feet.	Weight of Cane per Acre in lbs.	Weight of Tops per Acre in lbs.	Density.
Po-a-ole	19	6½	176,300	73,100	27
Norman	8	5	33,325	51,825	28
Tsimbic	24	7	213,925	95,675	22
Nain	15	5	88,350	60,200	23
Seete	18	6	123,625	83,850	24
Batramie	14	6	60,200	50,525	21
Tourkoury	13	8	148,350	43,000	18
Brisbane	16	7	177,375	68,800	21
Lahaina	16	8.6	142,975	52,675	21
No. 115	8	6	62,350	55,900	26
Grand Savanna	12	7	81,700	50,525	25
Bourow	18	7	176,300	96,750	18
Waphendnow	12	6	62,350	20,425	23
Gree Rose-ribbon	13	6.6	97,825	37,625	22
Hillii	20	7	135,450	75,250	24
No. 345	12	4	52,675	27,950	23
Vulu Valu	8	4.6	49,450	50,525	25
Tiboo	10	5	51,600	49,450	21
Cuapa	24	5	93,525	75,250	24
No. 78	16	6.6	105,350	49,450	18
No. 45	18	4	101,050	92,450	21
No. 282	11	3	49,450	36,550	24
Salangore	20	5.6	140,825	89,225	23
No. 108	11	5	62,350	66,650	16
No. 128	11	5	68,800	39,775	23
No. 275	13	5.6	64,500	37,625	20
No. 53	14	5.6	87,075	48,375	22
No. 149	16	5	159,100	83,850	21
No. 220	23	6	180,600	118,250	22
No. 105	10	6	94,600	62,350	18
No. 114	22	8	277,350	189,200	15
No. 49	20	7	202,100	105,350	22
No. 57	14	8	109,650	68,800	20
No. 345b	31	9	219,300	103,200	16
No. 102		Did not grow			
No. 116	25	10.6	303,150	164,475	22
No. 343	7	7	53,750	25,800	21
No. 59	14	9	150,500	66,650	19
No. 99	20	10	260,150	129,000	19
Bourbon	13	8	162,350	55,900	27
Sukii	16	7.4	107,500	61,275	23
Blk. Cane	15	6.5	139,750	64,500	26

REMARKS.

In noting the results of these Canes it would be best to do so comparatively, as nearly all of the tops were very poor, and I expect better results from the tops planted from these now reported on. I think No. 345b, 116, 99, and 114 should not be planted closer than 6 ft. 6 inches and No. 59, 94, and Tsimbic less than 6 ft.

I regret being unable to give you the Polariscope test of each, having no instrument, but the foregoing I hope may prove useful.

I refrain from noting the habits of each kind as that has already been published in the Bulletin.

In regard to the Cane mentioned as No. 345b, I found 2 bundles of tops marked 345, and as they seemed to be different I marked one 345b, and whether it has any name or not, it is quite distinct, and a good variety. I did not get a single top to grow from No. 102. No. 116 is one of the best canes I ever saw, and I think worth cultivating and looking after. I have planted all the tops from those now cut, and kept them apart, and hope to be able to report on them when they are next cut.

Some of the varieties would have done better if cut earlier, but plants as a rule in this district, get 16 to 18 months, and I wished to give these Canes the same time, and to get the tops to plant in the fall, instead of the spring.

I note weight of tops per acre, as in districts where cattle feeding is scarce, this is a valuable consideration.

The rainfall was as follows :—

Month.			Inches.
1895.			
April	...	...	5.11
May	...	...	7.29
June	...	...	3.23
July	...	...	3.68
August	...	...	5.35
September	...	...	5.10
October	...	...	9.13
November	...	...	5.35
December	...	...	2.40
1896.			
January	...	...	6.50
February	...	...	1.89
March	...	...	3.95
April	...	...	5.24
May	...	...	4.19
June	...	...	4.10
July	...	...	3.57
August 1st to 22nd.	...	...	3.73

PHARMACOLOGICAL NOTES ON KOLA.

By FRED. B. KILMER, Chemist, New Brunswick. N.J., U.S.A.*

In my judgment the work of the pharmacist does not end with his chemical assay.

Before a drug can be given a place on therapeutics, somebody must first accurately determine its physiological action. The proper value of a drug in medicine will largely depend upon the exhibition of its constituents in their most active condition. The pharmacist must know the physiological action as well as the chemical nature, else how can he make an eligible preparation?

With these thoughts, let us briefly review the pharmacology of the drug before us. By chemical assay we have separated two alkaloids, caffeine and theobromine. As found in the plant, they are so closely combined as to be difficult of separation. Physiologically, their action seems to materially differ from a simple mixture of the same two alkaloids in equivalent proportions. From a chemical point of view we have expressed the value of this drug on its alkaloidal contents, irrespective of all other constituents. Is this the correct and the total value? Is the measure of the drug summed up even by its total alkaloidal contents? Pharmacology would answer no. The alkaloids, separate from the drug, while presenting actions that resemble those of the drug itself, by no means replace or fully represent it.

An assay in the drug under consideration, from various authorities shows, besides the alkaloids named, sixteen other substances have been set apart and named as follows:—

ASSAY OF KOLA.

Caffeine	...	...	2,348
Theobromine	...	...	0,023
Kolanin	...	...	1,290
Fat	..	...	0,734
Essential oil	...	...	0,081
Resin	...	...	1,012
Tannin	...	...	1,591
Glucocse	...	...	2,875
Saccharose	...	...	0,612
Mucilage	...	...	3,040
Starch	...	...	30,990
Dextrine	...	...	2,130
Soluble salts	...	...	0,070
Ash	...	...	3,325
Albuminoids	...	...	6,325
Coloring	...	...	2,561
Moisture	...	...	10,117
Cellulose	...	...	30,876
			100,000

*Abstract by the author of a lecture delivered at the Pharmaceutical Meeting of the Philadelphia College of Pharmacy, January, 1896.

Some of these groups include a still larger number of separate constituents. Are these constituents no factor in the influence of the drug upon the organism? The physiological action of the drug, as reported by a host of observers, is far different from that of caffeine or any drug of the caffeine group. One record of observations, showing its influence upon muscular contractions, shows that caffeine acts upon the height of the contraction. The action of caffeine increases these, but the effect is of short duration, the amplitude being very restricted. The muscle is exhausted as rapidly, even more so than in the normal state.

The drug kola acts upon the number and intensity of the contractions. The duration of the contractions is greater, the amplitude is larger and longer sustained. The decrease which follows is in a very regular progression. (DuBoise.)

Dr. H. Marie has shown, by a series of comparative tracings that with caffeine the starting contractions are very elevating, but there is a sudden fall reaching below the starting point; while with kola there is a gradual elevation, which is continued until the drug begins to lose its influence, when the descent is very regular and gradual to the normal point. It is characteristic of caffeine and of other stimulating drugs that there is a depressing action, but there is none with kola. This has been verified by Drs. Smith and Leuf, who, in connection with Dr. Woodbury, recently made some interesting studies of this drug. A series of sphygmograph tracings made by them show an undoubted increase of the pulse and heart action, with no reaction thereafter. Thus we can see that the free alkaloids by no means account for the full value of the drug. The action of the other constituents, save one or two, has been barely touched upon. The essential oil has been defined as a tonic of the generative organs. Whatever action or influences lie in the substances grouped under the head of resinous matter and fatty bodies, etc., at present are unknown. In the light of pharmacology, one constituent, however, seems to be far superior in power and action to that of the other alkaloids, and gives the drug its place and rank. It is the substance termed kolanin. Observers have reported that this substance separated from the drug (containing, of course, no free alkaloids) "in very small amounts, increases the intensity and duration of the muscular contractions." The amplitude of the contractions is preserved longer than with the drug itself. The conservation of the muscular energy is in marked contrast with that of the alkaloids separated from the drug, exercising a well-defined action peculiar to itself. Dr. Edouard Heckel strongly reiterates and produces a vast amount of testimony as to the marked difference and superiority between the action of kolanin and that of the free alkaloids from the drug, and of the other substances of this class. Several other observations made recently in this country show a very marked action of this drug after exhaustion of all the free alkaloids. By so far all our studies upon this plant and those of its class have given but a feeble light upon their whole nature. There are still formidable difficulties to surmount before we can say we have reached the ultimate truth.

Among the many problems that arise, may we not rightly ask that

if by any means we could gain full control of this plant in its manifold stages of life, could we so direct its course that it might go on at our command, producing the peculiar glucosidal body kolanin, could we so govern the action of this ferment as to compel the continuous production of glucose, caffeine and other products? Are conditions possible whereby the yield of glucosides and consequent alkaloids could be increased? Could we here secure a perpetual fountain of chemical products? At present we dare not even attempt a penetration into the depth of the dead or the vitalized plant as to the compounds we have grouped in our assay as "matter." We may, therefore, turn from our chemical research to the pharmacist's ever-ready crucible, his trained and trusted senses. Take an undried seed of our Kola plant, prick through its skin coating or break it open. Mark the result. In a space of time that is not measurable, the colour of the flesh within the tissue assumes an orange brown colour rapidly extending over the whole abrasion. It goes on until the whole structure assumes this hue. What are those wondrous transformations that take place before our eyes? Is it not reasonable to assume that if our assay had been made before the tissue had been broken, it would have given different results than if made a few seconds afterwards? In this little act have we not in some way lessened the dormant chemic life stored within, and made its operations visible? Who can measure the infinitesimal energies evolved? By the prick of a pin we have started a chemical factory in motion, have involved reactions, equations so great that the scientific mind cannot calculate them. Bite off a piece of nut and chew it. At first the taste is bitter and acrid; under the grinding and mastication this changes to a sweet. The tongue and palate reason out glucose without the aid of Fehlings solution. Swallow the juice or the masticated substance, put your finger upon the pulse or heart, measure the beats and their force. They are stronger and more regular. Measure the contractions of muscular energy, try their vigour and test their power of endurance. The intensity and force is amplified. The brain, nerve and muscle have received an impetus and derived power from the energy stored within a little nut-shell. Is it because the plant contains the essence of energy or the alkaloid of power? Can we not more truly say that there is a definite chemical affinity between the several molecules of its constituent compounds and the molecules of the nerve organism, with stimulation and vigour as links in the chain? The native users of this plant endowed it with miraculous powers. An Arabian physician, a few centuries ago, named it the "tree of heaven." To-day, the medical and lay journals of Europe and America tell a story of a "wonderful tropical nut," "a marvellous drug from Africa." This somewhat crudely indicates our exact knowledge concerning it. A distinguished American botanist recently described this plant as, to him, the most fascinating and mysterious specimen of Nature's handiwork. A professor in one of our pharmacy colleges says that he dimly sees within and through its mysterious processes the key to all our alkaloid-bearing plants. When the door shall be wide opened and all is made plain, the influence and value of the discovery to science and medicine, he believes, will be so great that it may be counted with the "proin" of Berzelius, the "dawn of the day."

FERNS: SYNOPTICAL LIST—XL.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent, Botanical Garden, Demerara.

50. *Nephrodium asplenoides*, Baker.—Rootstock erect, often some inches high, stoutish, the crown densely scaly; stipites cæspitose, numerous, erecto-spreading, 3–8 in. l., slightly brown-scaly at the very base; fronds oblong-lanceolate, 1–1½ ft. l., 3–5 in. w., not reduced at the base, pinnate, the apex pinnatifid; chartaceous, pellucid when fresh; naked or puberulous, rather dull or greyish-green; rachis slender, greyish, and with costæ and ribs slightly ciliate and puberulous; pinnæ numerous, spreading nearly horizontally, or rather up-curved, usually shortly apart, or at the base subdistant subcordate and slightly stipitate, 2–2¾ in. l., about ½ in. b., the apex blunt and entire, below this cut into shallow rounded marginal lobes, the lowest pair rather enlarged, which are 1½ li. b. the upper pinnæ generally subentire; veins pinnate in the lobes, 3–6 to a side, branches simple, lowest opposite pair uniting and sending a vein to the sinus where the opposite next pair meet: sori small, dorsal, nearer the midrib; involucre minute, ciliate, early obliterated.—Pl. Fil. t. 102. *Polypodium*, Swartz. *Aspidium*, Griseb.

a. var. tenera.—Stipites as long but rather more slender, fronds about half as long, nearly as w., pinnæ as wide, sometimes wider, and usually more deeply lobed, and broader generally above than at the base. The second pair of veins not opposite, one or both entering the margin above the sinus; involucre evident, ciliate.—*Goniopteris tenera*, Fée. Fil. Ant. t. 15. fig. 3.

b. var. gracilis.—Fronds narrower, the upper part elongated, and only pinnatifid, the lower pinnæ reduced and becoming gradually more distant downwards, involucre evident, ciliate.—*Goniopteris gracilis*, Moore et Houlet. Fée, Fil. Ant. t. 15. fig. 2.

Common, and widely spread through the island in one state or another between 2,000 and 6,000 ft. altitude, on open or shady banks. A much larger and stronger plant than its sub-species *reptans*, with erect-spreading fronds, never extending and radicant at the apex. The involucre is more obvious in some of the forms than in others, but in nearly all they disappear with age.

a.—grows plentifully on the side banks on the way from Kingston to Bath and elsewhere. With this I include all the forms possessing the same shape of frond as the type, except that they are shorter and have fewer pinnæ, though they vary one from the other in texture, vestiture and other minor characters. *b* in its generally narrower form, and elongated tapering simply pinnatifid upper half or third of the frond, approaches some of the larger forms of *reptans* but it is, so far as I have observed, never radicant, and this is the only permanent distinction between the type and sub-species, and upon it the numerous intermediate forms, too variable to define as varieties, fall to one or the other group. But, possibly, even this distinction is not tenable.

1. Sub-sp. *sclerophyllum*.—Fronds larger than in the type, 1½–2 ft. l. and 6 in. w., not narrowed at the base, elongate lanceolate, the upper part tapering or long-tapering, acuminate; pinnæ mostly opposite

spreading distant below, subdistant above, 3-4 in. l. 6-7 li. w. sessile and rounded at the base, the margins subentire or slightly lobed, the outer part quite entire and tapering to the bluntish point; the lowest pair subcuneate at the base, the reduced upper ones broadly adnate to the rachis and oblong, round-pointed and entire; sori copious; involucre stellate-ciliate. *Polypodium sclerophyllum*, Sw. *Nephrodium* Presl. *Aspidium*, Kze.

There is some uncertainty as to what is the plant intended under the names above quoted. My specimens agree exactly with the Kew type, but plants which seem to me distinct are placed with that. In the plant here described there is a general resemblance to a much enlarged state of *scelopendrioides*, only that the rachis is free nearly to the summit, and only the pinnæ of the upper third of the frond are adnate to the rachis, after the manner of those of *Polypodium chnoodes*. It is a larger much less stiff plant than the type, with long slender petioles, and the fronds elongated rather in the upper part. The venation is variable.

2. Sub.-sp. *reptans*.—Fronds much smaller, the barren prostrate, 6-12 in l. or more by elongating into a slender lax radicans, outer part, 1-2 in. br.; the fertile erect, normal in form, and not radicans at the apex; pinnæ entire or shallowly lobed, the lower ones free often subcordate-the upper confluent and adnate, or all free.—Sl. t. 29 t. 30 f. 1.—*Polypodium reptans*, Swartz. *Aspidium*, Gr.

Common on limestone rocks and banks throughout much of the island up to 3,000 or 4,000 ft. altitude, very variable.

The fertile fronds are usually erect, on long stipites, pinnate to the apex or pinnatifid in the upper part, with an entire point. This character of the soriferous fronds is fairly constant, but they sometimes extend into the rambling oft-rooting and viviparous tail that is normal in the short-stiped, unsoriferous fronds, and that characterises the plant.

51. *N. brachyodon*, Hook.—Stipites erect, 1½-2 ft. l., greyish-puberulous, as is the rachis, and other parts, deciduously scaly at the base; fronds ample, 1, 2 or 3 ft. l. and nearly as wide; chartaceous, pellucid; dark greyish-green; puberulous, especially beneath, and most densely on the costæ and ribs, the upper-side at length glabrous, not reduced at the base, with a large terminal pinna and 8-10 pair of similar lateral ones; which are spreading, 9-12 in. l. 1½-2 in. w., truncate or rather rounded at the base and petiolate in the lower half of the frond, the lowest pair shortly narrowed there, oblong lanceolate, and nearly uniform in width to the acuminate outer part, the point sub-entire, approximate or sub-distant, the upper ones shortly adnate to the rachis; cut ½ or ⅓rd to the costæ into broad flat subfalcate obliquely rounded close segments that are 3½-4½ li. w. and ⅓-½ in. d. to the sharp sinus; margins entire, sub-crenulate, and slightly setose; veins simple, raised beneath, 12-18 to a side, lowest pair uniting and sending a branch to the sinus, below which 1-3 other pairs join; sori medial; involucre small puberulous, fugacious or early concealed by the sporangia. *Aspidium* Gr. *Polypodium*, Kunze. *Phegopteris Seemanni*, J. Smith.

Infrequent among the lower hills. A very fine plant, of few large pinnæ and great width of frond, of a dull grayish-green colour from the vestiture of stellate puberula, thinly chartaceous substance, copious veins, and minute, generally obscure, involucre. It closely resembles

Polypodium megalodes, Schk., for which it is often mistaken, and with which it has nearest affinity, but is well distinguished by its much larger size, copious puberulæ, and presence of involucre.

52. *N. bibrachiatum*, Jenm.—Stipites tufted, 2 or 3 in. l. slender, channelled, puberulous, grey-brown, a few small dark scales at the base; fronds bipinnatifid or bipinnate, 5-6 in. l. or over, $1\frac{1}{2}$ - $2\frac{1}{2}$ w., chartaceous, cloudy green, the rachis and ribs clothed with grey puberulæ basal pinnæ largest, and petiolated to $\frac{1}{2}$ in. 1-3 pairs much broader than those above and deeply pinnatifid, or fully pinnate at the base where they are reduced, the segments oblong linear, obtuse, those next above these about 1 in. l. $\frac{1}{4}$ in. w., free, sessile, somewhat lobed in the inner half, the basal lobes largest, the outer sub-entire and the points acute or blunt, uppermost of all entire, adnate and connected, passing into the lobate-entire apex of the frond; veins forked or simple in the segments of the lower enlarged pinnæ, the basal ones connected in the other and sending a branch to the sinus, the outer ones branched and free; sori small dorsal, the inferior medial, the rest nearer the mid-vein of the lobe; involucre small, distinct.—Gard. Chron. Feb. 24th 1894, p. 230.

A small plant that reminds one both of *Polypodium hastæfolium* and *Nephrodium tenebricum*. The merely lobed pinnæ quite resemble those of the latter, but the lowest two or three pairs are enlarged $1\frac{1}{2}$ in. l. $\frac{2}{3}$ - $\frac{3}{4}$ in. b. and cut to the costæ uniformly into narrow segments. The sori are plentiful, but minute. The venation varies with the character of the cutting.

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PLANTS.

From Royal Gardens, Kew.—

- Atalantia monophylla
 Bauhinia sp., India
 Boehmeria sp., Java
 Butyrospermum Parkii
 Kickxia africana
 Monodora tenuifolia
 Musa Kewensis
 M. Mannii
 M. rosea
 M. Sapiantum var., martabanica
 M. textilis
 M. "Pisang Ambor"
 M. "Kidang"
 M. "Maas"
 M. "Palembang"
 M. "Raja"
 M. "Raja Siem"
 M. "Susu"
 Strychnos Mackenii
 S. sp., Ivory Coast
 Uncaria Gambier
 Allamanda violacea
 A. Williamsii
 Antidesma Bunius
 Aphelandra micans
 Carex scaposa

Chonemorpha Griffithii
 Cordyline bellula
 C. Desmetiana
 C. Mrs. Glendenning
 Dipladenia amabilis
 D. carissima
 D. hybrida
 Dracæna Godseffiana
 Ficus irregularis
 Garcinia Mangostana
 Guatteria suberosa
 Ixora coccinea var., fl. lutea
 Kendrickia Walkeri
 Landolphia sp. Gambia
 Pandanus silvestris
 Spathiphyllum commutatum
 Strobilanthes sexennis
 Strychnos spinosa
 Trevesia palmata
 Urena lobata
 Vanilla sp., Lagos
 Dioscorea multiflora
 Abbeokuta Coffee
 Sansevieria Ehrenbergii

SEEDS.

From the British Minister in Mexico.—

Seeds of Manilla Mango

From Walter Jekyll, Esq., Robertsfield.—

Flower-Garden seeds, 15 kinds

From Baron von Mueller, Melbourne.—

Atriplex leptocarpum

A. halimoides

A. nummularium

Kennedyia monophylla

Acacia microbotrys

A. pycnantha

Trivella robusta

Eucalyptus calophylla

E. paniculata

E. Mulleriana

E. resinifera

E. corymbosa

E. tereticonis

E. miniata

E. hæmastoma

From Botanic Station, Gambia.—

Pterocarpus erinaceus

From Royal Botanic Gardens, Trinidad.—

Sacoglottis amazonica

Sabal sp.

Passiflora sp.

From Reasoner Bros., Florida.—

Vitis rotundifolia (Scuppernong Grape)

From Fred. Kemble, Esq., Kingston.—

Moringa aptera

From J. James & Son., Slough, England.—

Calceolaria

Cineraria

Cyclamen

From H. Powell, Esq., St. Vincent.—

Simaruba amara.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of October :—

IN FLOWER.	IN FRUIT.
<i>Cananga odorata</i> , Hook. f. & Thoms.	<i>Averrhoa Carambola</i> , Linn.
<i>Cassia bacillaris</i> , Linn.	<i>A. Bilimbi</i> , Linn.
<i>C. glauca</i> , Lam.	<i>Barringtonia speciosa</i> , Forst.
<i>C. siamea</i> , Lam.	<i>Bauhinia variegata</i> , Linn.
<i>Clerodendron macrosiphon</i> , Hook. f.	<i>Cæsalpinia Sappan</i> , Linn.
<i>Cordia alba</i> , Roem. & Schuit.	<i>Cananga odorata</i> , Hook. f. & Thoms.
<i>Combretum coccineum</i> , Lam.	<i>Cocos botryophora</i> , Mart.
<i>Colvillea racemosa</i> , Boj.	<i>Couroupita guianensis</i> , Aubl.
<i>Cynometra americana</i> , Vog.	<i>Diospyros discolor</i> , Willd.
<i>Dillenia indica</i> , Linn.	<i>Garcinia Mangostana</i> , Linn.
<i>Eugenia brasiliensis</i> , Lam.	<i>Morinda citrifolia</i> , Linn.
<i>Eugenia caryophyllata</i> , Thunb.	<i>Myristica fragrans</i> , Houtt.
<i>Eriobotrya japonica</i> , Lindl.	<i>Noronhia emarginata</i> , Thou.
<i>Erythroxylon Coca</i> , Lam.	<i>Omphalea triandra</i> , Linn.
<i>Ficus indica</i> , Linn.	<i>Pachira aquatica</i> , Aubl.
<i>Ficus rhododendrifolia</i> , Miq.	<i>Posoqueria longiflora</i> , Aubl.
<i>Garcinia Mangostana</i> , Linn.	<i>Semecarpus Anacardium</i> , Linn. f.
<i>Hevea brasiliensis</i> , Muell. Arg.	<i>Terminalia Arjuna</i> , Wight & Arn.
<i>Manihot Glaziovii</i> Muell. Arg.	
<i>Mesua ferrea</i> , Linn.	
<i>Myroxylon toluiferum</i> , H. B. & K.	
<i>Morinda citrifolia</i> , Linn.	
<i>Pachira aquatica</i> , Aubl.	
<i>Pterocarpus Draco</i> , Linn.	
<i>Posoqueria longiflora</i> , Aubl.	
<i>Semecarpus Anacardium</i> , Linn. f.	
<i>Swartzia grandiflora</i> , Willd.	
<i>Trachylobium verrucosum</i> , Oliver	
<i>Terminalia Arjuna</i> , Wight & Arn.	

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

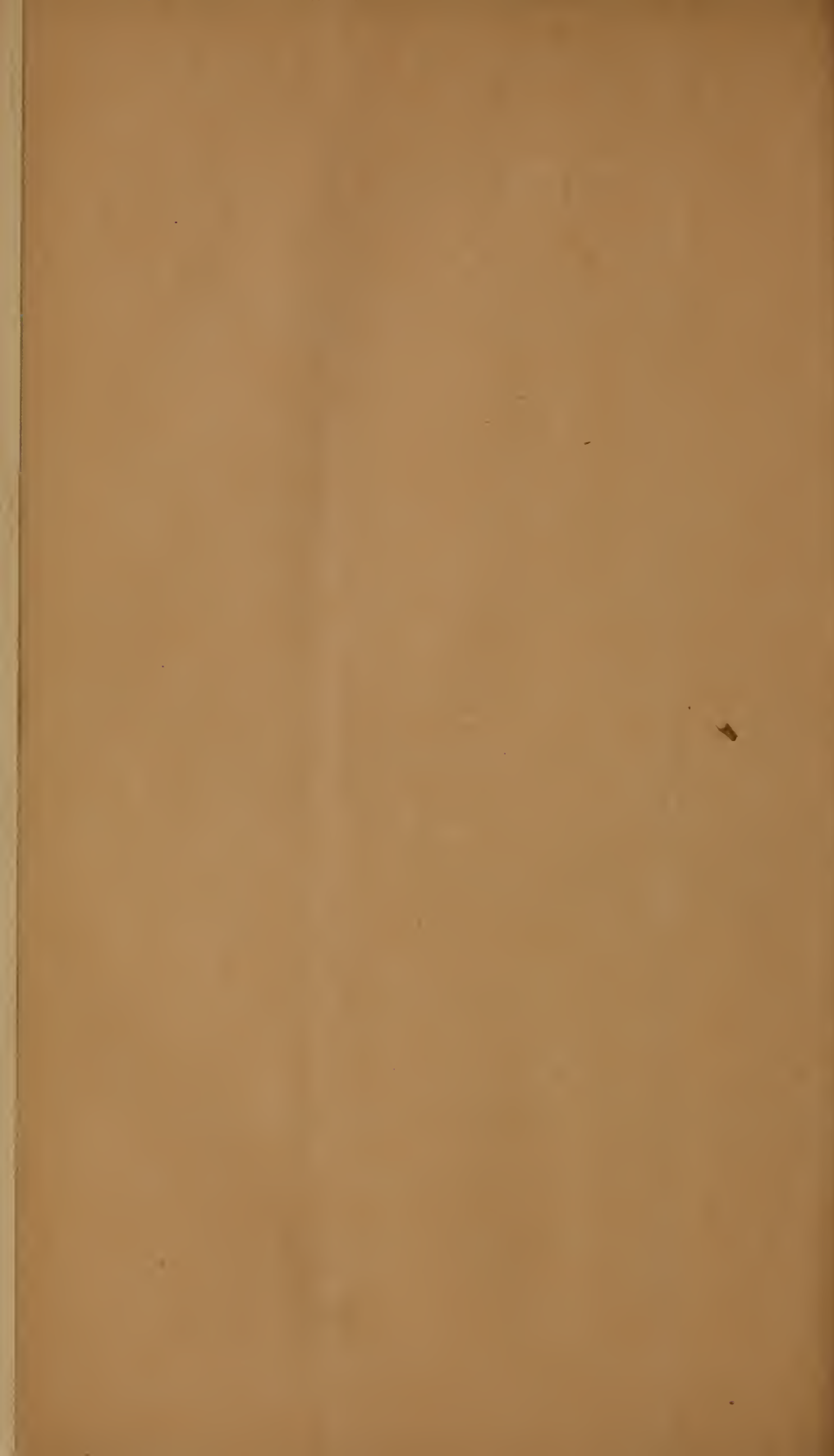
Soil Ferments Important in Agriculture	-	PAGE 217
A Natural Paper	-	224
Orange Cultivation in Sicily	-	226
An Anti-Malarial Tree	-	232
Plague of Caterpillars	-	233
Pine-Apple: Analysis and Manure	-	236
Ferns: Synoptical List.—XLI	-	236
Contributions to the Department	-	238
Castleton Gardens	-	240

P R I C E—Threepence.

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

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1896.



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OF THE

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Part 10.

SOIL FERMENTS IMPORTANT IN AGRICULTURE.

By DR. W. H. WILEY, Chief of the Division of Chemistry,
U. S. Department of Agriculture, in *Louisiana Planter*.

VITALITY OF THE SOIL.

Not many years ago the soil was regarded by the agriculturist as dead, inert matter, devoid of all vitality. The theories of fertilisation of the soil were based upon this idea, and the methods of culture were conducted according to the same theory. The only vital thing which the farmer considered was the growing crop itself, and there was no suspicion of the relation existing between the vitality of the crop and of the living organism of the field. The reader of the agricultural literature of to-day does not need to be told how all this has been changed in the last twenty years. The soil is no longer regarded as dead and inert matter, but is known to be so permeated with living beings as to entitle it to be considered a living mass. The parts of the soil which are not endowed with life now receive their highest significance as the environment of the living organisms which they contain and which they may help to nourish. The plant which forms the growing crop receives its nourishment through the media of the air and soil, but this nourishment must undergo a process of digestion before it becomes available as plant food, similar to that suffered by the food which nourishes animals. Indeed, the purely mineral, inorganic foods of plants are probably not always absorbed as such, and must undergo a decomposition before they are assimilated. A striking instance of this is shown in the case of silica, an important plant food and a type of inert mineral matter. Silica is highly insoluble and apparently the least suited of the mineral constituents of the earth to enter the vital organisms of the plant. Yet not only do we find it in the tissues of the mature plant, but also, strange to say, in greatest abundance in those parts of the plant organisms, viz. : the leaves, most remote from the sources of supply. It is evident from this that the highly insoluble silica of the soil must undergo a complete solution in order to be carried by the juices of

the plant through the net work of cellular tissues to be finally re-deposited in the leaf.

The same statement may be made with regard to the other purely mineral foods of plants. It is quite certain that they do not become a part of the plant organisms in the form in which they are found in the soil or applied fertilizers. In phosphorus, for instance, is found one of the most important mineral foods of plants. This substance exists in the soil almost exclusively as mineral phosphates, or is applied as such in fertilisers. Nevertheless, the phosphorus which is found in plants and especially in the seed of cereals, exists largely in organic combination, showing that the original mineral phosphates have been entirely decomposed by the process of digestion to which they have been subjected. Even the mineral phosphates which are found in plants are not those which pre-existed in the soil. Soil phosphates are chiefly those of lime, iron and alumina, while plant phosphates are chiefly those of potash.

SOLUTION OF SOIL PARTICLES.

At the present moment it is supposed that the purely mineral matters mentioned above pass into solution under the influence of the secretions and vital forces of plant rootlets. It is not probable, however, in view of the knowledge we already possess of independent soil organisms, that there may be a class of such bodies especially active in the disintegration of mineral particles and the preparation of them for plant digestion. Naturally, the first organisms which would act upon a bare rock would be those which could subsist upon a purely mineral environment. Such organisms could draw their nourishment solely from the mineral itself and from the air. One of the most important of modern discoveries is the fact that the nitrifying organism of the soil, the nature of which will be explained further on, and which is the chief instrument in providing and digesting nitrogeous nutriment for plants, is capable of subsisting and flourishing in a purely mineral medium. It is believed, therefore, that in the primary decay of bare rocks, especially at high altitudes, the nitrifying organism plays a highly important part and prepares the surface of the rock for the first growth of lichens and other low vegetable organisms from which the first traces of humus are formed. While these organisms are said to subsist in a purely mineral environment, it must be understood that the carbon dioxide and traces of ammonia, which the air may contain belong to this category. It has been shown that these bacteria can be developed by absorbing from the ambient atmosphere traces of ammonia and other bodies which may be present in the air. They even assimilate the carbon of the carbon dioxide much in the same manner as vegetables which contain chlorophyll. Thus, even in the denuded rocks of high mountains, the conditions for the development of all these inferior organisms exist. In examining the particles produced by attrition from such rocks it is easily established that they are uniformly covered by a layer of organic matter, evidently formed by microscopic vegetations. There is thus discovered in the very first products of the attrition of rocks the characteristic element of vegetable soil, viz. humus, the proportion of which increases rapidly with the process of disintegration, until finally the decaying mass is capable of sustaining chlorophyll-bearing plants.

Not only upon the surface of exposed rocks have these organisms been discovered, but also to a considerable distance in the interior of rocks on high mountains, fragments of which have been collected in sterilised tubes and subjected to cultivation in an appropriate environment.

DECAY OF ROCKS AT HIGH ALTITUDES.

The naked rocks of high mountains comprise mineralogical types of the most varied nature, viz, granite porphyry, gneiss, mica schist, volcanic rocks and limestones of all varieties, and all these have been found to be covered with the nitrifying ferment which is doubtless extremely active in producing incipient decay. At the high altitudes at which these observations have been made the activity of bacteria is necessarily limited by the low temperature to which they are subjected the greater part of the year. During the winter season their life is suspended, but is not extinguished since they have been found living and ready to resume all their activity after an indefinite sleep, perhaps of thousands of years, on the ice of the glaciers, where the temperature never rises above the freezing point. When the activity of these ferments in the most unfavourable conditions is recognised, it is easily seen how much more active they become when brought down to lower levels where they are nourished by the favouring conditions which exist, especially during the summer time, in cultivated soils. In fact, the importance of the action of these bodies on the mineral particles of which the soil is largely composed has never been fully recognised, and there is no doubt whatever of the great significance of their decomposing action in the liberation of plant food locked up in undecomposed mineral structures. In this case the activity of the bacteria is not limited to the surface of rock masses, but permeates every particle of soil and thus becomes effective over a vastly extended surface.

When the extreme minuteness of these organisms and the phenomena which they produce is considered there may be a tendency to despise their importance, but by reason of the fact that their activity is never-ceasing and of the widest application, it must be placed among the geological causes to which the crust of the earth owes a part of its actual physiognomy and to which the formation of the deposits of the comminuted elements constituting arable soil are due.

TRANSLATION OF MINERAL MATTERS IN PLANTS.

Consider for a moment a minute fragment of mineral matter of any description containing particles of plant food presented to the rootlet of a plant. It is evident at once that no mineral particle, however minute, can be bodily transported in a mechanical way and become an integral part of any plant tissue. Any attempt to move soil particles in this manner could only result in a clogging of the pores of the cellular tissues, the stoppage of the circulation, and consequent death of the plant. The mineral particles in question, therefore, must suffer a complete disintegration, and the only forces capable of affecting this, in so far as we know, are the solvent action of the plant secretions, the vital activity of the rootlet itself and the decomposing influence of the soil ferments. What particular proportion of the solvent action is due to each of these causes has not yet been determined. It is known, however, that the

weak organic acids which may be contained in secretions from the roots of plants are not capable of exercising a very important solvent influence on the soil particles.

In fact, one of the organic acids which may be found in the secretions of plants, viz, oxalic acid, is capable of exerting an influence which is unfavourable to the decomposition of mineral matters containing lime. A mineral which is composed in part of lime, when exposed to the action of oxalic acid, becomes coated with a film of lime oxalate which prevents any further decomposing action. The influence of nitric acid, which is due to the activity of soil ferments, is exerted in this case in the most beneficial way, attacking and dissolving the film of lime oxalate, and exposing fresh portions of the mineral substance to decay. Phosphoric acid, especially, which is so often found in combination with lime may be released by this action and made available. It must not be forgotten also that lime itself is an essential plant food, and must be supplied in appropriate quantities to secure a normal growth of the plants.

The "vital activity" of the rootlet, a phrase often used, has an indefinite meaning and conveys absolutely no comprehensive idea of solvent action. On the other hand, it is known that soil ferments are found in particularly large numbers, clustering about the rootlets of plants, and in fact existing in symbiotic union therewith. This signifies that the relation existing between them is so intimate as to make their vitality mutually dependent. It is therefore quite probable, as has already been intimated, that the preparation of soil particles for plant food is due quite largely to bacterial activity.

KINDS OF ORGANISMS.

The nitric organisms in the soil exist in common with hundreds of others, many of which are doubtless active in the solvent work. The nitrifying organisms themselves, as will be mentioned further on, have such important relation in the supply of nitrogenous food as to have escaped consideration in their more purely solvent action. The attention of bacteriologists has been devoted almost exclusively to a study of the nitrifying organisms in respect of their relation to albuminoid and ammoniacal bodies. For this reason the action of these organisms and others relating thereto as a solvent for mineral particles in preparing them for plant absorption has not received the consideration which it merits.

THE NITRIFYING FERMENTS.

The micro-organisms of most importance to agriculture, and those to which attention is particularly called in this article, are the bacteria which act upon nitrogenous matters and oxidise them to nitric acid, or which exert a reducing effect on nitric acid, bringing it to lower forms of oxidation or even to free nitrogen. These organisms belong to many different species, and act in very many different ways. The general group to which these organisms belong is known as nitro-bacteria. The classification of these organisms by genera and species would prove of little interest to readers of this article. In general it may be said that there are three distinct genera, comprising, in the first place, those organisms which form ammonia or carbonate of ammonia from organic nitrogenous compounds, such as albumen; in the second place, the or-

ganisms which transform carbonate of ammonia into nitrous acid. Each genus is necessary in the complete transformation of proteid matter into nitric acid, in which latter form alone nitrogen is chiefly available for plant food.

FORMATION OF AMMONIA.

The bacteria which are especially active in the formation of ammonia are found constantly in surface soils and in the air and rain-water. By the activity of these organisms in the decomposition of albumen or of an albuminoid body, large quantities of ammonium carbonate are produced. The organic carbon, which is present in the compound, is also acted upon during the decomposition of the albumen, and by its oxidation certain organic acids are produced, together with carbon dioxide. Any organic sulphur which is present in the original compound becomes converted into an acid. As a rule, nitrogen in the decomposition of albumen and albuminoid bodies is not produced in its free state unless, indeed, the de-nitrifying organisms should attack the products of the first oxidation. The ammonia ferment naturally produces alkalinity in the media in which it is active, but it has been found that its activity is not wholly destroyed even in the presence of a slight excess of acid, provided the amount of acid present does not exceed one per cent. As with the case of the other nitrifying organisms, the ammonia ferment is most active in a warm environment. A temperature of from 80 deg. to 100 deg. F. is found most favourable to the production of a maximum fermentative activity. As the temperature approaches the freezing point the activity of the organisms diminishes and finally ceases altogether, but their vitality is not destroyed. Above a temperature of 110 deg. F. the activity of the ferment is also much diminished, and at higher temperatures ceases. A temperature near the boiling point of water continued for some time destroys the vitality of the organisms altogether.

The demonstration of the fact that the transformation of organic nitrogenous matter into ammonia is due to micro organic activity is easily made in the following simple manner: Two samples of the same soil are placed in suitable vessels. The percentages of ammonia and of oxidised nitrogen which these samples contain are determined by the usual chemical process. One of the samples is then sterilised by heating it for a few hours to a temperature considerably above the boiling point of water. After the lapse of a few weeks or months, the ammonia, or its oxidised products, nitrous and nitric acids, is again determined in the two samples. In the unsterilised sample it will be found, provided the soils be kept moist and at the proper temperature, that there is a marked increase of ammonia. In the sterilised sample no such increase will be found.

In general, it may be said that the organic matter in the soil which is the source of the ammonia is not altogether albuminoid or proteid matter, but includes also the nitrogenous constituents of humus. Soil humus is remarkably rich in carbon, and under the conditions favourable to nitrification this is constantly suffering oxidation. As a result of this constant oxidation, the percentage of carbon in humus maintained for a long while under cultivation is much less in proportion to the other constituents of that body than in soils which are regularly fertilised with organic matters or in virgin soils.

The exact manner in which micro-organisms reduce the nitrogenous stores of humus to the form of ammonia is, of course, not known, and the ferments which are active therein have been the subject of less investigation and are more imperfectly understood than those which are active in the formation of nitrous and nitric acids.

It may be possible that the organism which converts organic matter into carbonate of ammonia, and that one which forms nitrous acid, are quite similar in character, but this cannot be definitely stated.

PRODUCTION OF NITROUS ACID.

The next step in the process of nitrification is the conversion of ammonia or its compounds into nitrous acid. With a moderate store of ammonia, the oxidation into nitric acid takes place, as a rule without any of the nitrogen being lost in a free state or being volatilised as ammonia compounds. When, however, there is a large excess of ammonium carbonate, a considerable loss of nitrogen may take place. The practical deduction to be drawn from this fact is apparent. Nitrogenous fertilisers should be applied only in moderate quantities, so as not to increase the stock of material beyond the power of the active ferments to handle it.

The nitrous ferment is by far the largest and most vigorous of the nitrifying organisms. It is from three to four times as large as the nitric ferment, and under a higher power of the microscope appears as minute globules, slightly oblate. These globules are multiplied by spores which develop rapidly to perfect organisms of full size. In most cases the organisms appear as distinct globules, but many are congregated into masses where the distinctive cell structure seems to be lost.

CONVERSION OF NITROUS INTO NITRIC ACID.

The last step in the process of nitrification consists in the oxidation of nitrous to nitric acid. As a rule plants absorb nitrogenous food only as nitric acid, but it cannot be said that the nitrogen may not be used by the plant in other forms. Some experiments seem to show that ammonia and its compounds may be directly absorbed by plants, but if this be true it must be only in a very limited quantity. The final step, therefore, in nitrification is necessary to secure this valuable food in its most highly available state. The nitrifying organisms are much smaller than their nitrous cousins, and of the same general shape but more globular.

It must not be supposed that these steps in the preparation of a nitrogenous food are performed with entire distinctness. The impression might be obtained that the ammoniacal ferment exerted its activity, converting the whole of the nitrogenous supply into ammonia, and that in this state only the nitrous ferment would become active and convert the whole product into nitrous acid which finally, under the influence of the nitric ferment, would form nitric acid. In point of fact, however, in arable soils and under favourable conditions the steps of nitrification may be almost synchronous. In the case of a growing crop, a chemical examination may find only traces of ammonia and nitrous and nitric acids. As each particle of ammonia is formed it is converted without delay into nitrous acid, and then at once into nitric acid. The nitric acid formed would be absorbed by the growing plant, and thus it might seem that the activity of the ferments present in the soil had been reduced to a minimum, when

in point of fact they were exercising their functions with maximum vigour. The separate stages of nitrification mentioned above can only be secured in the laboratory by a skilled bacteriologist patiently working to separate the different genera of nitrifying organisms until he procures them in an absolutely pure form. As may be supposed, this is very difficult to accomplish.

CONDITIONS FAVOURING NITRIFICATION.

The further discussion of the character of the micro-organisms producing nitrification and their relations with each other, although highly interesting from a scientific point of view, would have no great interest for the practical farmer. For him the most important thing is to know how to secure in the field the most favourable conditions for the development of those soil ferments upon whose activity the abundance of his crops so intimately depend.

INFLUENCE OF POSITION.

The vitality of a nitrifying organism is as a rule greatly diminished as it occurs at a greater depth below the surface. For this reason it is found that these ferments occur in the greatest numbers and with a maximum vitality near the surface of the soil. It follows from this that the conditions favouring the development of these ferments are largely found in good drainage and good cultivation. In experiments conducted in this division it has been found that in low, wet lands, especially those standing under water for a good portion of the year, the nitrifying organisms are almost unknown. Such a soil may be rich in stores of nitrogenous material but even after the water has been withdrawn and crops are planted it will be found that they do not grow luxuriantly by reason of the deficiency of the number and vitality of the nitrifying ferments. Practical farmers know very well that in reclaimed lands, after the water has been removed, it is found necessary to thoroughly plough the soil and leave it exposed for one or more seasons before good crops can be produced. One of the chief reasons for this delay is doubtless due to the fact that it requires a considerable time for the nitrifying organisms to be developed and properly distributed through the soil.

EFFECT OF TEMPERATURE.

Another condition favourable to the activity of soil ferments is warmth. As has already been indicated, a maximum activity of these organisms is shown at a temperature of from 85 to 95 degs. F. Every one who has lived upon a farm knows how rapidly the growth of a crop will be checked by a fall of temperature. It is evident, however, that this depression of temperature does not diminish in the least the quantity of prepared food to which the plant has access. The unfavourable influences of a low temperature are doubtless found not alone in the sluggishness of the movement of sap through the cellular tissue of the plant, but also in the fact equally as patent that the diminished activity of the soil ferments prevents the rootlets of the plants from absorbing their normal rations of food.

ACTION OF LIGHT.

At this point attention might be called to a fact showing the difference between the activity of the soil ferments and of the plant cells. It is well

known that in the latter case, viz. the activity of the plant cells, the influence of light is of the utmost importance. It is true that while plants may grow to a certain extent when deprived of direct sunlight, yet such plants grown in semi-darkness never reach maturity, and the products of their vitality are often quite different from those of the normal plant. In etiolated plants—that is, those grown in the dark—are often found products which do not occur at all in those subjected to normal growth. The action of sunlight is therefore indispensable to the full functional activity of the supraterranean parts of plants. On the other hand, it is seen that the action of sunlight is highly prejudicial to the development of the soil ferments. Exposed to a bright light the activity of these ferments is diminished until it reaches practically the vanishing point. Happily, the surface of the soil being almost impenetrable to light, preserves the organisms lying even near the surface from the deleterious action of the sun. Warm nights, therefore, are even more favourable to the development of soil organisms than warm days, and all are familiar with the phenomenal growth which many plants make during the night.°

BENEFIT OF AERATION.

From what has been said above, it can be inferred that a proper aeration is also necessary to the development of the functional activity of the fermentative germs. Good drainage and cultivation secure a free circulation of air through the soil, and this is essential to the process of nitrification, which is simply oxidation procured by low vegetable organisms. While it is important, as indicated above, to remove the excess of water to secure proper aeration, it should not be forgotten that a certain amount of moisture is necessary for the life of the micro-organisms. Experience has shown that when the soil contains from one-third to one-half of the total moisture it is capable of holding, the proper quantity of water is supplied for the most rapid growth of the nitrifying ferments.

(To be continued.)

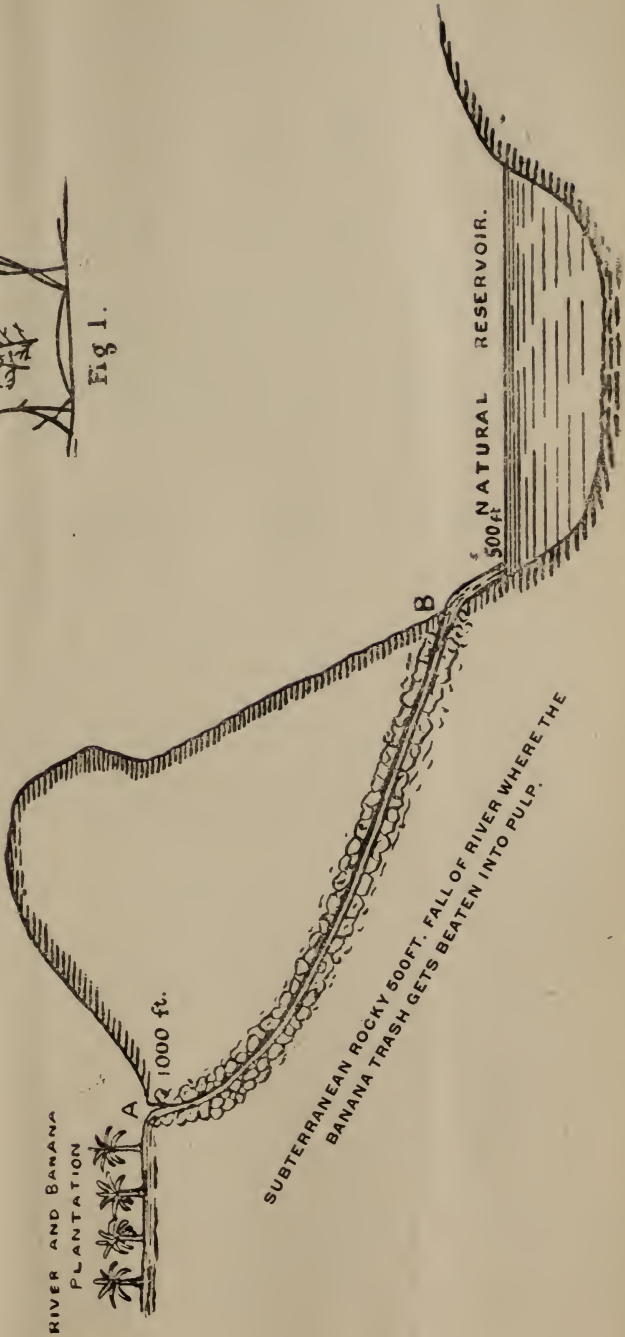
A NATURAL PAPER.

By S. T. SCHARSCHMIDT.

This ideal section goes to illustrate how a natural paper is formed and found distributed over the bottom of a natural reservoir, after the water had drawn off. A river when in flood, passes through a Banana Plantation, and carries with it quantities of the banana trash, which it beats into a pulp during its fall of 500 feet, through rocks from A to B as shown. When the reservoir becomes dry, the pulp being insoluble, is found distributed over the bottom, broken up in sheets of various sizes, owing to the contraction when drying. The paper generally has the appearance of thick unglazed packing paper, and sometimes when suspended among twigs in vertical position, is almost as fine and transparent as tissue paper completely infolding very fine water grass; (see Fig. I.) and in other cases as soft and white as cotton wool.



Fig 1.



ORANGE CULTIVATION IN SICILY.

By Acting Consul DE GARSTON.

(Extract from the "Foreign Office Report for the year 1895, on the Consular District of Palermo.")

REPORT ON THE CULTIVATION OF ORANGES, LEMONS, CITRONS, AND BERGAMOTS, AS PRACTISED IN SICILY AND THE "CALABRIE," WITH A BRIEF ACCOUNT OF THEIR CHIEF PRODUCTS, (concluded).

Ailments Peculiar to Lemons.

As with oranges so with lemons, the various ailments to which they are subject affect them very differently, some merely impairing slightly their outward appearance, others, decomposing the structure of the fruit, disorganising both the pulp and the rind, drying up or decomposing the juice, and obliterating the oil cells; others again, attacking chiefly one or the other, belong to neither exclusively or absolutely, but should be ranged under one of the two first categories, according to circumstances.

1. To the first class belong the stained *macchiati*, whose rind is merely marked with small circular green or grey spots, which, without injuring the fruit materially, so disfigures it as to compel the packers to set them aside.

2. Undersized lemons, which being deficient in juice and essential oil, are bought by home consumers at low rates.

3. Pricked, *punti*, which are immaterially affected or seriously damaged, according to the more or less early date of the puncture, which if light and suffered by the green fruit, soon heals; whereas if undergone at a later period, will usually cause the fruit to decompose.

4. Pitted lemons are those whose epicarp is extremely attenuated, and sometimes almost destroyed in parts; these are conspicuous from their darker hue, and the fruit is usually considered of a perishable nature when thus marked.

5. Those deprived of essential oil cellules, termed *spiritati*, are also of very little value.

Under the second category must be ranged mouldy, watery, saffron marked lemons, and which are mostly valueless, and can only here and there become slightly utilisable for the extraction of juice when picked ere the disease has made progress.

There is a third class of diseases which affect the whole tree, and destroy whole groves of lemon, orange, or bergamot plants. These ailments are one and all of an epidemic nature, and have now become in some regions quite endemic. The principal diseases of this kind are the gum malady, the gangrene of the roots, or general cancerous affection of the whole tree. As no radical cure has as yet been obtained, no mode of treatment has yet been accepted by common consent for its success in combating these epidemics, the only course left open to the cultivator is at present to eliminate those individuals who are assailed, or, at least, when they happen to be isolated, to amputate early the diseased limb, and in both cases to disinfect and renew the soil on the vacant space and round the infected trunks.

Manufactured Products derived from the Timber, Leaves, Flowers, and Fruit of the Citrus Group.

Wood.—Although orange-wood by reason of its compactness, homogeneous structure and aromatic properties could be advantageously employed by joiners and cabinet-makers, it is nowadays almost entirely supplanted by other ornamental wood, and is only at present used by turners who still fashion tops, balls, and handles for tools out of this valuable and once much sought for wood. Occasionally, however, despite the growing indifference to orange or lemon wood objects are made, which their elegance and durability should recommend to the public.

Leaves.—The products of the leaves are of several kinds:—

(1) Infusion of the leaves, which is greenish, bitterish, and slightly odorous.

(2) The decoction of the leaves, boiled with alcohol, of 32° Centigrade, which yields a green resinous substance.

(3) The distillation of the leaves finally produces two substances, a water called “naphore,” and a spirit called “petit grain,” all which products are neglected in Sicily, although they are manufactured on a large scale in the southern provinces of France, under less favourable natural conditions.

The “naphore” is made of equal weight of leaves and water, which yield one quarter of their combined weight of “naphore.” It is sometimes subjected to a second distillation, with flowers of orange or lemon. The petit grain, or essential oil, is extracted in a similar manner from the vesicles of the leaves which, in early spring, are replete with oil, and which in season is usually selected for the purpose.

Blossoms.—In their natural state the products of the blossoms serve to flavour drinks and sweetmeats, &c. When distilled they yield two very much esteemed products, the orange flower water or “acqua nanfa,” and an essential oil called “neroli.” Moreover, when candied they form a very delicious sweet, much in vogue in some regions of Sicily. The orange flower water is made of equal portions in weight of blossoms and water, which yield on an average about one-fifth of the combined weight of water and flowers, and “acqua nanfa” plus about 6 or 7 decagrammes per 100 kilos. of essential oil, that is from .0006 to .0007 per cent. Notwithstanding the abundance and excellent quality of the raw material, so to speak, still the best manufactories of orange flower water are to be found outside Italy,—in France where great quantities of this water are manufactured, as well as “petit grain.” As to candied sweet, concocted out of the blossom, it is doubtless more wholesome as well as more palatable than are many other productions of the confectioner’s art. The flowers are, in the first place, selected with care, weighed and immersed in cold water for 24 hours, after which they are dipped simply in cold water, rewashed in cold, and finally spread out on a linen cloth or sheet to dry. When completely dry they are laid out in low wide dishes, its flower separate from its fellow, and are then sprinkled with double their weight in sugar, administered at intervals during a period of 8 days or thereabouts; moreover, during the same period, the flowers should be frequently moved and kept in the shade, at the expiration of this term they are once more placed in the sun, whose rays dry them completely.

Fruit.—The fruit products consist generally in the juice of the pulp

and in the essential oil of the rind. From the first are manufactured the citrate and citric acid of commerce.

The raw juices of all the different varieties of the citrus species, except that of the bergamot, are available for commerce, but the juice of the lemon is the most highly prized, on account of the greater amount of acidity it contains and of its durability. But the raw juice, "argo crudo," however rich in acid particles can never vie in this respect with the same juice in a concentrated form, with the "argo cotto," in which form it enjoys besides a great superiority over uncondensed juice, in durability and in reduction of volume. This concentrated juice is prepared in the following manner. The juice is first of all clarified by being left to stand, then boiled in large chaldrons of tinned copper, one-third full, and the boiling liquid frequently stirred with an iron rod having its head wrapped in some common canvas or in rags which serve thus to keep the bottom of the boiler clear of all sedimentary matter; those necessary additions to the boiling liquid, which the constant evaporation of the aqueous particles renders expedient, are supplied from smaller supplementary boilers in which the liquid is kept sufficiently hot, to hinder any interruption in the ebullition of the juice contained in the large vessels. When the required density is attained, a point which is easily ascertained through the medium of the citrometer, it is poured into vats to cool, and finally drawn off through ordinary funnels into casks. Eight measures of raw juice are needed to produce one of concentrated at 60° of the citrometer, and this again when pure will contain about 30 per cent. of citric acid.

The adulteration of the acid or juice is facilitated by the ready absorption of certain well-known and easily obtainable substances, which increase the weight of the acid juice when concentrated. The most commonly employed substances for the purpose of adulteration are tartaric acid, chloride of sodium, and sulphuric acid. The methods employed in Sicily, in order to detect the cheat, if not so scientific and perhaps less accurate than those in use in England, are at least inexpensive, simple, and sufficiently effective. Thus the tartaric acid is easily detected by the addition of acetic acid and acetate of potassium, which combine with the tartaric acid to form tartrate of potash or cream of tartar. The presence of chloride of sodium is revealed by a solution of nitrate of silver, which decomposes the salt and attracts the chlorine. The sulphuric acid is likewise discovered in the juice by a less simple process. The numerous uses to which the juice, raw or concentrated, is adapted are well-known, but the two principal uses are those to which it is put, under the modified forms of citrate of lime and citric acid, the former being but a preliminary step towards the fabrication of the latter, which is the ultimate object of the produce of citrate, although in some regions where it is fabricated independently of its connection with citric acid, it forms a principal object of exportation. This separate production and exportation of citrate of lime prevails, especially throughout those regions, for which nature has done so much and men so little, in which the raw materials are so abundant and yet so little used that we witness yearly large shipments of concentrated juice and even of citrate of lime from the land of the orange, lemon, and sulphur, to those distant centres of manufacturing and commercial

activity, where capital, energy, and science more than compensate for nature's deficiencies, and the imported citrates are turned into the citric acid of commerce, which the proprietors of the vast orange and lemon groves and richest sulphur deposits in the world are unable, through want of capital, knowledge and enterprise to produce.

Citrate of Lime.

The citrate of lime which seems to be the safest form in which the acid principle can be conveyed, and is the substance whence the citric acid is directly manufactured, is now prepared to some extent in Italy, although up to within the last quarter of a century this preliminary process was considered impracticable in a remunerative point of view. A very well-known authority writing in extenso on the subject, laments in forcible terms the remissness and ignorance of his countrymen in Sicily, which alone permit foreigners to reap that harvest which Italians neglect to gather and garner for themselves. The objections raised in bygone days, from the supposed impossibility of procuring at home a sufficient quantity of proper chalk, have been shown to be utterly mistaken with respect to the production of citrate of lime, objections of a similar nature are now mooted with regard to the production of citric acid, and have been partially disproved already by the establishment of a British firm in Messina, which has undertaken successfully the manufacture of citric acid in conjunction with tartaric acid.

The theory of the chemical process for compounding citrate of lime is simple enough, the commercial value of the substance, however, depends greatly on the purity and good quality of the chalk employed. The Creta Inglese, or Craie de Mendon, were until very lately considered, not only the best sort of chalk for the purpose, but the only suitable kind, and were exclusively used in those rare exceptional cases in which citrate of lime was confectioned, rather as an experiment than as a practical speculation; the exclusiveness enjoyed by English or French chalk has been thought of late years, and the adaptability of Italian chalk recognised very generally in the manufacture of citrate of lime, which is now undertaken successfully in many parts of Southern Italy, although it is considered by some to be of a somewhat inferior quality to that fabricated abroad.

The juice which is to be operated upon is first clarified with white of egg, and warmed, after which it is drawn off and filtered into tinned boilers, in which it is heated to nearly boiling point and thoroughly saturated with finely powdered chalk, which is added gradually to the liquid, this is continuously stirred until the effervescence caused by the admixture of the carbonate of lime has ceased, when the deposit of citrate will be approximately complete; the remaining residue, which composes an acid citrate, being also easily reducible with lime milk. The supernatant liquid is now drawn off, and the solid insoluble citrate duly compressed and dried.

Citric Acid.

This most valuable substance, from the many and various uses to which it may be applied is the concentrated acid principle of the juice of the lemon, orange, and citron, but more particularly of the former,

has, strange to say, been manufactured only of late and on a very limited scale, in the land which produces all the raw materials for its preparation, except, perhaps, to a certain degree, the combustible employed, which from the scarcity of wood and absence of coal, has necessarily to be imported in a great measure from foreign lands. Indeed, up to quite recently, the very idea of making citric acid in Italy was scouted, and is only now manufactured in small quantities by one or two firms, notably by the firm of Aveline Brothers, who produce at Messina considerable quantities of citric acid in conjunction with tartaric and even sulphuric acids. Nevertheless, there seems to be no valid, or at least no insurmountable reason militating against the introduction of this industry into Sicily on a larger scale, and indeed the arguments adduced by those "laudatores temporis acti" who oppose on principle all innovations, are substantially but a repetition of those already used on other similar occasions, and especially against the feasibility of the manufacture of citrate of lime and of sulphuric acid. These arguments have been proved to be utterly unsound in the two latter instances, and they appear to be equally weak when brought forward against the introduction and diffusion of the manufacture of citric acid, as is shown by the favorable results of the few attempts made by foreigners, and as I have already stated, especially by Messrs. Aveline and Co., of Messina.

The citric acid, as produced at present is prepared as follows:—The citrate is mingled with a liquid composed of six parts of water and one part of undiluted sulphuric acid. The latter decomposes the citrate of lime and unites with the lime to form sulphate of lime or gypsum, liberating the citric acid which remains in solution in the water until evaporated into a bain-marie when the citric acid eventually crystallises in small rhombohedrons of various tints, it is finally purified with animal carbon and hydrochloric acid.

Essential Oils.

The essence industry in Sicily is both widespread and prosperous. Essence-producers and exporters are, indeed, numerous. The essential oils are derivable and derived from the rind of all varieties of the citrus group, albeit they differ considerably in quality. That expressed from bergamot rinds being the best, then follow in the order named, lemon, orange and citron essences, the relative values of the essences being in inverse order to that of the juices. The lemons and oranges serving for this purpose must be outwardly intact as well as internally healthy and sound, hence those slightly punctured, windstrewn, undersized fruit, &c., which are utilised for the production of concentrated juice are practically valueless in the expression of essence. From what I have been able to gather, the rind is first prepared by soaking it in cold water for about 20 minutes or thereabout, which preliminary operation is conducive to the turgidity of the oily vesicles and thus contributes, it is said, greatly to the expression of the oily essence. The rind is next rotated and pressed against the sponge held in the left hand, when this has become completely saturated it is squeezed over a vessel of glazed porcelain or of common earthenware. This first yield is far from pure, containing as it does a small quantity of juice and of mucilage or other organic matters, which, however slowly subsiding, form a deposit at the bottom of the vessel, the liquid sinks

next, and thus the essential oil is left alone floating on the top. The system of remuneration adopted here in Sicily is worth noticing from general fairness, as it allows of the workman being rewarded in proportion to the work performed. They are therefore neither rewarded at a fixed rate, which would encourage idleness by inducing the labourer to disregard the amount of rinds which he may squeeze, nor are they paid on the quantity of rinds employed, which might cause negligence in the squeezing of the essence; every sfumatore or strizzatore is remunerated therefore in proportion to the amount of essence he succeeds in extracting out of 35 kilos. of rinds, working day and night. This volatile substance, which serves so many purposes, is in such general demand that it commands good, and on the whole, steady price on the European markets when produced by well-known and respectable firms, so that all adulterations of these substances are carefully guarded against, although from the great facilities and inducements offered for adulteration through the ready absorption of some foreign substance, many instances have occurred of impure essential oils being exported. The most common adulteration of these volatile substances is through the medium of various fixed oils, such as resin and turpentine, and sometimes with turpentine. Apart from those scientific tests practised by those analytical chemists whose presence of late in Sicily has contributed to restore the old reputation of the Sicilian essences, tests which are not always practically available, there are several very simple methods sufficiently accurate for all ordinary cases, which require no chemical training, and, in the case of the adulteration having been effected through fixed oils or resins, no special apparatus. Should the foreign matter be an oil or a resin its presence will be revealed by pouring a few drops of the suspected liquid on a leaf of unsized paper and heating it; the heat will cause the volatile particles of the essence to fly off, leaving behind a small oily spot or stain, with a strong resinous odour if a resinous substance has been admixed; but if the substance added to the essence be alcohol, which being a spirit itself could not be detected by the same simple method of evaporation, a somewhat more complicated process is adopted in Sicily, and doubtless in the other essence-producing regions of Italy, viz: the introduction of a few pieces of chloride of lime into the adulterated essence, these combine very readily with the alcohol, and extract it from the essence. There is, no doubt, however, that the frequency of these adulterations had discredited and unsettled the market prices of this article, so that it became imperative, or at least most expedient, in some cases to submit it to analytical test ere it was exported, without which it was received abroad with much circumspection unless it bore the trade mark of some well-known firm. Thanks, however, to the measures taken of late to guarantee the genuineness of the Sicilian essential oils, these have redeemed their character and regained their place on foreign markets. *Caeteris paribus*, the value of the volatile oil depends wholly the variety of the citrus whence it is expressed, and that squeezed from the peel of the bergamot is the most highly prized, that of the lemon coming next, while the orange essence only occupies the third place in the scale of value.

Salted Fruit.

The preservation of lemons, oranges, and citrons destined for abroad, not for actual and immediate consumption in their integrity, but which

are nevertheless valuable articles of export on account of the various uses to which their juices may be applied, is a very important object in those cases where the shipment and conveyance to distant parts would be impossible either on account of the distance to be traversed or on account of the unsoundness of the fruit, or from both causes combined. It is hence customary to slice and steep the fruit in large casks filled with salt and brine.

The bitter oranges, lemons, or citrons are then first of all examined, and although not subjected to the same crucial tests which would be required were the fruit to be shipped entire, or their essence properties considered, still they must not be internally diseased, and must be of average juiciness, to be exportable and marketable. They are then soaked in salt water for a few days, the time varying between 3 and 8 days, according to the more or less maturity of the fruit.

On the arrival of the fruit it is repeatedly washed in fresh water until the salt contained has been completely dissolved and carried off. It is, however, unquestionable that whatever the preserving properties of the salt, the process involves an almost total loss of the essential oil of the peel, and a deterioration of the juice, and should only be resorted to in extreme cases, when the fruit would not be otherwise profitably used at home or shipped abroad.

In conclusion it may be stated and maintained unhesitatingly that an interchange of practical knowledge between the growers of oranges and lemons on the one hand, and the more scientific producers of all those manufactured substances which are yielded by the juices and volatile oils of the fruit would be most beneficial to both parties. The Sicilians would benefit largely by learning to utilise the rich and abundant raw materials which nature has lavished on this favoured island, the proprietors of the most flourishing and extensive orange and lemon plantations in Europe, the sole owners of inexhaustible sulphur mines would cease perhaps to neglect the full realisable value of those products, while in return the outlander would learn to pack and ship his fruit produce safely and securely to those distant ports which they now reach very often in a damaged condition through the inexperience of the growers who are lacking in the practical skill and deftness of the Sicilian in the proper sorting and packing.

AN ANTI-MALARIAL TREE.

Baron Sir F. von Mueller,* the veteran Government Botanist of Victoria, who has done so much for the economic botany of the world, sent to the Director in April, 1895, seeds of a *Melaleuca* (*M. leucadendron*), to which he thus refers:—"This tree should become of the utmost importance also to the Western Hemisphere. As a tropical tree, fit to grow in malarian swamps, and containing in its foliage much antiseptic and anti-miasmatic oil, it deserves your special attention. It will grow where no *Eucalyptus* could be reared." The young seedlings raised have now been planted out in Hope Gardens. They have grown somewhat slowly, but as they appear likely to succeed, more seed will be obtained from Australia and plants distributed to applicants.

* It is with great regret that we hear of his death on 9th October.—[*Ed. Bulletin.*]

PLAGUE OF CATERPILLARS.

The following correspondence appeared in the "Gleaner" Newspaper:—

It may not be generally known that some of the country parishes have for sometime past been, and still are suffering from a plague of caterpillars, which have caused great loss to penkeepers, doing almost incredible damage to cultivations, more especially those of grass, and almost equalling the devastation of locusts in other parts of the world.

In St. Catherine, and, particularly, in the districts ranging from Gregory Park on to Spanish Town, thousands of acres have been simply swept away by these insects, and in one case, that of a penkeeper who ships large quantities of grass to the city for sale upwards of eight hundred acres have been eaten down in the short space of about two months.

This plague, in its incipiency, is first observed by the approach of millions of butterflies, which, settling down into the grass pieces, lay their eggs there, and fly off again. These eggs quickly develop into caterpillars, which devour the blades of the grass totally, leaving nothing but the stalks, and then, changing into butterflies transport themselves into the next grass piece, depositing their eggs in turn as their progenitors did, and repeating the same process *ad infinitum*.

Possibly, this new plague is due to the destruction of our birds by the mongoose as the eggs of the butterflies, and indeed, the caterpillars themselves, formed excellent food for these birds and were quickly eaten up by them.

Perhaps, Sir, you or some of your readers, may be able to give useful information on this subject.

EXPLORATOR.

[We have noticed these large flights of butterflies in St. Catherine ourselves. From an article which appears in the current number of the "Journal of the Board of Agriculture" it appears that the attacks of caterpillars have been unusually noticeable this year in England. To prevent a recurrence of the attack it is recommended to lime infested fields with ordinary lime or gas lime and to plough it in deeply. Weeds should be kept down in fields and gardens as they afford shelter for eggs and food for the young caterpillars. Fresh pure, finely powdered soot scattered on both sides of infested plants and lightly chopped in has proved to be a considerable benefit. Lime mixed with soot in the proportion of 3 or 4 bushels of very finely triturated lime to one bushel of well powdered soot forms a pungent compound found to be very useful in similar caterpillar attacks and should be sprinkled close to infested plants. A little sulphur mixed with this composition at the rate of 1 lb. to a bushel of soot adds to its offensiveness. In market gardens and gardens and in the case of valuable crops, as cabbages, lettuces, celery, radishes, carrots and herbs, hand picking is advocated. In America baits of clover, lettuce, etc., sprinkled with Paris green are placed near infected crops to attract and poison the caterpillars. Our Correspondent's remarks about the birds receive confirmation, the article stating that "birds as partridges.

rooks, gulls, starlings and plovers are devourers of these caterpillars, and should be encouraged." We would suggest that our correspondent or any one interested should collect specimens of the caterpillars and the butterflies which lay the eggs from which they are hatched and forward same to Mr. J. E. Duerden the Curator of the Institute Museum who will, we feel sure, give the matter his attention and possibly may be able to suggest effectual means of dealing with the pest.—ED. GLEANER.]

In your issue of the 13th inst, I notice a letter from a correspondent on the subject of Caterpillars destroying grass.

In the United States the "army worms" are one of the best known of insect pests. Usually they do not occasion much loss, feeding upon the leaves of grass, etc., but sometimes become so numerous that they move along in "armies," eating everything before them. The caterpillars are of a greenish colour with longitudinal bands of yellow, gray, and black. When full-grown in about a month from hatching from the egg they enter the ground, and make earthen cells for themselves, from which in about a fortnight the handsome brown moths emerge and lay their eggs between the sheaths of blades of grass.

In the northern States one or two broods appear in the year, but in the south there are two or three in the season.

The most usual remedy is to burn the grass. To prevent their migration from field to field, boards are set up on edge inclining towards the caterpillars, and smeared on the upper edge with tar. On lawns probably the most effectual plan would be to run a heavy roller over the grass, crushing the caterpillars as they are feeding on the leaves. Another plan is to turn in poultry and pigs. Still another method is to sprinkle with Paris Green mixed with flour in the proportion of one part to eighty; caterpillars eating grass on which this is sprinkled would be at once killed.

I am, &c,

W. FAWCETT.

Department of Public Gardens,
15th October, 1896.

[INSTITUTE OF JAMAICA—MUSEUM NOTES.]

In the daily papers of the 13th inst., appeared an account of "A Plague of Caterpillars" which is leading to very considerable damage, particularly in the districts ranging from Gregory Park on to Spanish Town, where thousands of acres of grass have been swept away. The *Gleaner* suggested a number of extremely good remedies, abstracted from the "Journal of the Board of Agriculture." On the 17th inst., Mr. Fawcett, the Director of Public Gardens, referred to the matter stating the conditions in the United States in connection with the "Army-worms," and suggested suitable remedies for attacking the caterpillars here which belong to the same group as the American pests. Several correspondents have also contributed to the Museum information and material from different parts of the island. One writes as follows:—

“By to-day’s post I send you a small box with two varieties of caterpillars which have been ravaging guinea grass pastures, also eating young corn plants, potatoes and cassava in the southern districts of Manchester. I did not see the caterpillars that did so much damage in St. Elizabeth last year, but I have no doubt they were similar to these, as the first information I had this year about them was from Alligator Pond, which borders on the district infected last year. These caterpillars are now found at places more than six miles from Alligator Pond, travelling easterly, and I expect in a few weeks they will be in the neighbourhood of Milk River and soon spread to Vere. I notice a letter in the Tri-weekly *Gleaner* of 13th inst., complaining of their being in St. Catherine. “Several of my guinea grass pastures have been so fed down by those caterpillars that I can feed no stock in them and the season rains have been late in coming this year, that I am afraid there will be a shortage of food for stock unless these insects leave us shortly. From around Kingston and from Hope similar conditions are reported to exist.”

The caterpillars belong to the well-known group of the “loopers,” “measuring worms,” or “geometricians,” so named from their peculiar method of progression. They are rather long and thin, with three pairs of legs in front, and two or three pairs behind. They are found largely on trees, grasses and vegetables, the foliage of which they devour. Most larvæ of this extensive group burrow into the ground in changing into the chrysalis stage. In the Jamaican examples now under consideration the caterpillar folds the leaves around it and forms a kind of silky web, and in this condition above ground passes into the chrysalis.

Several of these have hatched in the Museum, and are evidently a species of the genus *Rimigia*. A few specimens were already in the collections, but are not specifically determined. The moth is of midling size, being about an inch and a half across the wings in the extended condition. It is dark brown with lighter and darker markings. Unlike the majority of moths it flies during the day, and is at present fairly common around Kingston and the suburbs. It is very different from that occurring in St. Elizabeth last year, which was the caterpillar of one of the arge hawk moths. From observations received later from the country, it appears that most of the caterpillars have now passed into the chrysalis state and are hatching.

Though the moths must be forms well known to entomologists in the island, the extraordinary abundance of the caterpillars at present is probably dependent upon some favourable climatic condition. Many of the remedies previously mentioned and referred to above are the best that could be suggested, and no doubt will prove effectual if persistently employed.

J. E. DUERDEN.

PINE APPLE: ANALYSIS AND MANURE.

By J. J. BOWREY, F.C.S., F.I.C., Island Chemist.

"ASH OF PINE APPLE.

Potash K_2O	...	49.42
Chloride of Potassium KCl	...	.88
Chloride of Sodium $NaCl$	...	17.01
Magnesia MgO	...	8.80
Lime CaO	...	12.15
Phosphoric Acid P_2O_5	...	4.08
Sulphuric Acid H_2SO_4	...	Trace
Silica SiO_2	...	4.02
Phosphate of Peroxide of Iron	...	2.93

99.29"

Judging from this analysis of the ash of the Pine Apple, potash is the most important mineral substance which it requires. Of course phosphoric acid is also necessary, and so are lime, magnesia and iron, but it must be a very rare soil which does not contain iron and magnesia in ample quantity and usually there is enough lime also present. It is difficult to make suggestions respecting manuring in total ignorance of the nature of the soil to be manured. But certainly no harm can be done and probably much good by adding phosphoric acid and potash to the soil; the former best as finely ground Basic Slag or Thomas' Phosphate Powder price about 55s. per ton f.o.b. in England. A dressing of from 5 to 10 cwts. per acre will supply phosphoric acid for 3 or 4 years and also some quantity of lime. The potash can I think be obtained here or imported into Jamaica most cheaply as chloride of potash; its price is about £8 per ton f.o.b. in England. From $\frac{1}{2}$ to 1 cwt. per acre would be a dressing for a year.

But the Pine Apple also needs nitrogen for its growth; this might be supplied as nitrate of soda at £10 per ton,—giving 1 cwt. per acre when the plants have started to grow rapidly.

FERNS: SYNOPTICAL LIST—XLI.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Garden, Demerara.

53. *Nephrodium pedatum*, Hook. — Rootstock short, erect, clothed with dark-brown subulate scales; stipites tufted, erect, 3-7 in. l., channelled, dark-brown or ebeneous, polished, clothed at the base like the rootstock; fronds cordate, subdeltoid, coriaceous, copiously pellucid-dotted, naked, the upper side very dark-green, under paler; 3-6 in. each way, tripartite; the central division largest and more or less deeply cut into broad oblong blunt or acute lobes; lateral divisions deeper on the inferior side and these pinnatifid like the central one, the superior side being shallowly lobed or sinuate; lobes $\frac{1}{2}$ - $\frac{3}{4}$ in. w. the lower ones 1-2 in. l. costal ribs flexuose, prominent, but evanescent outwards; veins immersed, pinnate in the lobes, the branches simple or forked, termi-

nating short of the edge of the margin or casually uniting; sori medial, terminal on a veinlet, involucre dark, coriaceous.—*Aspidium*, Desv.

Infrequent on rocks in moist woods from 3,000-4,000 ft. altitude; gathered in several parts of Portland. The fronds vary from subentire or trilobed to the state described. The largest are cut quite to the rachis, which is free $\frac{1}{4}$ - $\frac{1}{2}$ an inch, at the base of the central division; generally however it is winged there. The substance though pellucid, becomes opaque usually in drying. Casually the branches of the inferior veins, which do not run to the margin, curve and unite at their tips forming large interior areolæ. The aspect of the plant is that of young *Aspidium trifoliatum*, but the substance is thicker.

54. *N. cicutarium*, Swartz.—Rootstock $\frac{1}{4}$ - $\frac{1}{2}$ in. thick, shortly elongated and repent, coated with small brown scales; stipites tufted, spreading 2-6 in. l., slender, slightly deciduously scaly and puberulous; fronds prostrate, oblong, acuminate, 6-15 in. w., usually broadest at the shoulders and a little narrowed toward the base membranous-chartaceous, pellucid, glabrescent, the ribs slightly pubescent, dark-green; pinnæ distant below the pinnatifid apex opposite, spreading, deeper on the inferior side, 1-3 $\frac{1}{2}$ in l. $\frac{1}{2}$ -1 $\frac{1}{2}$ in. w., lobed or deeply pinnatifid, or the inferior shortly petiolate ones fully pinnate at the base, segments spreading, decurrent, with a rounded oblique sinus and their own width or more between them, blunt, repand sinuate or lobate, $\frac{1}{2}$ -1 in. l. from the sinus, $\frac{1}{4}$ - $\frac{1}{2}$ in. w.; rachis slender puberulous; viviparous in the axil of one of the central or upper pinnæ; veins copiously areolated, without free included branches; sori biserial in the lobes, often extending round the sinuses, confined usually to the upper half of the frond; involucre reniform-orbicular.—Sl. Herb. pg. 99. Pl. Fil. t. 150. *Aspidium hippocrepis*, Sw. *Polypodium*, L.

Common on dry banks and rocks in several parts of the country below 2,000 ft. altitude, usually at low elevations. There is a small form in which the fronds are only three or four inches long and one to two wide, fully pinnate only at the base, the pinnæ simply lobed or sinuate, with the exterior vein-branches free and the surface and rachises more pubescent. In the larger state the pinnæ are 2-3 inches apart. Of this there is a quite glabrous form. Differs from the next by its less compound state, small size, and prostrate habit.

55. *N. apiifolium*, Schk.—Rootstock very stout, erect, often a foot or more high, the crown clothed with brown scales; stipites cæspitose, strong, erect, naked, except at the base, 1 $\frac{1}{2}$ -2 $\frac{1}{2}$ ft. l.; fronds erect, ample, 2-3 ft. l. 1 $\frac{1}{4}$ -1 $\frac{3}{4}$ ft. w., bipinnate and again pinnatifid, as wide or widest at the base, the apex acuminate and pinnatifid, chartaceous, glabrous, the ribs rusty above, dark glossy green, papillose on the upper side; pinnæ spreading, opposite, petioled $\frac{1}{4}$ -1 in., oblong acuminate, 1-1 $\frac{1}{2}$ ft. l. 4-8 in. w., deeply pinnatifid or fully pinnate at the base; pinnulæ oblong lanceolate, 2-5 in. l. $\frac{1}{2}$ -1 $\frac{1}{4}$ in. w., the larger acuminate, decurrent at the base and more or less apart, lobed or pinnatifid from $\frac{1}{3}$ rd- $\frac{2}{3}$ ths deep; lobes 2-4 l. w. $\frac{1}{4}$ - $\frac{3}{4}$ in. l. blunt or rounded; rachis strong, channelled; veins freely areolated; sori biserial in the lobes, sunk; involucre reniform-orbicular, persistent.—*A. dilaceratum*, Kunze.

Common and widely diffused through the country on wet rocks

in woods or shady places; abundant in the eastern and central parishes. The sori are chiefly on free included appendages, the other areolæ being devoid of veinlets. The papillose surface is a striking feature in the growing plants. The upper pinnæ are adnate to the rachis and the higher ones decurrent. All the segments but the ultimate lobes are sharp.

56. *N. macrophyllum*, Swartz.—Rootstock stout, erect; stipites cæspitose, erect, strong, 1-2 ft. l. brown or purplish, with a few deciduous scales chiefly at the base; fronds erect, oblong, pinnate, 1-2½ ft. l. from less than 1-2 ft. w.; chartaceous, the surface repand usually naked, light or dark green, paler beneath; pinnæ in 2-6 or more usually large, distant pairs, horizontal or erecto-spreading, acuminate, 8-12 in. l. 1-3 in w.; the lowest pair not shortened, and shortly stipitate or sessile, forked, inferior division the shorter, the midrib below the fork devoid of membrane on the inferior side at the base; upper pinnæ more or less adnate at the base, specially on the lower side of the midrib, those below these rounded and free, not often lobed; terminal division large, decurrent tripartite generally, the central segment largest, and often deeply lobed, margins repand or sinuate lobate, main veins costæform, curving and evanescent at the margins, ¼-½ in. apart, the areolation fine, with free included veinlets; sori biserial between the primary veins, contiguous to and parallel therewith, involucre reniform-orbicular, persistent.—Pl. Fil. t. 145. *Aspidium*, Sw.

a. var pilosum—Both surfaces freely pubescent, including both rachis and stipe.—*Cardiochlaena pilosa*, Fée.

b. var. viviparum.—Pinnæ more numerous, mostly viviparous near the base on the upper and superior side; the lower ones lobed on both sides, pinnatifid or fully pinnate at the base.

Common in woods and forests and half-open places at low elevations. Variable in size, and in the number, lobing and size of the pinnæ. The forked basal pair have often a small lobe or lobes on one or both sides of the main divisions, and this incipient lobing sometimes extends to the two or three pairs next above them. *a.* was gathered by Miss Taylor in Jamaica. Her specimen, which I have, is densely pilose, but otherwise does not differ from the type. This form is found also in Brazil. *b.* is very abundant along some of the Guiana Rivers. The proliferous habit which it has developed in its aquatic home is a striking feature, the plants usually supporting numerous young, more or less developed, plants on their leaves. The pinnæ too are more numerous, and deeply lobed on both sides.

CONTRIBUTIONS TO THE DEPARTMENT.

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 SEEDS.

- From R. Botanic Gardens, Trinidad—*
 Thrinax argentea
 Peltogyne porphyrocardia
From Botanic Gardens, Rockhampton, Queensland.
 Bowenia spectabilis, var. serrulata
From Royal Gardens, Kew.—
 Dendrocalamus Brandisii
 Rhodomyrtus tomentosa
 Thysostachys Copelandii (New Bamboo)
From Messrs. Reasoner Bros, Florida.
 Serenoa serrulata
From Messrs. Damman & Co., Italy.—
 Morus alba
 M. nigra
 Strelitzia augusta
 S. juncea
 S. ovata
 S. Reginæ
 Lilium cordifolium
 Araucaria imbricata
From Col. Ward, Petersfield.—
 Citron
From Mr. S. G. Lawrence, Friendship, Lambs River.—
 Aster—seven varieties

From *Mrs. Julian Hawthorne*, (inadvertently omitted from previous lists).

Mammillaria	micromeris	Greggi
M.	lasiacantha	plumosa
M.	echinata	
M.	applanata	
M.	pusilla	
M.	daemonoceas	
M.	sp.	
M.	Bergonii	
E.	cornifera	

From *Royal Botanic Gardens, Trinidad*, (inadvertently omitted from previous lists.)

Oncidium	iridifolium
Diacrum	bicornutum
Oncidium	Papilio
Catasetum	tridentatum
Stanhopea	grandiflora
Oncidium	luridum
Epidendrum	Hartii, n.sp.
Oncidium	ampliatum
Epidendrum	Schomburghkii

From *Botanic Garden, Demerara*, (inadvertently omitted from previous lists).
Seedling Canes, Nos. 32, 89, 117, 119, 124, 145, 212, 246.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of November:—

IN FLOWER.	IN FRUIT.
Acacia brachybotrya, Benth.	Barringtonia Butonica, Forst.
Acacia cyanophylla, Lindl.	Bauhinia variegata, Linn.
Apeiba Tibourbou, Aubl.	Cananga odorata, Hook. f. & Thoms.
Aphelandra fulgens, Decne.	Coccoloba latifolia, Lam.
Bauhinia megalandra, Griseb.	Colvillea racemosa, Boj.
Calophyllum Calaba, Jacq	Garcinia Mangostana, Linn.
Cananga odorata, Hook. f. & Thoms.	Imbricaria maxima, Poir.
Cassia glauca, Lam.	Manihot Glaziovii, Muell. Arg.
Cassia bacillaris, Linn.	Michelia Champaca, Linn.
Cassia siamea, Lam.	Pachira aquatica, Aubl.
Colvillea racemosa, Boj.	Rhodoleia Championi, Hook.
Combretum coccineum, Lam.	
Couroupita guianensis, Aubl.	
Dillenia indica, Linn.	
Eriobotrya japonica, Lindl.	
Erythroxylon Coca, Lam.	
Eugenia caryophyllata, Thunb.	
Furcræa cubensis, Vent.	
Miconia magnifica, Triana	
Michelia Champaca, Linn.	
Musa coccinea, Andr.	
Napoleona imperialis, Beauv.	
Norantea guianensis, Aubl.	
Oncoba spinosa, Forsk.	
Rhodoleia Championi, Hook.	
Semecarpus Anacardium, Linn. f.	
Swartzia grandiflora, Willd.	
Tectona grandis, Linn. f.	
Trachylobium verrucosum, Oliver	

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

Soil Ferments Important in Agriculture. II	—	PAGE 241
Micro-Organisms & Tobacco	—	248
Orchid for Naturalisation	—	253
Coccidæ or Scale Insects.—IX	—	256
Jaffa Orange	—	259
Ferns: Synoptical List.—XLII	—	260
Contributions to the Department	—	262
Castleton Gardens	—	264

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BULLETIN

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Part II.

SOIL FERMENTS IMPORTANT IN AGRICULTURE.

By DR. W. H. WILEY, Chief of the Division of Chemistry,
U. S. Department of Agriculture, in *Louisiana Planter*.

(Continued).

UTILITY OF TILLAGE.

Among the influences which favour the process of nitrification tillage of the soil must be mentioned. A thorough breaking up of the soil and of the upper layers of the subsoil is necessary to the aeration, which is an indispensable condition to the progress of nitrification. The cultivation of the soil, therefore, in this way not only makes it possible for the rootlets of the plants to extend to a greater distance, and thus secure larger quantities of food, but actually increases the available quantity of nitrogenous food in the soil. In connection with thorough drainage the best tillage of the soil tends to make available its stores of inert nitrogen.

NECESSITY FOR LIME.

Since the final action of the nitrifying organisms results in the production of nitric acid, it is highly important that the soil contain some substance capable of combining with this acid, and thereby preventing its accumulation in a free state. The activity of these ferments is diminished by the presence of an acid and increased by a moderately alkaline environment. If the acid be allowed to accumulate to a certain point, not only is the activity of the ferments suspended, but a positive injury may be done to a growing crop. All practical farmers know how poorly sour lands respond to cultivation, and this injurious influence is due not only to the action of the acid upon plant growth, but also in a high degree to its effect in preventing the evolution of the nitrifying organisms. It is well known that a soil which has an abundant content of carbonate of lime is, as a rule, fertile. The value of lime as a fertilising agent in many soils is well attested, yet it is certain that this favourable effect is not due to the fact that an additional amount of lime is necessary for plant food. Soils are rarely found which do not contain an abundant supply of lime for all the nutritive needs of

plants. It is certain, therefore, that the chief value of the use of lime in agriculture is to be found in some indirect influence, which it exerts upon the soil. Heretofore three special methods have been pointed out in which lime exerts a beneficial influence. In the first place, it profoundly affects the physical structure of stiff soils, producing a flocculation of the silt, and thus preventing its deposition in individual particles. A well-limed soil is thus apt to be open and porous, and easily tilled. In the second place, the lime exerts a certain soluble influence on undecomposed particles of rock, thus favouring the speedy decomposition and the consequent freeing of the potash and phosphoric acid which they contain. In the third place, the added lime tends to correct any acidity of the soil which may be due to the accumulation and excess of humus, or which may arise from imperfect drainage.

It must be admitted, however, that one of the chief benefits of the introduction of lime into a soil is derived from the fact that it favours in a high degree the evolution and development of the nitrifying ferments.

The lime which is used for fertilisation is, as a rule chiefly in the form of oxide or hydrate, that is, slacked lime. After its incorporation in the soil, however, both the oxide and hydrate of lime are rapidly changed to carbonate under the influence of the carbon dioxide (carbonic acid) which is found in the atmosphere of the soil in notable proportions; in fact, in a much higher percentage than in the air. The soil thus becomes permeated with lime carbonate in a fine state of subdivision, a condition especially well suited to favour the growth of the nitro-organisms. Hereafter, therefore, in discussing the benefits of the application of lime, this function of it must receive due consideration. It will not be at all surprising if future investigations should establish the fact that this use of lime is of far more importance in agriculture than any of the others above noted.

SEEDING THE SOIL WITH NITRIFYING ORGANISMS.

In the previous paragraphs the conditions favouring the development and activity of nitrifying organisms have been briefly set forth, but the presence of all these favouring conditions will prove of no advantage in a soil which is practically sterilised. In such a case, however, if a few organisms can be supplied, a practically sterilized soil will, after a time, by the natural growth and distribution of nitrifying organisms, become fully impregnated with the nitrifying germs. The question naturally arises, is there any artificial way in which the seeding of the soil may be accelerated? The answer to this question is undoubtedly affirmative. In experiments which have been conducted in this department, and of which notice will be made further on, it has been fully demonstrated that different soils differ in the most marked degree in the number and vitality of the nitrifying organisms which they contain. As a rule, the richer the soil or the more highly fertilized it has been and the more fully cultivated, the greater will be the number of the organisms which it contains and the higher the degree of their vitality. It is thus seen that in a field which contains all the elements of fertility, but which by reason of unfavourable conditions, as, for instance, having previously been a swamp or marsh deficient in nitrifying organisms, may be practically sterilised, great benefit may be derived by spreading

over it as evenly as possible a little soil taken from a rich garden which has been kept in excellent cultivation. The amount of plant food added in such a soil would not be of any great importance, but the nitrifying organisms thus distributed would rapidly grow in the favourable environment in which they were found and the inert nitrogen of the field be thus speedily prepared for the wants of the growing crop.

The action of stable manure is another instance of the great benefit which is derived from manuring a field with nitrifying organisms. It is well known that the nitrifying ferments of decomposing stable manure are particularly numerous and vigorous. The production of ammonia in a pile of stall manure is often so rapid, as to be distinctly noticed by the passers-by from the odour produced. It has long been a matter of wonder among agronomists to find stall manure, when scattered over field, producing fertilizing results far in excess of what could be expected from quality of plant food contained therein. In the light of the facts set forth above, however, these results are no longer surprising. In the distribution of the manure large numbers of a particularly vigorous species of nitrifying organisms are incorporated with the soil, and these and their progeny continue to exercise their activity upon the inert nitrogen of the soil when the more easily nitrifiable portions of the stall manure are exhausted. The result brings to the attention of the scientific agronomist an entirely new factor in the process of fertilisation. Even in the poor soils chemical analysis often discovers quantities of plant food which seem amply sufficient to produce remunerative crops. The true theory of fertilisation, therefore, not only looks to the addition of appropriate plant foods to a soil deficient therein, but also to the making available the stores of plant food already present.

FERTILISING FERMENTS.

When the soil is practically free from albuminoid bodies and contains but little humus, the attempt to develop a more vigorous nitrifying ferment would be of little utility. Even in a soil containing a considerable degree of humus, it may be found that its nitrogen content has been so far reduced as to leave nothing practically available for the activity of nitrification. In such cases the only rational method of procedure is the application of fertilisers containing nitrogen. In other cases where the lack of fertility is due to the extension or attenuation of the nitrifying ferment, remunerative results may be obtained by some process of seeding similar to that described above. It is entirely within the range of possibility that there may be developed in the laboratory species of nitrifying organisms which are particularly adapted for action on different nitrogenous bodies. For instance, the organism which is found most effective in the oxidation of albuminoid matter may not be well suited to convert amides or the inert nitrogen of humus into nitric acid. We have already seen the day when the butter maker sends to a laboratory for a ferment best suited to the ripening of his cream. It may not be long until the farmer may apply to the laboratory for particular nitrifying ferments to be applied to such special purposes as are mentioned above. Because of the extreme minuteness of the organisms the too practical agronomist may laugh at the idea of producing fertility thereby, and this idea, indeed, would be of no value were it not for the wonderful facility of propagation which an organism of this kind

has when exposed in a favourable environment. It is true that the pure cultures which the laboratory would afford would be of little avail if limited to their own activity, and it is alone in the possibility of their almost illimitable development that their fertilising effects may be secured.

NUMBERS AND KINDS OF NITRIFYING ORGANISMS.

In regard to the numbers and kinds of organisms, which take part in the evidence of nitrogenous bodies, our knowledge is limited. It has already been noted that a great many species take part in the production of ammonia. The purely nitrous and nitric ferments seem to be of a more limited character, but it must not be forgotten that scarcely a beginning has been made in the investigation of these bodies, and it is entirely probable that the great differences in their nature will be established. It is not at all likely, for instance, that a nitrifying organism such as exerts its activity in an ordinary soil under ordinary conditions would belong to a species which was capable of development and work in an entirely different medium. There are in the arid regions indubitable evidence of strong nitrification in the presence of highly alkaline salts. While it is true that a slight alkalinity favours the ordinary form of nitrifying activity, it is likewise certain that such organisms would be practically paralysed if subjected to the alkaline environment of the arid plains. It is therefore highly desirable that the investigation of these organisms be pushed to the widest extent, not only for the scientific value of the investigation, but also for its practical utility in scientific farming. This is one of the objects kept in view in the investigation which the department has undertaken in respect of the extent and character of the nitrifying ferments in the typical soils of the United States.

FERMENTS OXIDIZING FREE NITROGEN.

In the preceding paragraphs the attention of the reader has been briefly called to the action of those species of ferments which attack nitrogen in some of its forms of combination. Since nitrogenous food is the most expensive form of nutriment which the plant consumes, it is a matter of grave importance to agriculture to know the full extent of the supply of this costly substance. It is evident that the continued action of nitrifying ferments finally tends to exhaust the store of this substance which has been provided in the soil. The quantities of oxidized nitrogen produced by electric discharges in the air and by other meteorological phenomena, and which are brought to the soil in rain waters are of considerable magnitude, but lack much of supplying the ordinary wastage to which the stores of soil nitrogen are subjected. Even with the happiest combination of circumstances, it is not difficult to see in what way the available stores of nitrogen could be diminished to a point threatening the proper sustenance of plants, and thus diminishing the necessary supplies of human food. The examination of the drainage waters which come from a fertile field in full cultivation is sufficient to convince the most sceptical of the fact that the growing crop does not by any means absorb all of the products of the activity of the nitrifying ferments, Nitric acid and its compounds, the nitrates, are exceedingly soluble in water, and for this reason any unappropriated stores of them in the soil are easily removed by heavy downpours of rain. Happily the living

vegetable organism has the property of withholding nitric acid from solution, either by some property of its tissues or more probably by some preliminary combination which the nitric acid undergoes in the plant itself. This is easily shown by a simple experiment. If fresh and still living plants be subjected to the solvent action of water, very little nitric acid will be found to pass into solution. If, however, the plants are killed before the experiment is made, by being exposed for some time in an atmosphere of chloroform, the nitric acid which they contain is easily extracted by water.

The losses, therefore, which an arable soil sustains in respect of its content of nitrogenous matter must be supplied either by the addition of nitrogenous fertilisers or by some action of the soil whereby the nitrogen which pervades it may be oxidised and fixed in a form suited to the nourishment of plants. The discussion in regard to the possibility of fixing nitrogen in the soil has been carried on with great vigour during the last two decades. The proof, however, is now overwhelming that such fixation does take place. It would not be proper here to enter into a discussion of the processes by which this fixation is determined, and, in fact, they are not definitely known. One thing, however, is certain, viz; that it is accomplished by means of nitro-organisms or ferments, similar, perhaps, in their nature, to those already mentioned, but capable of absorbing, assimilating, and oxidizing free nitrogen.

METHODS OF OXIDIZING FREE NITROGEN.

At the present time it is sufficiently well known that this operation takes place in two ways. In the first place, there are found to exist on the rootlets of certain plants, chiefly of the leguminous family, colonies of bacteria, whose function is known by the effects which they produce. In such plants in a state of maturity, as was mentioned above, are found larger quantities of organic nitrogen than could possibly have been derived from the soil in which they were grown or from the fertilisers with which they are supplied. Cultural experiments in sterilised soils, with careful exclusion of all sources of organic nitrogen, have proved beyond question that this gain in nitrogen is found only in such plants as are infected by the organism mentioned. The logical conclusion is, therefore, inevitable that these organisms, in their symbiotic development with the plant rootlets, assimilate and oxidize the free nitrogen of the air and present it to the plant in a form suited to absorption. Attempts have been made to inoculate the rootlets of other families of plants with these organisms, but so far without any pronounced success. There are, however, certain orders of low vegetable life—such as cryptogams, for instance—which seem to share to a certain degree the faculty of the leguminous plants in acting as a host for the nitrifying organisms mentioned. The observation above recorded becomes a sufficient explanation of the fact that the fertility of fields is increased by the cultivation of leguminous plants, which would not be possible except they could develop some such property as that which has already been described.

Another order of organisms has also been discovered which is capable of oxidizing free nitrogen when cultivated in an environment from which organic nitrogen is rigidly excluded. It seems probable, therefore, even in soils which bear crops not capable of developing nitrifying or-

ganisms on their rootlets it is possible that the actual stores of available nitrogen may be increased. This fact explains the observation which has frequently been made that in the fields which are not cultivated, but which remain in grass, there may be found an actual increase in the total amount of nitrogen which is available for plant growth. As will be seen further along, the soil is also infested with an organism which is capable of destroying nitric acid and returning the nitrogen which it contains in the air in a free state. It seems almost certain that in every complete decomposition of a nitrogenous organism a part of the nitrogen which it contains escapes in the free state. Were it not, therefore for the fact that this free nitrogen can be oxidised and made available for plant growth, the total stores of organic nitrogen in existence would be gradually diminished, and the time would ultimately come when their total amount would not be sufficient to sustain a plant life abundant enough to supply the food of the animal kingdom. Thus the earth itself, even without becoming too cold for the existence of the life which is now found upon it, might reach a state when plant and animal life would become practically impossible by reason of the deficit of nitrogenous foods.

Much less is known concerning the character and activity of the organisms that oxidize free nitrogen than of those which feed upon organic nitrogen. It cannot be doubted, however, that these scarcely known ferments are of the greatest importance to agriculture, and the further study of their nature and the proper methods of increasing their activity cannot fail to result in the greatest advantage to the practical farmer.

FERMENTS INIMICAL TO AGRICULTURE.

It has been noticed by many observers that when nitric acid is subjected to certain fermentative processes it becomes decomposed and gradually disappears. In studying the causes which lead to this decomposition it is found that it is due to the action of a micro-organism or ferment, which, by reason of the result of its functional activity, is called a denitrifying organism. While it is true that in numbers and activity this denitrifying organism does not equal its nitrifying relation, yet it is a matter of no inconsiderable importance to know fully the laws which govern its existence. As in the case of the bacteria which are found in ripening cream, where some produce evil and some good effects, so it is also with those in the soil. The favouring organisms, whose functional activity prepares nitrogen in a form suited for plant food, are accompanied by others, doubtless nearly related to them, whose functional activity tends to destroy the work which the first have accomplished. It thus happens that in the fermentation of nitrogenous bodies there is danger of losing, as has already been said, a part of the nitrogen, which may either escape as gaseous oxides unsuited for the sustenance of plants, or even as free nitrogen. The object, at least the practical object, of the investigation of these denitrifying organisms should be to discover some process by which their multiplication could be prevented and their activity diminished. At the present time all that is known is that in favouring circumstances these organisms are not developed in sufficient number to prove very destructive. It has already been mentioned, however, that in case of a very great excess of organic nitrogenous matter a considerable quantity of the nitrogen therein con-

ained may, through the action of these organisms, be lost. The practical lesson taught here is to apply nitrogenous foods in a moderate manner and avoid every unnecessary excess.

PATHOGENIC FERMENTS.

There are also other forms of ferments in the soil of an objectionable nature which are not related to the nitrifying organism. It has been observed in France that in localities where animals are interred which have died of charbon the germs of this infectious malady persist in the soil for many years, and that, especially when cereal crops are cultivated upon such soil, there is great danger of contaminating healthy cattle with the same disease. In one case it was observed that many sheep which were pastured in a field in which, two years before, a single animal which had died of charbon was buried, were infected with the disease and died. In like manner, it is entirely probable that the germs of hog cholera may be preserved in the soil for many years to finally again be brought into an activity which may prove most disastrous for the owners of swine. Every effort should be made by agronomists to avoid infecting the soil by the carcasses which are dead from any zymotic disease. Cremation is the only safe method of disposing of such infected carcasses. The investigations of scientists have shown that there are many diseases of an infectious nature due to these germs, and that these germs may preserve their vitality in the soil. Among others may be mentioned yellow fever and tetanus.

USE OF SEWAGE AS FERTILISER.

For the reason given above, the agronomist who also has at heart the health and welfare of man and beast can hardly look with favour upon any of the plans which have been proposed for the use of sewage from large cities for irrigation purposes. There is scarcely a time in any large city when some infectious disease, due to the activity of germs, does not exist, and the sewage is liable at all times to be contaminated therewith. In view of the fact that the vitality of the germs mentioned above may be continued for a long time in the soil, it is fair to conclude that it is of the utmost importance to avoid the contamination of the soil, where it is to be used for agricultural purposes, with any of the dejecta which may come from those infected with any zymotic disease whatever.

(To be continued.)

[MICRO-ORGANISMS IN THEIR RELATION TO TOBACCO PLANTING AND TOBACCO MANUFACTURE.

A REVIEW BY DR. BEHRENS.

*Abstracted and translated from Centralblatt für Bakteriologie and
Parasitenkunde by PERCIVAL H. GREG.*

Among diseases supposed to be caused by the activity of Micro-organisms, the writer mentions the "mosaic disease," which makes its appearance in certain districts of the Netherlands, and also in Germany. Tobacco leaves attacked in this manner take on a sort of mosaic-work pattern, caused by some parts of the leaves taking on a darker, others a lighter shade. Those parts that take on a lighter shade are thinner and finally die; the leaves then curl up, and for that season are useless for manufacturing purposes. Adolph Mayer concludes that the disease is of an infectious nature and due to the presence of an organised disease-producing ferment, for the reason that if the juice of such infected leaves is placed on healthy leaves, especially young ones, they were attacked in the same manner, while if the same juice had been previously kept at a temperature of 80° C. (176° F.) for several hours, treated with absolute alcohol, or filtered through several layers of filter paper, the juice lost its power to produce the disease. But the bacteria which were isolated out of the juice of such leaves were powerless on infection experiments being performed to produce a similar result. In a later communication it is related how a planter was successful in overcoming the attack by simply renewing the earth in his seed beds. While 25 per cent. of the plants from the old beds were attacked, among those from the new beds scarcely one diseased one could be found. More recently, Breda de Haan, in two articles, has been treating of the nature of the *Bibitziekte*, a disease by which the young seedlings or cuttings in Deli are attacked. He shews that it is caused by a *Phytophthora* which he provisionally names *Ph. Nicotianæ* (new species.) He also discovered how to battle with the disease and hold it in check to a considerable extent. This consists partly in a modification of the generally followed rules in raising the seedlings, which are to be kept drier and more exposed to the light than was previously the case partly in the employment of the copper-containing liquids which have been used with such success in the case of the *Peronosporæ*, especially the copper lime mixture.

Other diseases of Tobacco in the various stages of its preparation are spoken of as generally considered by various investigators to be due to micro-organisms, but nothing very definite appears to be known, though in the case of a disease of Tobacco investigated by Sturgiss and called Pole Burn, supposed to be identical with the German "Roof Burn," the author appears to have reached some definite result. Leaves so attacked are covered with dark brown to black patches, looking like so many burnt spots; in presence of sufficient moisture these patched grow larger and finally cover the whole leaf, which then becomes soft and wet, and is easily torn on being handled. It is, in fact, a decompo-

sition of the leaves, which only appears and becomes capable of working mischief when sufficient moisture is present. According to Sturgiss, this is caused by bacteria, which swarm on the leaves, among which two forms were invariably found in company, one a rod-shaped organism and the other a micro-coccus. Careful observation of healthy dry leaves, which were brought into a room saturated with moisture, shewed that the disease progressed in the following manner: first, small, brown patches caused by a *Cladosporium* were found here and there on the leaves; at the expiration of some weeks, this organism which did not multiply further, died off, and in its place appeared the above-mentioned bacterium. The author considers this pole burn to be primarily due to the presence of a mycelium, which partially destroys the leaf cells and thus allows of the entrance of putrescent bacteria into the tissues, and it is owing to this that the otherwise harmless *Cladosporium* becomes harmful. The remedy is self-evident, from the fact that in dry air the leaves are not attacked. Finally, the hastening of the drying process by artificial heat is indicated.

A disease called "Stem-Rot," which Sturgiss examined, is also mentioned. It appears on the stems of the tobacco leaves when hung up to dry. At first, a pure white, satin-like mildew appears on the stems, consisting of the mycelium of a *Botrytis* which the author identifies with *Botrytis longibrachiata*, Oudem. This fungus destroys the fibre and especially injures the leaves by inducing a foul decomposition. When the tobacco is ripe and has passed into the hands of the manufacturers, it is subjected to a so-called "fermentation process," which is brought about by putting the tobacco bundles into great heaps, on which the whole mass becomes warm. That this spontaneous heating is due to the activity of micro-organisms was formerly more a matter of conjecture than actual knowledge. The temperature in the middle of the heaps varies very much according to circumstances. The more the loss of heat is prevented externally, the greater, up to a certain point, will be the temperature in the middle of the heaps. Consequently, big heaps become warm quicker and easier than small ones. It is self-evident that a certain amount of heat and moisture is necessary to the commencement of the fermentation. In practice Nessler has recorded in the middle of the heaps a maximum temperature of 135.5°F . Suchsland that of 141.8°F . As a rule the temperature is not allowed to rise higher than 122°F ., the heaps are then taken asunder and built up again, care being taken that the outside of the heap is in the middle. This turning over is repeated until the whole mass is thoroughly fermented. Regarding the aim of the fermenting process, nothing very definite is known up to the present time. This much is certain that the fermentation improves the appearance and aroma of the tobacco, and perhaps it is only then that it becomes durable and transportable. The most important chemical change during fermentation consists in the loss of nicotine, about 24 to 28 per cent. of the original quantity disappearing. Behrens, who in his researches showed that the nicotine is not present in a free state, either in fermented or unfermented tobacco, but in a non-volatile combination, considers it probable that part of the nicotine is used up by the organisms of fermentation for their nutriment. He even proved by an experiment, under not too favourable conditions, that the mould *Botrytis cinerea* was able to supply itself with the ne-

cessary nitrogen for its nutrition from the nicotine present. Concerning the organisms which bring about the fermentation of tobacco, we scarcely know anything, notwithstanding the great interest which this question has of late years attracted, since the publication by Suchsland of his idea of improved fermentation. His idea is founded on the same point of view which led to the introduction of pure yeast into the fermentation industries and of pure lactic ferments into creameries, etc. Suchsland isolated the bacteria of tobacco from different sources, and found great differences among them. The organisms observed were mostly rod-shaped, less often spherical. They swarm on all raw tobacco in great numbers, but of not many kinds. When Suchsland had cultivated them in pure cultures and brought them on to other kinds of tobacco, the result was that they flourished and brought about in such tobacco changes in taste and aroma, agreeing with that of the tobacco from which they were originally derived. Suchsland, therefore proposed to inoculate before fermentation the ripe leaves of the poorer kinds of tobacco, with germs derived from the finest tobacco, such as Havanna, in order to obtain a good fermentation by means of these superior kinds of bacteria. Stimulated by Suchsland's first attempt, A. Koch experimented with Eichsfelder tobacco by adding to it cultures of these superior germs, and likewise obtained favourable results. Yet neither of these investigators have published any further information concerning the morphology and biology of the organisms which they have isolated, and specially their action on tobacco in pure cultures. Among practical men this method does not appear so far to have inspired much confidence.

After fermentation has been completed, the raw tobacco is prepared for the purpose for which it is ultimately destined, for which of course, its treatment subsequently varies accordingly. In this respect, it may be classed in two great divisions, of which the one comprises all tobacco destined for smoking purposes, such as cigars and pipe tobacco, while in the other is included the tobacco destined to be manufactured into snuff and chewing tobacco. In both of these divisions the tobacco has to undergo a certain preliminary treatment during which fermentation phenomena play no unimportant part and must assist considerably in preparing and improving the tobacco for the purposes for which it is to be employed. Wagner mentions, especially among the means adopted for the improvement of tobacco, the refining influence of age through long storage, a method especially employed with pipe and cigar tobacco. By this means, according to Wagner, many evil-tasting ingredients are destroyed or lessened on account of an imperceptible fermentation. The taste becomes milder; but if kept too long the tobacco generally becomes tasteless. There are no researches shewing whether the improvement of tobacco by storage is really partly or entirely due to the activity of organisms. But on the face of it, it does not seem either impossible or improbable, since for the purpose of ageing the tobacco, it is stored in a moderately warm and damp place under a limited access of air, thus the conditions are, in fact, favourable to the growth of organisms. That storage does not always improve the quality, and that under certain conditions organisms can grow which injure the quality, every smoker of a cigar which has become mouldy through too damp storage knows.

Frequently, however, smoking tobacco after the first fermentation, is

subjected to still another operation for the purpose of improving it which undoubtedly is connected with the introduction of fermentation agencies, and which attain the end of improving the taste and aroma much quicker than simply ageing. Such a treatment, Semler and Hananek say, is the custom in Cuba * Torn and injured leaves which are therefore of no use for cigar manufacture, but which nevertheless must be of irreproachable taste and aroma, are picked out and laid in water for about 8 days, till they become rotten. After the tobacco crop has been fermented and become dry, the separate bundles of tobacco are opened and moderately sprinkled with this water, but very cautiously, and in such a manner that they are not made too damp, as every leaf too damp or soft would rot. The bundles consisting of 20 to 30 leaves are then bound together again, and hung up for some hours in the drying house to get rid of the superfluous water. As soon as that is finished the bundles are tightly packed in boxes in which they remain until given over to be manufactured. Hananek has in his treatise, with perfect right, concluded that a fermentation takes place in the boxes, caused by the addition of organisms with the maceration water of the rotted leaves, and he points out the analogy between this method and the attempts of Suchsland and Koch to improve their tobacco by means of pure cultivated germs.

Even the twisting of tobacco influences the quality in as far as in the rolls a secondary fermentation takes place. According to Wagner, Virginia tobacco has, when fresh, a disgusting smell, which only disappears after 12-14 months storage. In order to save this time, it is at first exposed for a short time to hot-watery vapour, then allowed to "sweat" for a time in a room saturated with watery vapour at a pretty high temperature, and finally pressed damp into a hogshead, in which it undergoes a secondary fermentation, which certainly improves it in a very short time. Other tobaccos are also frequently treated in a similar way. They are allowed to ferment again in the absence, or in a very limited quantity, of air; and in order to induce fermentation, yeast and sugar, *i. e.* substances capable of fermenting, are often added, as well as tartaric acid or common salt, in order to hinder rotting. The addition of yeast, as well as the frequent occurrence of saccharine substances in the sauces† seem to indicate that by these improving methods, alcoholic fermentations take place. No special researches into all these secondary fermentations have taken place as yet.

Tobacco destined for snuff and chewing purposes, undergoes fermentation like ordinary smoking tobacco; but snuff tobaccos also undergo special treatment, which vary according to whether the tobacco is fermented in a finely divided or in a powdery condition, or whether it is made into "carrot tobacco", which entails a much longer period of fermentation. Since the fermentation of carrot tobacco takes such a long time and involves therefore a loss of interest on capital, the method employed in the manufacture of course snuff is chiefly used. The temperature here rises much higher than in the preliminary fermentation and cases of spontaneous combustion may even occur. With regard to the influence of air on the fermentation, it has been shewn by Pinal and

* See Bulletin on Tobacco, May, 1889, page 8.

† Tobacco is often "improved" by the addition of various concoctions technically called "Sauces."—*Translator.*

Grouvelle that only in a certain region which lies between the outside surface and the middle of the heap is the fermentation relatively satisfactory. Belhomme has shewn the importance of the moisture contact in the fermentation of snuff tobacco, even differences of 1 per cent. are the cause of great difficulty and trouble in the fermentation.

An important work by the elder Suchsland which treats of the chemistry of the fermentation of snuff-tobacco is said to prove that the same consists in the combustion of the organic matter at the cost of the atmospheric oxygen. Suchsland first of all sterilised a large quantity of tobacco of one quality in separate vessels by keeping them for $1\frac{1}{2}$ hours at a temperature of 115 to 120 degs. C., and then forced in equal quantities of air at an equal rate through all the vessels. Some of the vessels were infected with fermenting snuff-tobacco and samples of each were kept at temperatures between 40 and 70 degs. C. (104-158 F.) The result of these experiments in Suchsland's own words is "that beyond a certain temperature not exactly defined, but above 40 degs. and below 70 degs. C., and probably about 50 degs. C. (122 degs. F.) the action was a purely chemical one in which organisms took no part." Behrens considers this as proved, provided always that the sterilisation had been sufficient, which he thinks doubtful, as otherwise the strong fermentation which took place at 70 degs. C. might be due to the activity of thermophile bacteria.

Further experiments were performed with the fermentation of tobacco at high temperatures at 39, 70 and 80 degs. C., one result of which was to shew that the purely chemical action (where the tobacco had been previously sterilised) increased quickly with the temperature. Even here the same objection, as in the previous case, holds good, viz. : that the sterilisation had not been sufficient, and that even at 70 and 80 degs. C. thermophile bacteria had been active. Behrens considers however, the next experiment to be quite free from objection. In this case, the unsterilised tobacco was fermented at a temperature of 100 degs. C. (212 degs. F.) and developed in the unit of time far more carbon dioxide than at 70 or 80 degs., and what was most important, exhibited all the qualities of good snuff tobacco, the aim of fermentation was completely fulfilled and in much shorter time than at 70 or 80 degs. While the tobacco fermented at 70 degs. took at least two months before it was ripe, at 100 degs. it possessed all the physical and chemical properties of good snuff tobacco at the end of 10-12 days.

According to Suchsland's idea then the rôle of microbes in snuff tobacco fermentation was restricted to raising the temperature sufficiently high to enable the chemical action to take place.

MEMORANDUM RELATIVE TO A VALUABLE SPECIES OF ORCHID RECOMMENDED FOR NATURALISATION IN JAMAICA.

ODONTOGLOSSUM CRISPUM.

By ROBT. THOMSON, Bogota.

This species of orchid is indigenous to the western slopes of the Eastern Cordilleras of the Colombian Andes. Its habitat extends from about 3° to 5° north.

The flowers of this species are extremely variable, ranging from inferior types or forms which are rejected by the orchid grower, to forms comprising the most popular of all orchids. The famous forms are confined to the centre of the area of distribution, *i. e.*, the Pacho district. The inferior forms are characterised in general by narrow floral segments—"starry" type. The fine forms are distinguished by broad floral segments, thus in contradistinction to the narrow "starry" forms. The flowers of the fine types are otherwise remarkable in their varietal diversity; numerous shades of colour from pure white to rosy mauve—sometimes blended or tinged; their size, form and substance; the peculiar spotting on the segments, ranging from solitary spots to groups of spots, and differently coloured spots.

The plants flower almost throughout the year, and the graceful arching racemes last in bloom about two months. In Europe the flowers are much improved by cultivation as compared with the flowers in the forest. Another advantage which contributes to the value of this plant under cultivation is that it grows only in a cool temperature. Its altitudinal range in its native habitat is from 6,500 to 9,000 feet, and the range of the temperature is from 40° to 70° Fahr.

As already indicated this is in all probability the most popular of all orchids in cultivation. During the past 20 years the number of plants exported to Europe has averaged not less than 100,000 a year, thus two millions. Of course many thousands perish under cultivation in Europe, and some 25 per cent are lost in transit. The demand for these plants in Europe is increasing. This year several great orchid growers have requisitioned 250,000 plants.

Hitherto this orchid supply has been obtained from the Pacho district, that is from an area comprising some three hundred square miles of forest, occupying numerous spurs and ramified ridges of the Eastern Cordillera.

Some 15 years ago this orchid was obtainable in the Pacho district for a couple of dollars a hundred. Then a peon collector collected as many as 200 a day. Now a peon collects about 10 a day; and the price of collection has increased tenfold.

Of the 250,000 desired for Europe this year it is hardly possible to supply more than a third, and this with strenuous efforts,—efforts stimulated by the payment of exorbitant prices. Moreover the result of these

efforts will most seriously exhaust the available supply after the spring of next year.

It is noteworthy that during the present year something like a fraud is being perpetrated upon European orchid growers. In consequence of the difficulty of obtaining an adequate supply of the Pacho type for export, native orchid exporters have undertaken to supply the deficiency by bringing to Pacho about 100 mule loads of the inferior types from a distant region some four days' journey. Thus during the past six months some 50,000 of the inferior forms have been conveyed to Pacho where they are packed for transmission to Europe. These inferior forms on arrival in England are not distinguishable from the standard Pacho type, until under cultivation they have flowered.

The vast majority of these orchids grow on trees, and large numbers of trees are cut down annually in order to secure the plants. But many plants are also found growing on the ground—on banks of moss and on rocks: in general, but not always, under the shade of the forest,—that is to say they are frequently found in places more or less exposed to the sun. Frequently too when a clearing is made in the forest by fire, in rocky places, many thousand of plants spring up on these spots on which self-sown seeds require some eight years to become strong plants.

Another circumstance which has materially diminished the resources of the Pachodistrict, a circumstance that threatens in the near future to exterminate the plant—at any rate for commercial purposes, is, thousands of acres of forest in which this orchid has been dispersed are yearly cut down for the establishment of pastoral farms—a great industry on these elevated lands. Also, some eight years ago, during an exceptionally prolonged drought, many thousands of acres of forest, on which these plants abounded, were destroyed by fire.

In a state of nature seeds of this orchid are produced in vast abundance. The seeds being extremely minute and light float in the air. Millions are thus disseminated yearly.

The price of the newly imported plants in the sale-room in London, according to the size of the plant averages from a half crown to a half a guinea each. It may be anticipated that the price will be augmented owing to the collapse in the supply. It may also be mentioned that special or rare forms of established plants in flower fetch from two to five and even ten guineas each. Furthermore, about three per cent of the plants obtained in the Pacho region consist of peculiar or unique varietal forms. The anticipation of such forthcoming novelties enhance the enthusiasm with which orchid cultivators are inspired.

I have been engaged in the *Odontoglossum crispum* business during several years. At present and until the spring of next year all the plants of this orchid—the famous forms growing on one hundred square miles of mountains are under my exclusive right and privilege. The number of plants available on this mountain tract may be estimated to comprise more than one third of all that now remain of the famous forms in a state of nature.

A few weeks ago I had the pleasure to forward forty plants of this orchid to the Jamaica Botanic Garden for cultivation at the Cinchona

plantation. Having resided ten years at that plantation, which was established under my supervision, I am well acquainted with the climatic conditions of the Blue Mountains of Jamaica. The temperature at the Cinchona plantation between 4,000 and 6,000 feet exactly coincides with temperature at from 6,000 to 8,000 feet where *O. crispum* grows, (latitude accounts for the difference of temperature equivalent to 2,000 feet). The wet seasons and the dry seasons are exactly similar on the Blue Mountains and on these Cordilleras.

From the upper limit of Coffee cultivation in Jamaica, about 4,500 feet, up to 7,000 feet there is a very considerable extent of land under forest—a region comparable in extent with the Pacho region. It is impossible to conceive a more eligible tract for the naturalisation of this orchid than is afforded between 4,500 and 7,000 feet in Jamaica. The way in which this enterprise—the naturalisation of this orchid on the Blue Mountains—could be best accomplished would be to establish groups of the orchid at intervals of probably a mile in the forest. Healthy plants tied to the trunks and branches of trees would require no further care. The majority of the plants would flower in about a year. After flowering seeds mature in a few months. Thus within a couple of years myriads of seeds, by reason of their buoyancy would be dispersed over the forest. And it may be confidently predicted that in the course of ten years scores of thousands of plants would be naturalised and fit for export annually.

This orchid thrives on the Cinchona trees, hence some hundreds of it might be established at the Cinchona plantation. Wider scope is afforded for cross fertilisation when a considerable number of plants are under treatment, *i. e.*, large groups embracing varied forms. It would also prove advantageous to grow a small percentage of a few closely allied species of *Odontoglossum* in order to induce hybridisation. Thus the Cinchona plantation alone, on the trees and on the rocks, would become a nucleus of production.

It has been mentioned that some 25 per cent (sometimes far more) of this orchid exported from Colombia perish in transit to Europe. The plants are received from the peon collectors at a height of 7,000 feet above the sea-level. The plants are then packed in cases, carried on mules' or bullocks' backs two days over a lofty, bleak and dreary ridge of the Andes, 11,500 feet, then fifty miles partly in carts and partly in short railways over the great savanna of Bogota, then four days on mules to the river Magdalena, then about a week down that river to Savanilla. Thus a severe ordeal by reason of the violent change of temperature and the time occupied. There could be practically no loss by exporting from Jamaica, and the expense attendant upon transit from Jamaica would be comparatively light.

It may not be amiss to refer to a notable example of naturalisation furnished by Jamaica* by which that island has been enriched to the extent of millions of money and this by spontaneous production, *i. e.* Logwood.

* The nun Orchid (*Phaius grandifolius*) is said to have been introduced by Mr. Wiles, whilst in charge of the Botanic Garden at Gordon Town, and it is now very abundant on the higher lands of the interior.—[ED. BULLETIN.]

COCCIDÆ OR SCALE INSECTS.—IX.

By T. D. A. COCKERELL, Honorary Entomologist of the New Mexico Agricultural Experiment Station.

(Continued from *Bulletin Jan., 1896*).

Genus *Lecanium*. (Shield-scales.)

(52.) *Lecanium nigrum*, Nietner. (Black scale of India.)

Mr. Fawcett has sent me specimens of this species on leaves of teak, from Hope Gardens, Jamaica, in June, 1896. They are accompanied by the usual black fungus. This is, if I remember right, the first scale recorded from teak, and anything relating to that tree is of special interest at this time, in view of the admirable articles by Sir D. Brandis on the Teak Forests of Burma, appearing in "Garden and Forest." The scale is a common East Indian species, and has been introduced into Jamaica, doubtless, on teak or some other East Indian plant. See under *L. depressum*. Bull. Bot. Dep. Jamaica May 1894, p. 70.

Genus *Howardia*.

Messrs. Berlese and Leonardi have lately proposed the generic name *Howardia* for three species, *H. biclavis* (Comst.), *H. citri* (Comst.) and *H. elegans*, Leon. The generic character they assign,—the absence of the grouped glands—is certainly not of generic value, and they do not state which of the three species is the type of the new genus. I will therefore take for the type of *Howardia* the first mentioned species, the *Chionaspis biclavis* of Comstock, which I have long felt ought to be separated from *Chionaspis*. The second species, *citri*, will fall in a new subgenus of *Chionaspis*, which may hereafter be regarded as a distinct genus. The third, *H. elegans*, seems to be an *Aulacaspis*, but unfortunately the male scale is unknown.

(53.) *Howardia biclavis*, Comst. (The Burrowing Scale.)

Diagnosis.—A small, nearly circular scale, which is covered by the epidermis of the twigs on which it occurs, so as to be extremely inconspicuous. Maskell describes a variety from the Sandwich Is. which is not covered by the epidermis. The species is easily recognised on microscopical examination by a pair of club-shaped organs, directed inwards, at the hind extremity of the female.

Distribution.—Mr. Hart has found it on *Flacourtia* in Trinidad, but this is the only record for the West Indies. Elsewhere, it occurs on hothouse plants in the city of Washington (Comstock), in the Sandwich Is. (Koebele), in Tahiti and Mexico (Craw), and in Ceylon (Green).

Food-plants.—Various; *Flacourtia*, *Cinchona*, tea, coffee, *Grevillea*, orange, lime, *Diospyros*, *Ficus*, *Tamarindus*, *Achras*, *Elaeocarpus*.

Destructiveness.—Mr. Green, writing of its occurrence in Ceylon, says, "Very common on stems of *Cinchona* and Tea, sometimes in such numbers as to considerably injure the plants." It is also important to note that it attacks Citrus trees. Being so extremely inconspicuous, it may become abundant before its presence is suspected.

Genus *Chionaspis*. (The Snow-scales.)

(54.) *Chionaspis citri*, Comst. (The Orange Snow-scale.)

Diagnosis.—The female scales are small, elongated, of a blackish-brown color; their very dark color distinguishes them at once from other West Indian species of the genus. The male scales are very small, white, and occur in great numbers, so that the trees sometime look as if they had been whitewashed.

Distribution.—Originally recorded by Comstock from Louisiana and Cuba. Since found in Trinidad (Hart and Caracciolo), Antigua (Barber), Demerara (Morgan), Mexico (Townsend), Tonga, New Zealand and Australia (Maskell); also in Bermuda (Ins. Life, iv, 267).

Food-plants.—*Citrus Trees*.

Destructiveness.—This is an extremely pernicious scale of orange and lime trees, and every effort should be made to prevent it from becoming universally distributed in the West Indies.

(55.) *Chionaspis brasiliensis*, Signoret. (The Brazilian Snow-scale).

Diagnosis.—Flat pyriform reddish brown female scales, accompanied by minute tricarinate snow-white male scales. The female scales vary in depth of colouring.

Distribution.—Originally found at Bahia, Brazil. Since detected in Trinidad (Urich and Hart), Ceylon (Green) and South Australia (Maskell.)

Food-plants.—Usually found on leaves of ferns and orchid. Green found it on *Strobilanthes* and *Acacia*.

Destructiveness.—Not usually very troublesome, but must become so when very abundant, as Green found it in Ceylon.

Remarks.—It is considered by Maskell that this and *C. aspidistræ*, Signoret are forms of one species. The name *aspidistræ* has priority of place in Signoret's work. The typical *C. aspidistræ* is reported by Maskell from India, and I have seen it from Japan, whence it has been brought to California.

(56.) *Chionaspis minor*, Maskell. (The Small Snow-scale.)

Diagnosis.—Small, elongated snow-white female scales, with male scales similar to those of the last species.

Distribution.—First found in New Zealand Common in Jamaica; also found in Trinidad, Antigua, Grenada and Grand Cayman. It is probably a native of the West Indies.

Food-plants.—Especially common on *Hibiscus*. Also on *Parsonsia*, *Rhipogonum*, *Erythrina*, cotton, pepper, *Pelargonium*, coco-nut palm, &c. A form of the species found by Mr. Barber in Antigua burrows under the epidermis of *Hibiscus*. Mr. Hart wrote from Trinidad that the species "affects all kinds of *Pelargonium*, especially the Cape kind and *Zonals*."

Destructiveness.—From its frequent abundance, it becomes quite troublesome on garden plants.

(57.) *Chionaspis major*, Ckll. (The Large Snow-scale).

Diagnosis.—The scale is much larger and rounder than the last, with the brownish exuviae near the edge. The male scale is white, small, tricarinate. This insect is not a typical *Chionaspis*, but might almost as well be put in the genus *Diaspis*.

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

Food-plant.—Numerous on stems of Heliotrope.

Destructiveness.—It would be quite destructive if it became common.

Genus *Diaspis*.

(58.) *Diaspis amygdali*, Tryon. (The White Peach-scale).

Diagnosis.—Female scale small, nearly circular, white with a red-brown spot representing the exuviae. Male scale small, only slightly keeled, white with the brown exuviae at one end.

Distribution.—The extraordinary history of this destructive scale should stand as a warning to horticulturists. Described by the Australian Entomologist Tryon in 1889, it is now known from Australia, Ceylon, Hong Kong (Maskell, as *gerani*), Japan, California, district of Columbia, Florida, Georgia, Jamaica, San Domingo, Grand Cayman, Barbados, Martinique, Trinidad, and Cape Colony.

Food-plants.—It has come into prominence as a peach-scale in the United States, but it has a great number of food-plants, including peach, plum, geranium, grape, *Guazuma*, *Cycas*, *Capsicum*, *Argyrea Bryophyllum*, *Jasminum*, cotton, *Calotropis*, *Hibiscus*, *Zizyphus*, mulberry, apricot, pear, *Carica papaya*, oleander, cherry, walnut, persimmon, *Elæagnus*, *Callicarpa*, *Tylophora*, &c.

Destructiveness.—An extremely destructive species. In the United States great trouble was experienced in dealing with it on peach trees. In Cape Colony Mr. C. P. Lounsbury reports it as “probably the most destructive scale attacking deciduous fruit trees in the Colony.” (Rept. of the Govt. Entomologist of the Cape of Good Hope for the year 1895, p. 48). Mr. Green records it as “very destructive to cultivated geranium” in Ceylon. Although it was so recently discovered, quite an extensive literature has appeared on this scale. It is hardly necessary to repeat what has been written on the subject here, as full details and excellent figures are easily accessible in the Annual Reports of the U. S. Department of Agriculture for 1893 and 1894.

Parasites.—For some time, no parasite of this scale was known, but lately Mr. L. O. Howard has recorded the breeding of *Aspidiotiphagus citrinus* from it in Ceylon. A parasite of the same genus—probably the same species—has been bred from it by Mr. Lounsbury in Cape Colony. In Cape Colony it is attacked also by at least five species of lady-birds (*Coccinellidæ*).

Remarks.—Although *D. amygdali* is the oldest name for this species, it is much better known as *D. lanatus*, Morg. & Ckll. It was formerly considered that *amygdali* and *lanatus* were different species, but I am convinced that they are the same, the supposed distinctions being attributable to variation. Mr. Maskell is of the same opinion.

(59.) *Diaspis cacti*, Comst. (The Cactus Scale).

Diagnosis.—Round greenish-white female scales with the exuviae appearing as a dark brown spot. Male scales very small, linear, white, with the yellowish or brown exuviae at one end. The var. *opuntiae*, Ckll., has the female scale with the exuviae not dark enough to contrast strongly with it.

Distribution.—The var. *opuntiae* is found in the Parade Garden, Kingston, Jamaica. Another variety (*opunticola*, Newstead) occurs in British Guiana. The typical form of the species is native in Arizona and New Mexico, and has been introduced into hot-houses in other parts of the United States; it has also been lately reported from India by Maskell.

Food-plants.—Species of *Opuntia*, also *Phyllocactus*.

Destructiveness.—It confines itself to cacti, but sometimes injures the garden and hot-house sorts. Comstock says it was so abundant in a conservatory at Ithaca, N. Y., that a large number of the cactus-plants had to be thrown away.

Genus *Aulacaspis*.(60.) *Aulacaspis rosæ*, Bouché. (The Rose Scale.)

Diagnosis—A small circular white female scale, with the exuviae appearing as a light yellow spot on one side of the scale. Male scale small and linear, tricarinated.

Distribution.—Found at Flamstead, Jamaica by Dr. Hy. Strachan in 1892. It is a European species, also found on cultivated roses in the United States, Australia, the Sandwich Is., and New Zealand. Mr. Maskell also cites it as from China.

Food-plants.—Various kinds of roses, also raspberry and blackberry.

Destructiveness.—It may become troublesome on Garden roses.

Parasites.—*Arrhenophagus chionaspidis*, a remarkable chalcidid, has been bred from it in Missouri by Miss Murtfeldt. *Aphelinus diaspidis* has been bred from it in Florida and California; *Aphycus brunneus* is another of its parasitizes in the United States. In Europe it is parasitized by *Coccophagus notatus* (*Coccobius notatus*, Ratzeburg.)

JAFFA ORANGE.

The Jaffa Orange appears to be the favourite orange now in England and the following quotation from a Foreign Office Report, "On Irrigation and Orange-growing at Jaffa" (Misc. Series, No. 300, 1893) will be interesting to many here. This variety has been introduced into the Public Gardens both from Europe and Florida.

"Jaffa, the chief town of the Caza of that name, owes its importance to its climate, which is extremely favourable for Orange-growing. As a natural consequence, this seaport is surrounded on the land side by orange groves, covering an area of some 720 hectares (about 1,780 acres). Jaffa oranges, thanks to their excellent flavour, have of late years acquired a world-wide reputation, and while some 18 years ago this fruit was known only to Beyrout, Alexandria and Constantinople, enormous quantities of it are now exported to Europe, America and even to India and its cultivation has consequently increased to a very considerable extent. A special feature of Jaffa oranges is that they will keep from 30 days to 40 days, and if properly packed, for two months, and even three months. New orange groves are continually being laid out, and now number some 400, against 200 some 15 years ago. This, again, has influenced the population of Jaffa, which now contains 42,000 inhabitants, against 15,000 inhabitants some 12 years ago. The revenues have doubled, and the vicinity of the custom-house is crowded with piles of cases of oranges waiting shipment to all parts of the world. The Imperial Ottoman Government, with a view to encourage the export of oranges, levies an export duty of only 1 per cent. on them, and the exports for the last few years have averaged 36,000 boxes per annum. Owing principally to the trade in oranges, Jaffa now ranks next to Beyrout in importance among Syrian coast towns."

"Orange growing in Syria is conducted exclusively by natives. Each orange garden contains some 2,000 square feet of planted area, equal to about 1,300 trees to the hectare (= 2·471143 acres). The trees begin to bear the fourth year after planting, but it is estimated that it takes seven years, and sometimes eight years, before an orange orchard yields a remunerative crop. During all this time, and even afterwards, the

orchards have to be watered continually, and this irrigation is the most difficult and the most laborious part of the work in connection with orange growing, inasmuch as the water has to be drawn by means of more or less primitive water-wheels from wells dug in the gardens 90 feet and even sometimes 100 feet deep."

FERNS : SYNOPTICAL LIST—XLII.

Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By G. S. JENMAN, Superintendent Botanical Garden, Demerara.

GENUS XXVII. NEPHROLEPIS, SCHOTT

Sori reniform or roundish; receptacle punctiform, terminal on the anterior veinlets, uniserial, and medial or intra or submarginal; involucre superior, scale-like, reniform or reniform-orbicular, attached by the sinus and free around the edges; fronds simply pinnate; pinnæ oblong or linear-oblong, deciduous; veins not reaching the margins, free, forked, with clavate apices, which on the upper surface are often covered by cretaceous scales; rootstock freely stoloniferous, with wiry flexuose roots, which in some species, beneath the soil, bear abundant, small, potato-like tubers.

There are eight to a dozen or so variable species in this genus; the restricted number of the species however being fully made up for by the multiplicity of the individuals. It is what is called a natural genus,—that is the several species have a general aspect in common which is unmistakable, whether the plants be in fruit or not. In the technical characters of the fructification the genus does not differ much from *Nephrodium* their peculiar likeness of habit and general aspect being in fact the principal generic characteristics. All prefer open sunny situations, occupying strong open ground, rocks and banks, ascending the bases of trees, aloft on their branches, with bromeliads and other plants, and in the crowns of certain palms. The sori are either oblique or transverse with the veins that bear them.

a.—Pinnæ inequilateral, dimidiate-cordate at the base.

b. Fronds—1-2 in. w. 1. *N. pectinata*, Schott.

Fronds 2-4 in. w. 2. *N. sesquipedale*, Jenm.

a. a.—Pinnæ equilateral, or fully cordate at the base.

b. b. Fronds—1-2 in. w. 3. *N. cordifolia*, Presl.

b. b. b. Fronds—3-8 in. w. 4. *N. exaltata*, Schott.

5. *N. biserrata*, Schott.

1. *N. pectinata*, Schott.—Stipites tufted, hardly any to 3-4 in. l. light brown or straw coloured, with spreading flexuose, wiry like-coloured stolons superficial on the surface around, roots devoid of tubers; fronds erect, a span to 18 in l. $\frac{1}{2}$ - $1\frac{3}{4}$ in. w. naked, light green, thin; pinnæ oblong, sessile articulate, often cretaceous dotted. $\frac{1}{4}$ - $\frac{3}{4}$ in. l. 2-3 li. w. dentate, rounded, superior base expanded into a deltoid auricle, inferior shortly cut away to the pedicel; rachises nearly or quite naked, slender, channeled, light brown or stramineous; veins forked; sori submarginal, transverse; broadly reniform; involucre pale, shield-like, persistent. Abounding from 2,000 ft. altitude upwards on banks, open stony areas, and in coffee fields, universally plentiful in the mid-region, over the greater part of the open higher ground of the colony. Gen-

erally it is much more slender, smaller and paler than *cordifolia*, with which it is sometimes united; common with fronds $\frac{1}{2}$ -1 in. w. and only a few inches high, quite fertile. The curvature of the inferior base of the pinnæ to the point of attachment, more slender, more naked, stipes and rachises, and absence of tubers to the roots clearly mark it.

sub-sp. *pendula* much stronger; fronds 2-4 ft. l. $2-3\frac{1}{2}$ in. b., pinnæ acuminate, often falcate, serrate, $1\frac{1}{2}$ in. l. base auricled on both sides, that of the superior deltoid, or developed into an acute point, the under truncated,—*N. pendula*, Pr. *Aspidium pendulum*. Radd. Fil. Bras. p. 30. t. 45.

The much larger size, pendulous habit, narrow acuminate segments that are auricled on both sides of the base are its distinguishing characters.

2. *N. sesquipedale*, Jenm. —Rootstock erect, slender, with numerous superficial brown wiry stolons spreading from it; stipites strong, erect or spreading, slightly scaly, eventually naked, dark brown, channeled deciduously paleaceous beneath, furfureous down the face; fronds pinnate, chartaceous, dark green, naked, 2-4 or more ft. l. $2\frac{1}{2}$ -4 in. w. uniformly narrowed to the base; pinnæ numerous, close, spreading usually more or less up-curved at the end, serrate in the outer half, plain-edged within, obtuse or acute, $1\frac{1}{3}$ -2 in. l., 3-4 li. w., the inferior base narrowed and cut away with a curve to the axis, superior expanded into a deltoid auricle; veins oblique, curved, once forked; sori apical on the shorter-anterior veinlet, (not transverse) and slightly nearer the rib than margins; involucre reniform with a narrow sinus.—*Aspidium*.

Gathered on high rocky banks, where it is plentiful, on the slope of Stony Hill at about 800 ft alt. In size and general habit and aspect this resembles most *exaltata*, but differs in the sori, and their character and the uniform contraction of the inferior base of the pinnæ clearly distinguish it. I cannot find that under Willdenow's specific name, *sesquipedale*, it has ever been removed from *Aspidium*.

In the Guianas this is the commonest species, abounding in great profusion in the decaying débris of spathes and spadices which accumulate under the lofty crowns of *Maximiliana regia*.

3. *N. cordifolia*, Presl.—Rootstock slender erect, stoloniferous, the wiry flexuose roots bearing subterraneous ovoid potato-like tubers; stipites strong erect, tufted, 2-6 in. l. clothed with deciduous rather matted fibrillose tomentum; fronds erect, curved, 1-2 ft. l. $1\frac{1}{4}$ - $2\frac{1}{2}$ in. w. narrowed at the base; firm and rather opaque; bright or dark green; rachis stiff channeled, polished dark horn brown, freely deciduously fibrillose, ultimately devoid of pinnæ, surfaces otherwise naked; pinnæ very numerous, close and often imbricating, horizontal and converging forward in growth, $1-1\frac{1}{4}$ in. l. 4-5 li. b., sessile, rather cordate at the base, the upper side dilated into a triangular auricle, over-lapping the rachis, the inferior rounded; point obtuse or acute; margins entire or serrulate; veins close, obscure, once or twice forked; the upper surface often cretaceous dotted at their ends, midrib fine, purple distinct; sori medial, broader than deep; involucre pale, oblique or transverse with the margin with a broad sinus, at length semilunar. Pl. Fil. t. 64. *N. tuberosa*, Hook.

Abundant at 4000-6000 ft. altitude on banks, rocks, open ground,

and in light wood. With the growing fronds stand the stiffly erect, tapering rachises of past ones, from which all the pinnæ have fallen. The vestiture of the stipites and rachises, though abundant at first, is transient, leaving the fronds, in age, quite naked. A plant is found occasionally with fronds dichotomously forked or fasciated at the apex and the ends of the pinnæ. The species has three ways of multiplication,—by spores, by stolons spreading wide over the surface, and by the abundant subterranean tubers.

4. *N. exaltata*, Schott.—Stipites tufted, strong, 6-12 in. l., deciduously fibrillose with fulvous scales, glossy, dark-coloured; fronds piant, 2-6 ft. l. 3-5 in. w. narrowed at the base; firm; glabrous and bright green; rachis channeled, more or less deciduously fibrillose or tomentose, glossy; pinnæ numerous, close and often imbricating, usually distant below, $1\frac{1}{2}$ -3 in. l. 4-6 l. w., blunt or pointed, often sub-falcate; sessile and subcordate at the base with a distinct auricle on both sides, the upper one larger and deltoid, the lower rounded, margins serrulate with appressed teeth; veins obscure, once or twice forked; midrib immersed; sori nearer the margins than midrib, rather sunk in the surface; oblique, and, with the shield-like involucre, cordate-orbicular, the sinus deeper than broad. *Aspidium*, Swartz.

Common; ascending to 3000 ft. altitude, growing on banks about the trunks of trees and on the heads of palms, spreading freely and often ascending a considerable height by the stoloniferous shoots, hence the common name walking fern. Pinnæ when prolonged more sharply serrated at the end, at length deciduous, and sometimes bearing a juxtamarginal line of cretaceous dots over the sori on the upper side. This is the common and abundant species of the lower elevations. The habit is weak and prostrate or pendent. Pl. Fil. t. 63. Sl. t. 31. Plts. 22. *Polypodium*, Linn.

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PLANTS.

From Royal Gardens, Kew.—
 Queen Pine Suckers.

From J. C. Lewis, Esq., Greenwich
 Park.—

Fig Cuttings.

SEEDS.

From Botanic Gardens, Trinidad.—
 Thrinax sp.

From O. Marescaux, Cherry Garden.—
 Areca alba.
 Michelia Champaca.

From Director, Botanic Gardens, Adelaide.—

Acacia eburnea
 A. retinodes
 A. graveolens
 A. suaveolens
 A. linifolia
 A. Julibrissin, rosea
 A. dealbata
 A. cyanophylla, magnifica
 A. pinifolia
 A. salicina
 A. semperflorens
 A. lophanta
 A. lophanta, speciosa
 A. melanoxylon
 A. armata
 A. pycnantha
 A. cyanophylla
 A. Sentis
 A. farinosa
 A. calamifolia
 A. saligna
 A. pulverulenta
 A. lophanta Newmanii
 A. decurrens
 A. Julibrissin
 A. Nemu
 A. albicans
 Cyathea dealbata
 C. medullaris
 Clematis aristata
 Clerodendron tomentosum
 Clerodendron glabrum
 Callistemon coccineum
 C. violaceum
 Casuarina quadrivalvis
 Cedrela Toona
 Coprosma lucida
 Crotoparia Cunninghami
 Dammara australis
 Doryanthes Palmeri

Dracaena australis
 D. striata
 Eucalyptus Baileyana
 E. calophylla
 E. calophylla, v. coccinea
 E. citriodora
 E. corynocalyx
 E. corymbosa
 E. ficifolia
 E. Globulus
 E. gigantea
 E. hæmastoma
 E. gomphocephala
 E. Lehmannii
 E. leucoxyton
 E. maculata
 E. Muelleriana
 E. miniatus
 E. marginata
 E. microcorys
 E. obliqua
 E. paniculata
 E. Planchoniana
 E. pilularis
 E. rostrata
 E. resinifera
 E. siderophloia
 E. tereticornis
 E. viminalis
 Eugenia Smithii
 Fucrea longæva
 Frenela columellaris
 Grevillea robusta
 Heptapleurum venulosum
 Humea elegans
 Hakea laurina
 Iris Robinsoniana
 Kennedya monophylla, alba
 K. monophylla
 K. nigricans
 Melaleuca genistifolia
 M. Leucadendron
 Myoporum insulare.
 Nephelium leiocarpum
 Olearia ilicifolia
 Panax elegans
 Pandanus sp.
 Phormium tenax

Pithecolobium pruinatum
Pittosporum sp.
P. eugenioides
P. crassifolium
P. nigricans
P. Tobira
P. undulatum
Ptychosperma Alexandræ
Rhus rhodanthema

Scolopia Brownii
Seaforthia elegans
Spondias Solandri
Stenocarpus simulatus
Sterculia acerifolia
S. heterophylla
Tecoma australis
Telopea speciosissima.

CASTLETON GARDENS.

Visitors to the Gardens may expect to see the following plants in flower or fruit during the month of December:—

IN FLOWER.

Amherstia nobilis, Wall.
Bauhinia variegata, Linn.
Beaumontia grandiflora, Wall.
Broughtonia lilacina, Henfr.
Brownea Rosa-de-monte, Berg.
Cananga odorata, Hook. f. & Thoms.
Carapa guianensis, Aubl.
Caryocar nuciferum, Linn.
Cassia glauca, Lam.
Cinnamomum zeylanicum, Nees.
Cola acuminata, Schott. & Endl.
Dypsis madagascariensis, Hort.
Erythrina umbrosa H. B. & K.
Erythroxylon Coca, Lam.
Eugenia caryophyllata, Thunb.
Fagraea obovata, Wall.
Musa coccinea, Andr.
M. rosacea, Jacq.
Napoleona imperialis, Beauv.
Quassia amara, Linn.
Rhodoleia Championi, Hook.
Stiffia chrysantha, Mikan.
Tectona grandis, Linn. f.
Victoria regia, Lindl.

IN FRUIT.

Andira inermis, H. B. & K.
Barringtonia Butonica, Forst.
Cananga odorata, Hook. f. & Thoms
Cinnamomum zeylanicum, Nees.
Fagraea obovata, Wall.
Garcinia Mangostana, Linn.
G. Morella, Desrouss
Myristica fragrans, Houtt.
Napoleona imperialis, Beauv.
Omphalea triandra, Linn.
Posoqueria longiflora, Aubl.
Semecarpus Anacardium, Linn. f.
Swartzia grandiflora, Willd.
Terminalia Arjuna, Bedd.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

C O N T E N T S :

Annual Report of Director

Index to Vol. III.

Title Page

P R I C E - Sixpence.

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

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1896

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.]

DECEMBER, 1896.

Vol. III.

Part 12.

Report of the Director on the Department of Public Gardens and Plantations for the Year ended 31st March, 1896.

“In a purely agricultural country like Jamaica a well organized Department of Gardens and Plantations is invaluable, not only for introducing and propagating such plants as are most suitable to the climate and soil, but also for the dissemination of the knowledge requisite to cultivate the products of the Island to the best advantage.”
Royal Finance Commissioners’ Report.

CONTENTS :

	Page
I. Introduction : Objects	265
II. On the Gardens	268
III. Educational	272
IV. Popular Lectures	278
V. Herbarium	285
VI. Library	286
VII. Superintendents’ Reports—	
(a) Hill Gardens	289
(b) Hope Gardens	293
(c) Castleton Garden	301
(d) King’s House Gardens and Grounds	305
(e) Public Garden, Kingston	306
(f) Bath Garden	307
VIII. Reports on (a) Free Grants	307
(b) Onions	308
IX. Meteorological Tables	311

I. INTRODUCTION :

OBJECTS.

The quotation from the Royal Commissioners, which is placed at the head of this Report has always been the guiding motto of the Department. All the officers have thrown themselves into all and every work which might be helpful to the agricultural progress of the Island. We have not confined ourselves by any means to botany and horticultural

ture, and the consequence has been that our work has increased enormously.

Although the means and the number of men at my disposal are infinitely small as compared with the resources at the command of the Government of the United States, we try to follow at a very long distance the aims and the methods adopted by them. Dr. A. C. True, the Director of the Office of Experiment Stations in the United States, has lately given a lucid exposition of the objects and work of these Stations, and an extract from his Bulletin will very clearly illustrate what we should always be striving after here. Dr. True states what the objects are as follows :—

“An agricultural experiment station is an institution in which scientific and practical investigations are made with a view to improving the methods of agriculture and introducing new crops or industries. The primary object of an experiment station is to apply scientific principles and methods to the problems of agriculture. It seeks to use for the benefit of agriculture the stores of knowledge regarding the operations of nature which science has accumulated, and to employ in the service of agriculture the trained brains and hands of scientists. Taking advantage of whatever has been discovered in any line of scientific research, the experiment stations should institute investigations to increase accurate information regarding the great principles which underlie the growth of plants and animals and to make new applications of well-known principles in the practical work of the farmer. It is very important that we should keep clearly before us the conception of the experiment station as primarily a scientific institution. This will enable us to understand its proper functions and prevent us from misjudging much of its work.

“The importance of scientific investigations as related to the arts has long been recognized in many industries. Hidden away in almost every factory may be found a chemist, microscopist or electrician, busily engaged in endeavours to solve the problems of the industrial arts. These men are working on the materials used in the arts, and have in view practical results, but they are using scientific methods and are employed solely because the manufacturers hope that rich rewards will result from the application of scientific principles to practical ends. The wise employer leaves these men to work in their own way—he does not expect that the chemist will use the blacksmith’s bellows, or the grocer’s scales, or the carpenter’s tools. He must have the apparatus of the chemist and he must be free to follow the methods of the laboratory rather than those of the workshop. The factory chemist may have large wages, he may spoil much valuable material, and he may work for months without any result that will bring a single additional dollar into the manufacturer’s treasury, but as long as there is a reasonable hope that something profitable will result, the chemist is kept at his task. One day he may find out something which will give the employer the advantage over his competitors and pay a thousand times over for all the expense which the chemist has caused. There is always the risk of total failure, but experience has shown that in the long run the arts have profited exceedingly by the labours of scientists.

“What manufacturers have been doing for themselves because they found it very profitable, the Government has undertaken to do for the

farmers. Scientific investigations are necessarily expensive. Such investigations as are likely to be of advantage to agriculture must be conducted on so extensive a scale as to be beyond the means of the individual farmer. Agriculture is so fundamental to all other arts, and its success is so vital to all classes of people that it has been deemed expedient to extend governmental aid to this industry on consideration of the public welfare."

He afterwards enters into more details as to the work of the stations, thus:—

"The work of the agricultural experiment stations as organized in this country may be classified in a general way as follows: (1) they act as bureaus of information on many questions of practical interest to the farmers of their several localities; (2) they seek by practical tests to devise better methods of agriculture and to introduce new crops and live stock, or to establish new agricultural industries; (3) they aid the farmer in his contest with insects and with diseases of his crops and live stock; (4) they help to defend the farmer against fraud in the sale of fertilizers, seeds, and feeding stuffs; (5) they investigate the operations of nature in the air, water, soil, plants, and animals, in order to find out the principles which can be applied to the betterment of the processes and products of agriculture.

"The experiment stations are conducting a wide range of scientific research in the laboratory and plant house, and an equally large amount of practical experimenting in the field, the orchard, the stable and the dairy. Thirty stations are studying problems relating to meteorology and climatic conditions. Forty stations are at work upon the soil, investigating its geology, physics or chemistry, or conducting soil tests with fertilizers or in other ways. Fourteen stations are studying questions relating to irrigation. Thirty-nine stations are making analyses of commercial and home made fertilizers, or are conducting field experiments with fertilizers. At least fifteen stations either exercise a fertilizer control in their respective States, or make analyses on which the control is based. All the stations are studying the more important crops, either with regard to their composition, nutritive value, methods of manuring and cultivation, and the best varieties adapted to individual localities, or with reference to systems of rotation. Thirty-five stations are investigating the composition of feeding stuffs, and in some instances making digestion experiments. Thirty-seven stations are conducting feeding experiments for milk, beef, mutton, or pork, or are studying different methods of feeding. Thirty-two stations are investigating subjects relating to dairying, including the chemistry and bacteria of milk, creaming, butter-making, or the construction and management of creameries. Forty-five stations are studying methods of analysis and doing other chemical work. Botanical studies occupy more or less of the attention of about thirty stations; these include investigations in systematic and physiological botany, with especial reference to the diseases of plants, testing of seeds with reference to their vitality and purity, classification of weeds, and methods for their eradication. Forty-three stations work to a greater or less extent in horticulture, testing varieties of vegetables and large and small fruits, and making studies in varietal improvement and synonymy. Several stations have begun operations in forestry. Thirty-one stations inves-

tigate injurious insects with a view to their restriction or destruction. Sixteen stations study and treat animal diseases or perform such operations as dehorning animals. At least seven stations are engaged in bee culture, and three in experiments with poultry."

Chemical analysis and the study of live stock are outside the limits of our sphere, but attention is paid to nearly all the other points detailed above.

Dr True continues:—

"The service which the stations have rendered in promoting the education of our farmers is incalculable.

"Even if the station bulletins recorded only facts well known to scientists and advanced agriculturists, the influence of such a far-reaching system of popular education in agriculture must be very great. So vast a scheme of university extension has never been undertaken in any other line.

"The stations have also taught the farmer how to help himself."

The Jamaica Bulletin, which was started in a small way in 1887, appearing at irregular intervals, has now increased to a publication of 24 pages, appearing regularly once a month. It is sent free by post to all who ask for it, and the circulation is steadily increasing.

The Department, indeed, takes in some respects a wider scope than the Experiment Stations of the United States, for not only are practical lectures given in various parts of the Island, but an agricultural elementary school is managed under its auspices, and the boys are trained in practical work in the Gardens.

II. ON THE GARDENS.

HILL GARDENS.

In previous Reports, *e.g.*, in 1892, I have urged the establishment of a Botanic Garden at some elevation between Hope Gardens and Castleton at 600 feet and 580 feet respectively, and the Garden in the Blue Mountains at 5,000 feet. The failure of the orange crops in Florida has shown the necessity for an Orange Experimental Garden here in a suitable locality, and at length this has been started at the old coffee property known as "Resource," where a collection of citrus fruit has been brought together and planted out. That the situation is an excellent one for oranges is testified by the excellent fruit produced in the locality, and as it can be worked as part of the Hill Garden, the expense of another Superintendent, with buildings, etc., is thereby saved.

The following account, written in February last, may be embodied here as expressing my hopes for the development of a large district of the Island, and of the work which a Hill Garden may do in helping on that development—and not of one district alone, but of the whole Island. It is an accepted maxim in industries connected with plant life—in horticulture, agriculture, forestry—that plants should be taken from a cooler climate to a warmer, when transplanted, and not the reverse:—

"The ceremony by His Excellency the Governor of cutting the first sod of the new driving roads along the southern slopes of the Blue Mountain Range, inaugurated a new era of prosperity for a wide stretch of country from Newcastle to the Cuna-Cuna Pass.

The only means of communication, until quite lately, in all this region from one district to another and to the sea coast road, was by bridle paths, a terror to nervous riders and impossible for invalids. The road connecting the plain of Liguanea with Gordon Town is so short that it scarcely counts when there is now a commencement of the construction of roads which are to be 100 miles in length.

The whole scheme is due to the initiative of Captain Taylor of Moy Hall, who, with unflinching energy and hard work, first surveyed the interior road from the 11th milestone on the Windward Road and then laid down a general scheme for the other roads.

The only cultivation in these mountains on a large scale has been coffee, and this industry has been seriously hampered by the expense and difficulty of transport.

In 1867, Sir John Peter Grant with great foresight made the first attempt at other cultures beside coffee—one which could be carried on at higher elevations, namely cinchona. The experiment was a complete success, for the Government established the fact that cinchona could be grown in the Island, and realized a sum of about £17,000 by the sale of bark. But for the very reason that the whole region was without roads, planters hesitated so long about embarking in the new industry, that the golden opportunity was lost, the price of cinchona bark fell, and many lost money in the venture, whereas in Ceylon, with good roads and railways, fortunes had been made by all the pioneers.

Here, in Jamaica, the loss to private individuals of large sums over cinchona planting, coinciding with low prices for coffee and general depression in trade, led to the cry some ten years ago that the Hill Garden instituted by Sir J. P. Grant, had proved a failure, and should be abandoned. Fortunately this desponding wail has not been generally supported in the Island, nor acceded to by the Government. Six or seven years ago, Mr. Thistleton-Dyer, the Director of Kew Gardens, gave it as his opinion that it was quite possible that the Hill Garden might again become the chief Botanic Garden of the Island; and this prophecy, unlikely though it might have seemed to most, seems now in a fair way to become fulfilled, and to justify the faith of the few. It is situated about half way between Newcastle and Abbey Green, and the elevation of the Government property ranges from about 3,000 to 6,300 feet, so that very varied experiments can be made in cultures requiring different altitudes.

The Hill Garden, however, was not devoted solely to the cultivation of cinchona. Vegetables have been grown and instruction imparted so successfully, that all the settlers round for many miles grow such "English" vegetables as peas, cabbages, carrots, turnips, potatoes, artichokes, horse-radish, cucumbers and beet-root.

Tea has been grown of a quality declared by London brokers to be excellent, and an order has just been received from a planter for 1,000 plants.

Timber trees of various kinds have been planted out and tended for years, and a knowledge gained of the capabilities of different trees for use in these hills where nearly all the valuable timber has already been cut. The nurseries at present, contain some thousands of seedling trees.

Fodder plants have been under experiment as well as many different kinds of economic plants, which will be taken up by planters in the near

future, such, for instance, as Jalap, which sells at 1s. 6d. per lb, Orris Root at 75s. to 80s. per cwt., China Grass, a variety of Ramie which can only be grown successfully in the hills, and realizes twice the price of the tropical Ramie; fruit trees of temperate climates, and of high elevation both in the new and old worlds.

As this region is the best in the Island for coffee, it is reasonable to suppose that it is the best for oranges, since the soil requirements of both are much the same. Although no tests have been made in comparing the oranges of Manchester with those grown here, many, who know both, declare in favour of those grown in the Port Royal Mountains, where splendid fruit is produced at as high an elevation, at any rate, as 4,100 feet.

The Government has just lately established an Orange Experimental Garden and Nursery as part of the Hill Garden establishments at an elevation of about 3,900 feet. A large number of budded and grafted trees have been imported from Florida, and also from Rivers in England, who supplied growers in Florida and California in the early days for their groves: these are permanent stock trees, from which buds will afterwards be taken for budding on Seville and Lemon Stocks. Several thousand seedlings of the above stock are being grown, also of the Jamaica Sweet Orange, Grape Fruit, Tangerine and Shaddock.

Olives have been grown in the Island for many years, but so far no fruit, nor even a flower, has been produced. It is probable that this may be accounted for by their having been planted at too low an elevation. Eighty plants of the variety, Frantojo, yielding an excellent oil, have just been presented for trial by Col. (now Lord) Malcolm of Knockalva, and these, together with others from Florida, have been put out at various elevations ranging from 3,500 feet to 5,500 feet.

Grape plants from Persia have been imported from California. They grow on the table-lands of Persia, have a distinctive character of their own, very highly spoken of by travellers; they ripen early and as they have a firm flesh and tough skin, they will probably prove serviceable for early shipping. The native Grape of Jamaica, so abundant in these hills, though of no value as a fruit, may turn out to be of special worth for grafting the more tender European varieties.

These are a few of the cultures which may be taken up when roads are made. The prosperity of Jamaica will advance by leaps and bounds with the increased production rendered possible by means of communication, and a temperate climate all the year round will be available for invalids, within a few hours' drive of Kingston. But these benefits will also attract settlers from England when it becomes known that we have a Florida and a California in an Island under British rule, with all the advantages of those climates and none of the disadvantages.

The road to Newcastle is already being made, and it is to be hoped that very soon a beginning will be made with the road by Guava Ridge to Mavis Bank, as this is the main artery for all the country from Silver Hill to Arntully; from Mavis Bank it is to be continued up the Yallahs Valley to Silver Hill on the west, to the Hill Garden on the east, and on to Whitfield Hall, Abbey Green, Radnor and Arntully."

HOPE GARDENS.

Seven and a half acres are devoted to various economic plants, of which three acres are under a collection of about 90 different varieties of sugar canes; two and a quarter are devoted to the nursery, where several thousand plants are always in stock; about three and a quarter are under ornamental borders; and six under lawns. There are also five or six acres under teak, and about twenty under pasture—making altogether about forty acres, requiring constant care and attention.

The question of the water-supply is always a source of anxiety. I still recommend a trial sinking for water in the upper part of the Hope lands as a source of supply for the Gardens; and the formation of a large reservoir in the form of an artificial lake where water lilies and other aquatics could be grown.

Trials in sinking a tube-well would perhaps cost £100, and might not result in any water being found; but still when £120 per annum is paid to the Water Works, and our supply is sometimes limited to eight hours, with a possibility of its being cut off altogether, the speculative outlay of £100 appears to me to be quite justifiable. If the Hope Gardens, besides Kingston and the Liguanea plain, are to be efficiently supplied with water, other sources besides the Hope and Wag Water rivers must be laid under contribution. If an underground supply cannot be tapped, then the narrow rocky gorge through which the Yallahs river has cut its way near Windsor Lodge might be utilised for the construction of a dam and the formation of a reservoir, whence water might be taken by pipes to Kingston. A sufficiently high dam would create a lake above it which would hold all the water that pours down from the hills from the season's rain; this would prevent the river "coming down" and endangering life and property, do away with the necessity of an enormously expensive bridge on the sea-coast road, and relieve the danger of a large city like Kingston being left without water, whilst it would release a large amount, now badly wanted, for the use of Hope Gardens.

My design for the formation of an artificial lake at Hope was mapped out on the plan of the gardens that I drew up about 9 years ago. I have lately had specifications prepared for about one-third of it. This portion would cost, if made all at one time, £804; or if made in three parts, one part a year, it would cost the first year £236, the second year £415, and the third year £202. The capacity of this third part is 529,800 gallons; the total capacity of the whole reservoir is 1,582,600 gallons.

CASTLETON GARDENS.

Castleton Gardens, though small, is one of the most beautiful of Botanic Gardens. It has a fine collection of palms, and other tropical plants, such as orchids and ferns; and its situation on sloping ground on the banks of the Wag Water river is most romantic. Several of the overcrowded duplicate trees and shrubs have been removed, the river bank has been opened up, new views obtained, and room allowed for proper growth and expansion of the plants.

On the economic side much attention is devoted to such plants as Liberian coffee and other species of the same genus, the Citrus fruits, Vanilla, Black Pepper, Rubber plants, and such fibre plants as Ramie and Manilla Hemp.

The water supply has been thoroughly gone into by the Superintendent, Mr. W. Thompson, and placed on a much better basis. The tanks at the top of the Garden have been enlarged to hold 15,000 more gallons of water; piping has been put down, and small tanks put up in the nursery for convenience of watering.

A post office and telegraph station has been erected close to the Gardens. A Constabulary Station will be established on part of the Garden grounds. The small hotel in the Gardens, known as the Castleton Cottages, is run by the Boston Fruit Company, and is a great convenience both to the travelling public and to visitors to the Gardens. The Railway Station at Annotto Bay will be another convenience for visitors, and the drive of 9 or 10 miles between the station and the Gardens is one of the loveliest in Jamaica.

PUBLIC GARDENS, KINGSTON.

The lawns have been almost destroyed by people passing over them in every direction from gate to gate, so that the aspect has become rather that of an open square than a Garden.

To remedy this, and at the same time to continue the convenience of the gates, fencing will be erected by which those who make use of the garden as a thoroughfare will be kept to the paths, while visitors who wish to enjoy the benefit of a public garden will have the privilege of passing within the fencing. Until the grass has been re-established it will be necessary to close altogether, for a time, certain parts of the lawns.

In this way it will be possible to avoid the very serious step, otherwise unavoidable, of again closing most of the gates.

BATH GARDENS.

This the oldest Botanic Garden in the West Indies, has renewed its youth. It is situated in one of the most charming parts of the island with wonderful growths of tropical vegetation and close to a hot mineral spring which will doubtless soon attract hosts of visitors. The small grant from the Legislature is not adequate for its maintenance as a garden proper, but should be considered as supplementary only to proper provision made by the Parochial Board out of the parochial funds.

If funds can be provided by this means, or in any other way sufficient to maintain a good garden, it would be necessary to appoint a Superintendent who can give up his whole time to the work of the Garden.

KING'S HOUSE GARDENS AND GROUNDS.

The usual work has been carried out, and some improvements have been made. The avenue borders which are such a feature of the King's House Gardens, have been thinned out; the rose garden has been partially renewed. Nearly two acres have been added to the lawns, laid down with Bahama grass; and about 10 acres of new pasture have been formed.

III. EDUCATIONAL.

INDUSTRIAL SCHOOL.

The management of an Industrial School does not properly come under a Department of Public Gardens, but it was considered expedient to transfer it from the Inspector of Industrial Schools to the Director of Public Gardens; because, to carry out any efficient scheme of agricultural training, the Director should have control over the appointment and work of the officers, and over the whole time of the boys; and, because the constant supervision which is necessary can only be

maintained by a person who lives on the spot like the Superintendent of Hope Gardens.

To carry out the scheme properly and to obtain fair results, there are several conditions necessary, viz., a special teacher of agriculture, increase of numbers at rate of from 5 to 10 a year, free admission to school for deserving boys throughout the country, provision for keeping boys after they leave the school for 3 or 4 years

Dealing with these points in order, an agricultural teacher is required. In Great Britain boys are trained in the same way as for the trade of carpentry, they learn the practical part in large gardens or on farms by working with experienced men.

In the Jamaica Public Gardens, the labourers have had no training as boys, and they come and go as they please so that they cannot gain experience; the only thoroughly experienced men are the Superintendents, and their constant supervision of numberless minute details in the working of the Gardens leaves them no time for actual teaching.

Agriculture needs a better teacher than carpentry or farriery, for much more is required than mere skill in the use of tools. The teacher should be able to give reasons for the various operations, uniting science with practice. He should be with the boys the whole time they are working.

At present I have to do the best I can, and the Superintendent at Hope Gardens gives half an hour's teaching daily to all the boys in the school. The boys over 12 years of age work all their time every day in the Garden except two hours which are devoted to keeping up their knowledge of reading, writing and arithmetic, while the boys under twelve go on with their elementary school work, and do the necessary work of cleaning, etc., in the buildings and grounds of the school. Mr. Cradwick has thrown himself into his extra work with great energy and ability; the boys like his teaching and are profiting by it. A warden is provided out of the Hope Gardens funds to supervise them in their mechanical work.

The school was originally planned for 100 boys, but the buildings have not been completed, and there is only room for about 30, while the average number is 25 to 27. While the number is thus limited, the results will not be as satisfactory, compared with the expenditure, as if there were 100 boys. It might not be well to increase the number by a large amount suddenly, but the gradual addition of one boy a month would not upset existing arrangements. The additions depend at present upon the Resident Magistrates who send boys who are without visible means of support. In order to keep the school full, I consider that it would be a good thing to offer the advantages of the school even to the sons of those who are able to support them. A certain number of deserving boys might be admitted free and they might be selected from those who pass the Third Grade Pupil Teachers' Examination, for which many boys now enter. There has been a good deal of talk about the desirability of starting industrial or farm schools all over the island, but it would be well first to fill the school at Hope, and extend it.

Provision in the way of barrack accommodation should be made for those boys who leave the school at 16 years of age, and are kept on at the Gardens. There are many difficulties in the way of actually apprenticing these boys, but whether they are apprenticed, or stay as

ordinary labourers, accomodaiton is required for them. It seems to me to be the cruelest plan to place a child in such an Institution where necessarily they are well looked after and then turn them adrift just at an age when they are most susceptible to temptation.

The apprenticeship system is, from all I can hear, a failure, chiefly because the master-tradesman loses time and has to undergo much trouble if he finds it necessary to punish his apprentice. The boy knows that he may be idle and may do careless work with impunity for he cannot easily either be discharged or punished.

Applications have been made from time to time for the services as "trained gardners for short terms" of these boys either while still at school, or while employed afterwards in the Gardens. I have frequently stated in my Annual Reports and on other occasions that we cannot with the present system undertake to turn out trained gardeners, all we can do is to teach boys the elementary principles and practice of agriculture so far as they can be learnt in the Gardens. I object very strongly to any interruption of a boy's work and any relaxation of the discipline, that would necessarily happen in hiring a boy out to private individuals.

Mr. Reed, Inspector of Schools, states in his Report :—

"I had the pleasure of hearing Mr. Cradwick question the boys on many points of vine culture, on the pruning of chocolate and those properties of shape, symmetry, etc., upon which much of the value of the tree depends, on watering and on budding, The boys are thoroughly interested and their thoughtful answers spoke volumes for the genuine training they have received. The questioning took place in the Gardens and the boys watched critically the practical work that some of their number were required to do. If the questioning under the Code heading of Elementary Science might have stopped in the Gardens I should not have hesitated to give the full 6 marks, but when other subjects were taken in the Schoolroom I was obliged to reduce it to some extent; the other answers were almost valueless."

The following is the Report furnished by the Master-in-Charge :—

Hope Industrial School, 7th May, 1896.

SIR,

I have the honour to submit the following Report of the Hope Industrial School for the year ended 31st March, 1896.

(2.) Towards the end of the year, the Night Officer was placed on the staff, which now consists of the Master-in-Charge and two Warders. The Resident Superintendent of the Hope Gardens exercised as usual a general supervision over the school.

(3.) On the 1st April, 1895, there were 27 boys in the Institution. During the year 6 boys were admitted, 3 were discharged, 2 were transferred to Stony Hill for gross misconduct, and one was removed to the Public Hospital, Kingston. The number of boys at the end of the year was still 27. Of those discharged, one is now working under the Superintendent of the Hope Gardens.

(4.) The daily routine has been kept up. The method being followed at present in the school has been fully stated in the latest Annual Report of the Director of Public Gardens and Plantations; and in the same publication, the Superintendent of Hope Gardens has given a detailed

account of the practical work being done at the Gardens by the older boys. The smaller boys have been occupied as usual in keeping the buildings and grounds in order. Besides performing various duties of a domestic nature, the boys in general have also been engaged in the planting and caring of shade and fruit trees, and ornamental shrubs.

(5.) The demonstrations by Mr. Cradwick at the Gardens have been regularly attended by all the boys, and by the Master-in-Charge. The Bulletins of the Botanical Department have been regularly read by some of the older boys.

(6.) The Elementary School was closed from the beginning of the financial year, when Mr. Wilson was away, to the 17th June, when the present teacher took charge. Until the end of September the number of School hours daily had been as usual two, but has since then been increased to three. The school was examined, on the 9th August, 1895, by F. E. Reid, Esq., and took 48 marks—being a total increase of 4 marks. It was again closed for six weeks from the 9th December, 1895, to the 18th January, 1896, on account of a general outbreak of sore eyes in the Institution. The Bulletins of the Education Department and other circulars issued to Managers and Teachers generally have been received.

(7.) The Expenditure for the financial year has been £695 8s. 3¼d.; but against this amount the Institution has been credited with the sum of £364 2s. 6d., as reimbursements by the Parishes of Kingston, St. Andrew, St. Elizabeth, Westmoreland and Clarendon for the maintenance of children sent in under the Industrial Schools' Law. An immigrant boy in the School is a charge on General Revenue. This leaves the actual cost of the Institution at £317 11s. 3¼d. The expenditure has been under the usual heads:—Salaries, diet, clothing, lighting, soap, fuel, forage, books for school, agricultural implements, hospital extras and miscellaneous. The average number of boys for the year under report is 31. The gross cost per head of the average number £22 8s. 7.846d. The actual cost per head of average number £10 4s. 10.556d.

(8.) During the year some minor repairs were done by the Public Works Department: but general painting and the erection of a verandah around the additional dormitory are now in operation. With respect to increasing the accommodation of the school, the Inspector of Industrial Schools said, in his last report that the working of the school would be much more satisfactory and economical when it has its full complement of boys.

(9.) The health of the boys has been on the whole good. In the month of December there was a general outbreak of sore eyes (catarrhal conjunctivitis) in the Institution, which lingered until about the end of January. A little boy suffering from heart-disease was ordered by the Surgeon to be removed to the Public Hospital, Kingston. He was sent on the 17th January, 1896, but died in that Institution since the end of the financial year. Some general directions in cases of accidents have been furnished by Dr. Cargill.

(10.) Prayers have been read daily in the Institution, and the Sunday Schools have been regularly held. On Sunday the boys usually attend Public Service at the Grove Church, with the exception of a Roman

Catholic boy who goes to Kingston. Rev. H. F. Kirton, of the Grove Church gives religious instruction to the boys once a week.

Several visits have been made to the school. His Excellency Sir Henry Blake's personal concern for the welfare of the boys being well known. The Official Visitors have been:—Honbles. Fred. Evans, (Col. Secy.), W. Fawcett, T. Capper, Dr. J. Pringle, their Lordships the Bishop of Jamaica and Bishop Gordon, His Honour Justice W. Hyndman Jones, Rev. H. H. Isaacs, and James Verley, Esq. On different Public Holidays Mr. and Mrs. Cradwick have kindly prepared treats for the boys, besides supplying them with Magazines, etc., all of which have been much appreciated. An interesting volume of "Stories of Boy-Life" was also presented through them by Mr. Newstead, late Superintendent of the Water Works.

I have, &c.,

A. J. HOPWOOD, Master-in-Charge.

AGRICULTURAL STUDENTS IN HOPE GARDENS.

It has been suggested that an agricultural course should be instituted at University College, and that part of the practical training should be given to the students in the Hope Gardens.

The success of any such scheme depends altogether, I believe, on the practical work.

If the education of the present day has to some extent failed, it has done so in so far as it has depended solely on books and mere oral instruction. Such exclusive dependence is not wise even for literary culture, but should be combined with the training of hand, eye, and the whole body, in order to turn out men and women fit for their work in the world.

It is a question whether it matters very much what this practical training consists of, so long as it is based on sound theoretical principles. But if it can be made the foundation for the child's life-work afterwards, he starts with this double advantage over children who have learnt from books

In this island, the practical training should be almost universally one in agriculture.

If so, it is even more important that the teachers of elementary schools should have a thorough training in this respect than those who are going to be actually engaged in agricultural work; for the latter get their training somehow and after a fashion, whereas the others who have to teach, cannot find the time, even if they had the inclination.

If this be granted, provision should be made that students in training colleges should spend the last year of their course in practical work at Hope with the regular agricultural students; or, perhaps 6 months of their second year, and 6 months of their third year.

In either case the end of their course should be the practical work, partly to correct the tendency to bookishness, and partly to send them fresh from such work to their duties in school where the practical should be considered the more important side of education.

What then should be the course of training in agriculture at Hope? The danger that I foresee,—the rock on which it may split, is in making the course a collegiate one rather than a practical training. This may

happen even if all the teachers are thoroughly practical men, and specially for the following two reasons ;—

First: people are inclined to think that the theoretical teaching on which practice depends requires more time than the practical training. Secondly: it is much easier to teach the whole of the underlying principles in due proportion in a regular series of lectures than from concrete examples.

But much of the advantage of the practical work is lost if sufficient time is not given up to it; and the theory can be duly instilled if a syllabus of principles be drawn up for illustration by examples.

Care should be taken then that the agricultural training should be eminently practical, and if it is limited to one year, it certainly ought to be altogether out-of-door work, as distinguished from merely oral instruction or study from books.

The instruction should be on the following lines :—

Veterinary Surgeon: Feeding and general treatment of stock.

Diseases of cattle, their prevention and cure; Physiology and anatomy of farm animals; Horse-shoeing.

Engineer: Mechanics, mensuration, land-surveying, building construction.

Carpenter: Carpentry.

Gardener: Preparation of land; Sowing and cultivation of various crops, and their preparation for the Market: Use of Agricultural Machinery; Forestry.

Science Teacher: Elements of Geology, Chemistry and Botany, Book-keeping.

All other teaching, included under the head of "literary culture" should absolutely cease.

If necessary, a pass examination might be instituted to ensure a certain amount of knowledge before agricultural training commences.

Text-books may be recommended by the teachers, but should be used only in the student's spare time.

Certificates might be granted by the teachers, as a result of their work during the course.

It would be better to begin by making the course at Hope to last only one year, for the following reasons :—

- (a) A much larger number can pay for a one year's course, than for one lasting two or three years
- (b) It would suit students from training colleges.
- (c) School-boys might take it instead of their last year at school in an ordinary way.
- (d) It is better always to begin in a small way, and allow growth in the most serviceable manner.
- (e) Alterations can more easily be made if the course is for one year, than if for two years.
- (f) A one year's course can easily be altered into a two year's course if found advisable, but a two years course is partly spoilt, if it is terminated at the end of half the time.
- (g) It will be easier to avoid the danger of making the course collegiate instead of practical.

Since writing the above on the importance of practical work, the Committee of Council on Education have issued their report for Eng-

land and Wales, which points out the need of giving right direction to the activity and intelligence of children, especially in the earlier stages of the school life. The principle is accepted that one of the chief aims of education should be to train the scholar to acquire knowledge for himself by observation and experiment. This power, it is observed, so far from being developed, is actually stunted and suppressed when the scholar is treated as "the passive recipient of instruction". Danger thus arrives that, the natural activity of the mind being deadened, the child will leave school "with healthy interests unawakened, and with the faculty of accurate and independent observation still untrained." The Committee of Council on Education have, therefore endeavoured to encourage "a more living form of Education," by means of teaching designed to cultivate the habit of observation and the further use of the various powers of expression. The Committee are glad to think that "deftness of hand, correctness of eye, power with the pencil and brush, the study of actual objects at first hand and the habit of using the faculty of intelligent observation, have all become in recent years a more important part of the educational aim of our elementary schools". Not merely because training of this kind prepares the scholar for acquiring practical dexterity in his future calling, but also for higher reasons, the department has approved the introduction of such training in various forms, into the curriculum of Elementary Schools.

VI. POPULAR LECTURES.

The popular lectures given by Mr. Cradwick have been much appreciated and there is no doubt that very great good is being done in this way. In order that I may have the means of extending this useful work, I would recommend that an Assistant Superintendent be appointed for Hope Gardens at a salary of £100 to £130 a year with house.

I could in this way utilize Mr. Cradwick's experience at Hope when he is not actually engaged in lecturing, and at the same time spare him for lecturing to a very much greater extent than I now can.

I append his reports to me written directly after the completion of the lectures, containing, as they do vivid impressions of the need of the people for such instruction, and their anxiety to help themselves if they are only shown how to do it.

Reports by Mr. W. Cradwick, Superintendent of Hope Gardens, on lectures delivered on the cultivation and curing of agricultural products.

BRANDON HILL DISTRICT.

On Wednesday the 19th February I visited the Brandon Hill District.

About 30 adults attended the lecture and demonstration, and as is usually the case, several of these evinced the keenest interest in the subjects dealt with, minutely observing the methods of pruning, curing, etc., explained to them.

Coffee, Cocoa, and Canes are the chief products of the district. The two former are well adapted to the district, usually growing well, but as the people themselves realize now, they do not bear anything like the crops they might from the want of proper pruning.

Canes grow fairly well, and the people were much interested when told of the new canes at the Gardens, the more so as the Selangore almost the only cane now grown in the district, was obtained by them from the Gardens.

A few orange trees were observed in the district, nearly all of which are in good health, free from borer or white ants.

STEWART TOWN DISTRICT OF ST. ANNS AND TRELAWNY.

The subjects dealt with, were, structure of plants and the uses of their several parts; the composition of soils, the uses of manures, particularly of stable and pigstye manure, and the value of vegetable matter in changing the physical character of the soil; the curing of produce and the enhancement of its value by the curing being well done; pruning of coffee and orange trees, the necessity of freeing them from parasitic growths, the desirability of shading coffee at low elevations, how to bud sweet oranges on to sour trees and the advantages of doing so.

February 25th. Lectured in the Watt Town School Room to about 70 adults and about double that number of School Children, the people here were keenly alive to the importance of the subject and for an hour and a half after the lecture, kept up a string of sensible questions.

February 26th. At 7 o'clock in the morning nearly 20 of the Watt Town people appeared at Cheri Magna to see the pruning of coffee, cocoa, oranges and the budding of the latter, three hours were spent in the fields explaining the various operations.

At 12 o'clock a meeting with lecture took place at Gibraltar, about an equal quantity of adults assembling and about the same number of School Children. A great number of questions were again asked and after the lecture the whole of the adults repaired to the fields, and a long time was spent in demonstrating as at Cheri Magna.

February 27th. In consequence of the meeting of the people interested in the formation of an Agricultural Society at Browns Town being fixed for the 28th, Mr. Webb had altered the meeting at Keith to Thursday at eleven o'clock. The audience consisted here of about forty people fairly interested. At 7 o'clock in the evening a meeting of 200 people was addressed in the Chapel at Stewart Town. The people here seemed also much interested and a number of them asked most pertinent questions.

February 28th. A demonstration was given in the field of Mr. Webb, about half a dozen persons only turning up.

A visit was paid to the Westwood Girls School, and an address delivered chiefly on the structure of plants.

This tour should prove useful to the people of Watt Town and Gibraltar, a large district of coffee cultivators, mostly freeholders.

The soil in this district is chiefly of a light, very porous nature, particularly liable to be affected by drought, being on a subsoil of a honeycomb limestone formation; the remainder being of a sour boggy nature, the acidity of which renders the life of any plant of short duration on it.

The chief points to which cultivators on the light soils should give their attention, are the addition of humus rendering the soil heavier and more retentive of moisture without rendering it sour or acid; this will be best brought about by heavy dressings of vegetable matter, mul-

ching with pig stye and stable manure, either rotten or fresh; leaves, grass, trash of any kind, will in fact greatly benefit the soil; the covering of the soil with trash by shading it, will also protect the roots of the coffee and other plants from the effects of the sun. Secondly, the more thorough shading of the coffee plant with suitable trees; from the want of proper trees planted at correct distances through the fields the coffee plants suffer very much.

The heavy soil requires somewhat different treatment, although the land would be greatly benefited by the shading and the application of the manures and trash above mentioned. It however requires to be thoroughly dug up (as explained to the people in all lectures) to ensure thorough aeration and the addition of lime to remove the acidity and to prevent the fungus growth called by the people "Cacoon" so prevalent in the soil and so destructive to plant life. The quantity of lime too applied to the land would vary according to the state of the land, the minimum being 10 tons per acre, the maximum 20 tons per acre. When the coffee or other crops have died out and it is desired to replant the land, the line should be dug in thoroughly some time before replanting, to allow its purifying action to be partially carried out.

BROWN'S TOWN DISTRICT.

Monday, 2nd March, 1896. Lectured in the Chapel at Brown's Town in conjunction with Mr. Douet to about 300 people. The subjects dealt with being kola, cocoa, Liberian coffee, nutmegs and rubber plants; the use of and the necessity for shade trees; the reasons for manuring, liming, digging and draining land. Oranges were dealt with by Mr. Douet.

Tuesday 3rd. Visited Lower Buxton and lectured to a gathering of about 40 people of whom two thirds were land-owners, dealt with the same subjects as at Brown's Town, with the addition of oranges, demonstrated on pruning of coffee and oranges, and the budding of the latter. This is a district where last year a planter complained of a large patch of coffee not bearing, except round the outside. I pointed out to him that the trees were too thick and advised him to remove about half of them to a new field, and gave him practical instructions how to carry this out. He commenced the removal and then got frightened; but as the trees which he removed are now all growing nicely he has recently removed a much larger quantity, and the original patch has been much benefited by the accession of air and light caused by the removal and the consequent thinning of the trees.

Coffee in this district, the people complained, dies out quickly, most frequently in patches. The cause, as I pointed out last year, is usually acidity or sourness of the soil; the remedy, digging up, liming and manuring. I fully explained this last year, and one small settler at once carried out my instruction on five or six trees; these trees which last year were rapidly dying and were leafless are now recovering and putting out new growths, and the owner is now burning lime for the purpose of continuing the operation on other trees. The coffee growers around seeing the great efficacy of the application of lime, etc., are doing likewise.

Wednesday 4th. Visited Friendship Penn and coffee property, early in the morning with Mr. H. Levy who also showed me the benefits he had derived from carrying out last year's instructions, as to the mov-

ing of large coffee plants, the application of lime to land where the coffee trees were suffering from the want of it. He showed me trees which at the time of my visit last year had not a single leaf on them, and now had recovered to a marvellous extent.

Lectured at Philadelphia to about 70 people, more than half of whom were land-owners, the subjects being the same. This is the first time I have visited this place but the people seemed keenly alive to their lack of knowledge of the proper methods of cultivation.

Thursday, March 5th. Demonstrated at Brown's Town on pruning coffee and orange trees.

Lectured at Grateful Hill. This is a new centre also and is the centre of a number of people who have a hard struggle. They were formerly employed on the now abandoned sugar estates. I demonstrated to them on pruning and manuring coffee.

Friday, March 6th. Visited Tobolski and had a long consultation with Mr. Young about Coffee. Mr. Young had applied some lime to his coffee before my last year's visit, but had not paid much attention or attached much importance to it. The importance he now attaches to it will be understood when I say that he is now burning three large kilns of lime for the sole purpose of applying it to his coffee. I gave him also practical instruction how to bud and how to prune his orange trees. He had considerably damaged many of his orange trees by improper pruning, not so much because he did not know the way the trees should be pruned, as that he did not realise the importance of the proper methods, or the harm that could be wrought by improper methods.

Lectured at Bethany to about 40 people. This is the second visit to this place and the people were much interested; demonstrated on coffee pruning, manuring, etc., orange pruning and budding. At Dehany last year I showed the people how to bud, putting four Tangierine buds on to a sour orange stock, all these grew and intensely interested the people. The buds put on in August last have attained a growth of 42 inches,

GENERAL REPORT ON BROWN'S TOWN DISTRICT.

The chief crops are Coffee, Pimento, Ground Provisions, Bananas and now Oranges.

The peasantry are ignorant of the proper methods of pruning Coffee trees, they attach little value to manure, or to the efficacy of lime.

They have known nothing of the need of air and light, as shown by the way they crowd up their small patches of coffee, planting the trees in some cases less than 2 feet apart. Nor were they aware of the immense damage which can be wrought by parasites.

Proper shade for their coffee has also been much neglected.

ST. MARY.

March 16th, Monday. Demonstrated at 11 o'clock, about a dozen people being present including the proprietor, in the fields of Quebec, on the curing of coffee and cocoa, the best kinds of cocoa to grow and how to plant the same, also on budding oranges.

Lectured in the Town Hall at Port Maria at 5 o'clock in the evening to about 70 persons on the products mentioned, demonstrating the process of budding and grafting by means of some branches of orange trees. The audience here had any number of questions to ask, most of which were purposeful and to the point.

March 17th, Tuesday, was set down for Brimmer's Hall and Bailey's Vale.

The Rev. J. H. W. Graham, under the impression that the people from several districts could easily collect there, thought this would be a good centre, but from some cause or other not a soul appeared.

March 18th, Wednesday, was the day for Retreat and an extremely useful day made up for Tuesday's blank. About half-past 10 o'clock I started a demonstration on budding in the school yard to fully 50 freeholders. They were intensely interested in orange growing, the Retreat District being a very favourable one for the business. Several fine young sour orange stocks were budded with sweet oranges, tangierines and grape fruit. All the bigger scholars from the large school at Retreat were also present and were much interested in a demonstration on pruning coffee and cocoa and planting kola, as might be expected from such a gathering of people who have to get their living from the products. No small quantity of questions were asked, the quantity may be imagined when I state that from halfpast 10 until a quarter to two, I was kept fully occupied.

I then left with Mr. Graham for Jacks River where, in order to make up for Tuesday's failure, I had consented to give a second demonstration.

Arriving there at half-past three a demonstration on budding was started at once, continuing with coffee, kola, cocoa, and logwood pruning. The cocoa trees here grew very luxuriantly, but one or two were rapidly dying, in my opinion from bad drainage, and an absence of lime in the soil. I explained as plainly and simply as I possibly could the best method of draining the land and the best way to supply the needed lime.

March 19th, Thursday. Lectured in the School Room at Hampstead to about 70 people, on the cultivation of the soil, draining and manuring in relation to its effects on plants; giving notice that the following morning at 7 o'clock I would give practical demonstration, in pruning, budding, etc.

March 30th, Friday. At 7 o'clock I gave a demonstration on one of the properties of Mr. Rudolph at Hampstead in budding, and on an adjoining property on the pruning, planting and general care of cocoa and coffee, two and a half hours being occupied.

At 11.20 gave a demonstration at Highgate in the field of Mr. Dryden on pruning and planting coffee, cocoa, kola, and in the parsonage grounds on the budding of Oranges, about 40 people attending here.

By special request of Mr. Swaby no lecture was delivered here, simply the demonstration, as he particularly wished me to go on to Bellfield.

We arrived there at three o'clock and at once set to work pruning cocoa and coffee and budding oranges in the presence of about 50 people. All were much interested in the process explained, keeping me occupied up to a quarter to six, after which I drove to Castleton finishing up at eight o'clock, a day of 13 hours' hard work.

GENERAL REPORT ON TOUR.

Through some misunderstanding the meetings of Quebec, Port Maria, Brimmer's Hall and Bailey's Vale were not advertised as they should have been and the attendance was poor in consequence; but at all the

other places the attendance, though not as large as the districts would warrant, was satisfactory, the right sort of people turned out, that is, the small freeholders. One man who was at the Quebec demonstration last year, again walked six miles to Quebec to get further information as he said that his cocoa had improved immensely from the treatment he gave it last year on my advice.

Mr. Edwards of Mason Hall, Port Maria, also attended the Quebec demonstration, he being anxious to see the demonstration on pruning. He had come all the way to the Hope Gardens and received instruction on budding, by means of which he is now quite expert, having successfully budded a lot of sour orange trees on his own property.

At Retreat the people who attended seemed to be keenly alive to the importance of the demonstrations, and were particularly interested with the budding operations.

At Jacks River a very nice field of young cocoa and coffee was demonstrated on.

At Hampstead a fine field of young cocoa, the property of Mr. H. J. Rudolph, was also demonstrated on, both young and old coffee plants also being obtainable.

At Highgate I lectured in a very fine field of young cocoa about six acres in extent. The cocoa trees were of all ages up to two years, planted by sowing two and three seeds in one spot, in order that one tree might be secured in each place. Then in the usual fashion the whole were left to grow. Most of the trees required to be pruned also to prevent them from becoming six acres of gormandiser-growing, non-bearing cocoa trees. I explained the reason for pruning, and showed how to prune.

At Belfield a fine young field of cocoa was shown, which was simply going to bush for want of pruning. It was growing on good land, was kept clean and was old enough to bear; and yet it was not bearing, simply from the want of a knowledge of the proper treatment of the tree on the part of the owner.

With regard to the soil in the districts visited, my second visit has still further impressed on my mind the importance of the opinions I expressed after my first visit. The soil of the part of St. Mary visited by me is beyond doubt very fertile, and yet requires scientific cultivation. The soils around Hampstead particularly require the utmost forethought with regard to drainage, by means of the cutting of trenches, the addition of lime, and of vegetable matter, and aeration by constantly digging up the soil. The carrying off the water on the very heavy soils by means of trenches is a matter of the greatest importance, so as to prevent the soil getting sodden, and to prevent the loss of heat by the evaporation of large quantities of water from the soil.

The district traversed as may be gathered from the first part of this report is full of young cocoa fields of all ages and sizes; but many of the people are becoming tired of the cultivation, as they say that the trees grow up all right, but bear little or nothing. I think that it is of the greatest importance that the people should have it drummed into them that it is not the fault of the trees, locality, or soil, but simply that they allow the trees to grow gormandisers until they become orest trees with scarcely a pod on them.

Rev. W. M. Webb to Director of Public Gardens.

Stewart Town, 11th March, 1896.

I am pleased to report that the series of lectures delivered by Mr. Cradwick at my stations was quite a success in point of attendance and practical value to agriculturists and small settlers who availed themselves of Mr. Cradwick's presence, and attended the lectures.

2. The following places were visited, viz. :—

Watt Town, Tuesday, Feb. 25th, 12 noon.

Gibraltar, Wednesday, Feb. 26th, 12 noon.

Keith, Thursday, Feb. 27th, 12 noon.

Stewart Town, Thursday 27th, 7 p.m.

3. At all the lectures the people were greatly interested by the practical teachings of Mr. Cradwick on the best methods of planting, growing, cleaning, and curing coffee which is the chief product of all these districts.

4. At the close of the lectures, various questions on the subject were asked, and much useful information elicited.

5. A new and special feature of Mr. Cradwick's instruction was his practical lessons in pruning coffee, and budding sweet orange on sour orange trees. As the orange trade is likely to continue to be of great importance, and there are rich orange districts, Mr. Cradwick's instruction cannot be overestimated.

6. The present practical results, are :—

1st. That attention is being paid to the pruning of Coffee, and

2nd. Many who witnessed the process of budding are attempting the process, and preparing trees to send out shoots for the purpose.

7. I must not close this brief report without adding that on Friday the 28th being in the neighbourhood of the Westwood High School, Mr. Cradwick was invited by myself, as the Manager, to visit the School, and deliver a lecture on the nature and treatment of plants, and show the process of grafting. The lecture and budding process were much appreciated by both teachers and pupils.

8. It is earnestly hoped that the Department will arrange for a repetition of Mr. Cradwick's visit and lectures, and he will no doubt be gratified by observing some useful results of his late visit.

W. M. WEBB.

Rev. J. H. W. Graham, Port Maria, to Director of Public Gardens.

March 27, 1896.

I have not written since Mr. Cradwick's visit to say how much we appreciate his coming. His visits are productive of much good, and will be increasingly so as more people get to know of the kind of work that he does. The meetings here were not as largely attended as might have been expected; but this was due perhaps to my not knowing what the lectures were like. I was too ill when he came last year to attend them. I am sure however on his next visit that the meetings will be much more largely attended. For this reason I should be glad when on his visit to Gayle if you will arrange that he pass through one or two other places on his way home in this locality. His nearest way home from Gayle will be via Bonny Gate and Port Maria and he could just stop on the way and I would get out a goodly number of persons to meet him.

I say again that visits like Mr. Cradwick's are necessary and are of great value to the peasantry and what is more that they do and will more largely appreciate them as they get more known. Trusting you will be able to help us as asked.

JOHN H. W. GRAHAM.

V. HERBARIUM.

When I entered on my duties in the Island in January 1887, the collection of plants in the Herbarium was contained in six cabinets. Since then 27 more cabinets have been filled. But there are still very many species of plants both of economic value and botanical interest, of which we have not been able to secure specimens. I will mention one here which I am very anxious to obtain, that is, Jamaica Satin Wood. Judging from the leaf only, it appears to be allied to Torch Wood or Candle Wood (*Amyris*) and Prickly Yellow Wood (*Xanthoxylum*), but it is necessary to have the flowers and seed-vessels to determine it exactly.

Mr. Harris has continued his collecting with great success, and the following are new additions to the flora of Jamaica.

New Species found in Jamaica.

Ternstræmiaceæ.

Ternstræmia Hartii, Kr. & Urb. (Engler's. Bot. Jahrb. XXI.)

T. rostrata, Kr. & Urb. (1.c.)

T. granulata, Kr. & Urb. (1.c.)

Rutaceæ :

Fagara Hartii, Kr. & Urb. (1, c)

Bromeliaceæ.

Tillandsia Fawcettii, Mez (Monogr. Phanerog. IX.)

Guzmania Fawcettii, Mez (1. c.)

Polygaleæ.

Polygala Jamaicensis, Chodat (Monogr. Polygal.)

Species new for Jamaica.

Ternstræmiacæ :

Marcgravia rectiflora, v. Brownei, Triana & Planch

Freziera Griesbachii, Kr. et Urb.

Malvaceæ :

Abutilon crispum, Medic.

Sapindaceæ :

Cupania Americana, Linn.

Leguminosæ :

Lupinus angustifolius, Linn. (naturalised).

Tephrosia candida, DC. (naturalised).

Desmodium gyrans, DC.

Rosaceæ :

Rosa bracteata, Wendl. (naturalised).

Compositæ :

Vernonia anthelmintica, Willd. (naturalised).

Oleaceæ :

Linociera axilliflora, Griseb.

Amarantaceæ :

Alternanthera Achyrantha, R.Br.

Chenopodiaceæ :

Boussingaultia basselloides, H B.K.

Laurineæ :

Acrodiclidium sericeum, Griseb.

Orchideæ :

Trichopilia mutica, Reichb f.

Bromeliaceæ :

Tillandsia fasciculata, Sw. var Bogotensis, Andre.

T. incurva Griseb.

Vriesia platynema, Gaudich.

V. panniculata, Mez.

Guzmania erythrolepis, Brogn.

G. capituligera, Mez.

Pontederiaceæ :

Heteranthera reniformis, Ruiz & Pav.

VI. LIBRARY.

The following is the catalogue of the works placed in the Library in addition to those already acknowledged as contributions in the monthly Bulletins. The names of donors are added in square brackets; and in this connection I beg to call special attention to the donations from Kew and the British Museum.

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VII. SUPERINTENDENTS' REPORTS.

HILL GARDENS.

The following Report is by the Superintendent, Mr. W. Harris:—

ROADS—The principal roads through the plantations were cleaned and kept in order.

FENCES.—All the fences have been kept in a good state of repair.

PASTURES.—These were billed and kept clean.

GARDEN.—The usual garden work such as manuring, pruning, forking, propagating, potting and watering plants; mowing grass, weeding beds and borders was carried on during the year.

YOUNG FOREST TREES.—A quantity of seed of *Pinus sinensis* was received from the Botanic Gardens, Hong Kong, in March 1895, and plants have been raised.

Podocarpus elongata, the *Cape Yacca*.—A large number of plants of this valuable tree will soon be available for distribution.

Juniperus Bermudiana, the *Juniper Cedar* of Jamaica. The trees of this in the hills bore large crops of seed last season, and a good supply was secured, not only for distribution, but for sowing. Seedlings are now appearing in the beds, but as they are of rather slow growth, it will be some little time before they are ready for distribution.

OLIVES.—Eighty plants of the variety known as *Frantojo*, 18 plants of *Manzanillo*, 7 *Nevadillo Blanco*, and 2 *Redding Picholine* have been planted out at various elevations from 3,500 to 5,500 feet elevation. The variety *Frantojo* is said to be the best oil-producing sort grown in the South of France. Olives have been grown in Jamaica for many years, but without success, and it is now thought that their non-success may be due to their having been planted at low elevations.

Fodder Grasses.—*Kentucky Blue Grass*, and *Texas Blue Grass* con-

tinue to do well, also the *Himalayan grass*,—*Pennisetum orientale*. Seed saved from old plants of the latter grass grew freely, although imported seed failed to germinate. Stock are extremely fond of the three grasses named, and our animals never miss an opportunity of cropping them.

ORRIS ROOT.—Our plants of *Iris germanica* are growing luxuriantly and have already formed rhizomes of a considerable size. If the rhizomes develop the peculiar violet odour here, and there does not appear to be any reason why they should not, the cultivation of that plant should become of considerable importance in the hills. It grows in poor soil, without manure, and its preparation for market is of the simplest, the roots being merely dried in the sun, trimmed and the skin pared off. In December last *Orris root* was sold in London at 64/6 per cwt. It is largely used in the preparation of toilet powders (violet powder), perfumery, and to some extent medicinally.

CHINA GRASS—This grows to a height of 10 feet or more at the Hill Gardens. It is the variety of *Bahmeria nivea* (Ramie) with the under surfaces of the leaves *white*, and produces better quality of fibre than the *Rhea* or *Ramie* of the Malay Archipeligo, the leaves of which are *green* on both sides. China Grass is suitable for cultivation in the hills, whilst *Rhea* or *Ramie* is only adapted for cultivation in the lowlands.

ORANGE CULTIVATION AT RESOURCE—Resource is a property of 162 acres which reverted to the Crown about 25 years ago. It is situated on the southern slopes of the Blue Mountains, about 9 miles from Gordon Town, and ranges in elevation from 3,400 to over 4,000 feet. Some of the best oranges in Jamaica are grown by settlers on land adjoining this property. A parochial road runs through the property, and as it is within half-an-hour's ride of Cinclona, it has been placed under the management of that establishment, and now forms one of the Hill Gardens.

As might be expected, an old property which had been so long out of cultivation, save a few patches of provision ground worked by tenants, required a great deal of heavy work to restore it to something like order. There were no fences, no field roads, and rank bush and large mango trees of useless sorts grew everywhere, filling the land with roots and impoverishing the soil. These had to be removed, the ground thoroughly dug up, and immense quantities of roots and stones removed.

It is important that the ground for oranges should be thoroughly and carefully prepared; time is lost rather than gained by putting out the plants in soil that has not been worked into condition suitable for their growth, and moreover, they are likely to become diseased and stunted. The removal of stumps is not absolutely necessary, but renders subsequent culture much easier. In a word, everything is to be gained by careful cultivation at the start. Work was commenced in October last by enclosing a portion of the land with a substantial wire fence; since then 149 chains of fence have been erected; 95 chains of road have been dug, and ground was prepared for plants ordered from Messrs. T. Rivers & Son, England, and Messrs. Reasoner Bros., Florida. Seed beds were prepared and have been sown with large quantities of sweet orange, sour orange, lemon, lime, shaddock, grape-fruit and other seeds, the best fruits obtainable being procured to supply the seeds.

The plants of seville orange and lemon raised from these will be used as stocks, when large enough, for budding good kinds on. The plants imported from England and America will form stock trees for the supply of eyes for budding. In all, 27 varieties of orange, 8 varieties of lemon, 3 varieties of lime, 4 varieties of grape-fruit, and the best kinds, respectively, of shaddock, citron, and forbidden fruit have been imported and planted out in permanent positions. The following are amongst the plants received :—

St. Michaels.—This is a thin-skinned and well flavoured orange. The tree bears young and is prolific, and has few thorns. Several thousands of grafted plants, and seedlings have been distributed for many years throughout the island from a tree in the Public Gardens originally imported from Messrs. Rivers, England. The fruit of one of these seedlings grown in the Port Royal Mountains has been submitted for an opinion to an experienced fruit buyer now purchasing oranges in the island for export : he states that it is one of the finest grades of the true St. Michael's orange, that this fruit would fetch the highest price in the New York market, and that there would always be a demand for these from Jamaica, as the St. Michael's grown in the island, and specially in the Port Royal Mountains, are much finer than any grown in either Florida or California.

There are several varieties of the St. Michael's, of which the following, as well as the ordinary variety, have been imported from Messrs. Rivers :—

Botelha, with thin rind, and rich pulp ;

St. Michael's Egg, very large, rind thick, remarkably juicy, a great bearer.

Exquisite, a thin-rinded, rich, and juicy fruit.

Sustain, large and remarkable for the delicacy and high flavour of the pulp ;

Silver or *Plata*, pale yellow, thin rind, pale flesh, flavour piquant and delicious.

Besides the *St. Michael's* and its varieties, the following have been received from Messrs. Rivers :—

Jaffa, originally from Syria and the fruit is preferred to any other orange in England.

Pernambuco, fruit fine and, delicious, tree robust in growth.

Blood, pulp stained with deep crimson, fruit large and delicious ; skin thin ; foliage and growth very different from the St. Michael's.

Malta, like the Blood in size and form of fruit, but pulp not red.

Embigo or *Navel*, fruit large, flesh fine, melting and tender, juice sweet, vinous and aromatic ; quality excellent. The fruit of this variety is usually seedless, and it has a peculiar umbilical formation at the top. It was originally imported from Bahia.

From Florida the following have been imported, besides the *Jaffa* and *Navel* :—

Jaffa Blood, a new Blood orange originating in Sanford, Florida.

Parson Brown, a Florida seedling, productive and ripening early ; large, juicy, and sweet.

Tardif, medium sized, round, skin smooth and thin, grain fine, a common Florida orange, in quality above the average, retains its juices

until July, or later, and is especially valuable on this account; tree prolific, with very few thorns.

Whitaker, quality of the very best, type of the finest Florida sorts, medium to late ripening, vigorous and productive.

Of the *Mandarin Orange* we have the *China Mandarin*, small flattened, deep yellow colour, skin thin, skin and segments loosely adherent, flesh dark orange colour, spicy and aromatic, tree dwarf, bears young, prolific, vigorous, willow-like foliage, with few thorns; *Dancy's Tangierine*, fruit a little larger than the China, which it resembles, except in its deep colour, tree unlike the other Mandarin varieties, resembles the sweet orange in size and foliage, though it retains the peculiar aroma, thorny; *Satsuma*, a native of the Japanese island of Kinshiu, and named after one of its chief provinces, fruit medium sized, flattened, deep orange colour, smooth, thin skin, which is sweet, aromatic.

Of Lemons we have *Imperial*, fruit very large, with a fine aroma; habit of tree robust and vigorous; *Bijou*, fruit small with a delicious aroma; growth of the tree very dwarf and fruitful, a remarkable sort; *White*, one of the largest and best; *Genoa* imported into California from Genoa, Italy, an early bearer, ever bearing, and fruit of the best quality as a market lemon, rind sweet, standing the test of both hot and cold water for twenty-four hours without developing bitterness, tree usually nearly thornless; *Villafranca* in very high favour as a lemon for market and home use, quality of the very best.

In addition to plants of the Citrus family, about 100 fruit trees have been put out at Resource, these include *Peaches*, *Pears*, *Plums*, *Persimmons*, *Currants*, two kinds of *Fig*, four kinds of *Pomegranate*, four kinds of *Mulberry*, *Loquat*, *Olives*, etc. As there is plenty of land available, Resource should become a most valuable property for experimenting with, and propagating fruit and other plants from sub-tropical and temperate climates, which would be likely to succeed at elevations from 2,000 feet upwards.

SUGAR CANES. Over 50 varieties of sugar-cane from Hope Gardens are also being tried, to find out which kinds are best suited for growing in the hills. The canes grown from these will be distributed *free* to settlers in the district who cultivate cane for making "new" sugar.

BERMUDA LILY. This beautiful lily is cultivated as a field crop in the Bermudas, to supply English and American growers with bulbs, and it appears to be a very remunerative industry. Mr. A. Crane who has recently settled in Jamaica, from Florida, imported 40,000 young bulbs, and these have been planted at Resource, being placed eight inches apart in rows which are eighteen inches asunder. The work of thoroughly cleaning and preparing the ground, and planting the bulbs entailed considerable expense, which has been borne by Mr. Crane. This is a highly interesting experiment, as if it succeeds, bulb farming in Jamaica will, doubtless, become of considerable importance.

BUILDINGS. In addition to the work outlined above as having already been carried out at Resource, three small buildings have been erected, viz.: a small office, a tool shed and store-room, and a mule shed.

PLANTS DISTRIBUTED. The number of plants sold during the year amounted to 546, and of tree Tomato fruits 270 dozens, weighing 542lbs.

The number are as follows :—

SOLD	...	...	546
FREE GRANTS—Economic plants	...	...	563
“ Ornamental do.	...	...	933
Total number of plants distributed ...			2,042

SEEDS DISTRIBUTED. Quantities of Juniper Cedar, West Indian Cedar, Cherimoya, Tree Tomato, Pimento, and Grias cauliflora.

The elevation of the house at the Hill Gardens is 4,907 feet above sea-level. The average annual mean temperature is 62°.7 Fah. and the average annual rainfall 105.99 inches for 25 years. The amount of rain that fell during the year was 122.45 inches; August, October and November being the wettest months, and July, September and March the driest.

The mean temperature for the year was 61°.8 Fah.

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

The number of letters received—650, despatched—920.

HOPE GARDENS.

The following report is by Mr. W. Cradwick, Superintendent :—

NURSERY. The importance of the nursery at Hope can hardly be over-estimated; being near the City of Kingston, and convenient for the despatch of plants by Coastal Steamer from the most convenient wharf in the Island, by train from the chief station of the Island Railway system, by Mail Coach from the chief Post Office.

43,380 plants have been despatched from Hope Gardens during the year. The complaints of plants being damaged in transit have not been more than half a dozen, and most of these arose from an unavoidable circumstance, viz. : the very rough voyage experienced by the Coastal Steamer on one of her trips. Even then although many of the plants went nearly twice round the island, the percentage of losses was very small, which speaks volumes for the care bestowed on them by the Atlas Steamship Company.

Plants delivered by the Railway authorities also are usually spoken of by the consignees as arriving in perfect order. The most satisfactory method of despatching such plants as can be transmitted by that method is however by Mail Coach; a parcel of plants despatched from Hope on the 14th of the month through some remissness on the part of the Consignee's agent was not delivered until the 31st, yet the Consignee writes that they were received quite fresh.

I myself visited an orange grove, in which about 600 seedling orange plants from bamboo pots sent from Hope had been planted, and about 400 plants from beds sent by Mail Coach, there was not a particle of difference between the plants, and the cost of the plants by Mail Coach is about half, and in some cases less than half that of the plants by rail or steamer. Orange plants, Liberian Coffee, Cinnamon, nearly all ornamental and timber trees can be transmitted in this way. Kola and Nutmeg on account of the fleshy cotyledons being liable to get broken off and being severely damaged in consequence, cannot be so transmitted.

It is however of the greatest importance that plants despatched by Mail Coach should be planted directly they are received, and all

preparation should therefore be made before ordering the plants; plants should not be ordered in this way except at the commencement of a rainy season, unless it is possible to give water artificially.

Great attention has been paid to the propagation of plants, with a view to having the plants strong and healthy and packed well on sending out. We have been careful also to keep the nursery as tidy as possible, in order to render it attractive,—no easy matter when the character of the labour which we have to employ is considered. The men take very little interest at first, and usually after a short term of service they take none at all, except such as they feel bound to take to prevent reduction of wages by fines. Sometimes for a longer period than usual a man takes an interest in his work and then he may be sent to one of the many applicants for good labourers, who is delighted with him for a week or two; but soon from lack of supervision he loses all interest in his work and then his employer gets disgusted with him and blames the Gardens for what is really the fault of the raw material.

The treatment of seeds and seedlings has been carefully looked after, difficulties have been overcome which were hitherto thought to be almost insurmountable in the way of raising large quantities of Eucalyptus, Casuarina, and many other trees, the seeds of which are so liable to be carried away by ants, cockroaches, etc.

When sown in beds, they can now be successfully dealt with, by immersing the seeds in kerosine before sowing them. The kerosine bath does not harm the seeds in the least, and entirely prevents the ravages of insects. Many other methods of preserving the seeds have been tried but with little success, watering the seed beds with Jeyes' fluid, carbolic acid, kerosine and water, but no method was an unqualified success except the immersion of the seeds in kerosine. It is not necessary for the seeds to be in the kerosine any longer than is needed for sufficient kerosine to adhere to the outside of the seed to render it distasteful to the insect attacking it.

We have also been very successful with the treatment of seedlings, oranges particularly having been grown to fine plants in a very short time. The method adopted with them is as follows:—When the seeds are to be sown, a bed is dug up thoroughly and the soil made nice and fine on the top; the seeds are spread evenly over the surface and then covered about half an inch thick with previously prepared soil sifted fine. The beds are never shaded, and never allowed to get dry, and the consequence is that the plants spring up as evenly as possible. They grow very fast, in six weeks from the time of sowing they have put out their first pair of true leaves and are ready to be transplanted into other beds. They are then planted in properly prepared beds, the end of the tap root being cut off at the time of transplanting. This is found to be advantageous in two ways, first by reducing the risk of the labourers' doubling up the long root when replanting the seedling, which would be very detrimental to the young plants, secondly by causing the plant to send out a larger quantity of small fibrous roots and lessening the danger in the second transplanting. Liberian coffee seeds treated in the same way produce good plants in twelve months. The same applies to Casuarinas, and to all the Eucalypti except such as have hairy leaves when young, like *E. citriodora*, which cannot be

handled in this way, but have to be transferred to bamboo pots as soon as they are big enough.

At the end of the financial year there were in the nursery about 40,000 Liberian coffee plants,—seedlings and transplants, about 7,000 Eucalypti, about 4,000 Casuarinas, and 4,000 Kola. All the Kola were already bespoken, only waiting for the season to be despatched.

7,500 Grape fruit seeds, 46,000 sweet orange seeds, and 15,000 Tangerine orange seeds were sown. Most of the seeds are growing nicely. All the seeds are from tested selected fruits of the best quality only; any inferior fruit being thrown away. The propagation of plants by other means than by seeds has also received attention. Roses which have long been giving trouble are now being propagated by circum-position, a plan which is perhaps a trifle slow but sure. The best roses can be propagated in this way and good plants are produced. There is no waste of wood, which is an important point as many of the best roses if repeatedly denuded of wood, lose their vigour and soon die.

The stock of economic and ornamental plants in the nursery at Hope, other than those already enumerated, is estimated at 35,000.

With the large output of plants, the procuring of proper soil in sufficient quantities to sow seeds, place cuttings in, and finally pot the plants in, is an important item. The soil in which seeds or cuttings are placed is soon considerably exhausted and needs recuperating by the addition of good soil; this soil has to be manufactured out of grass, leaves and any vegetable rubbish.

Several large trees with large leaves have been removed from the nursery with a view to encouraging the growth of Juniper Cedar, Cassia siamea and other plants with smaller leaves, which will protect the young nursery plants from the fierce rays of the sun, and the wind, without at the sametime rendering them delicate by casting a dense shade over them or damaging them by heavy drip after rains. Anyone making a permanent nursery in the tropics would do well to take note of this and only plant for shading young nursery plants such trees as Juniper Cedar or Cassia siamea.

A hedge of *Aralia Guilfoylei* and *Cassia siamea* has been planted on the west side of the nursery for the purpose of forming a wind-break, the *Aralias* prevent the wind from blowing between the stems of the *Cassia* as it grows tall. *Cassia siamea* trees in eight months have grown to a height of 20 feet, and this with repeated stopping to make them bushy.

ECONOMIC PLANTS.—The nutmeg trees at Hope this year are carrying a fair crop. The Liberian coffee trees have improved and bear a nice crop of fruit,—63 young trees have been planted out. The Cocoa trees are growing and bearing well, the effects of careful pruning and irrigation being very well illustrated.

The fine trees of Ceylon Cinnamon bear a good quantity of seeds; some trees cut down have coppiced well, showing that the growth of Cinnamon as an article of commerce is an easy matter.

A small plantation of Arabian coffee has been made, consisting of 137 trees. The plants put out in October are all shooting up very well, being planted through bananas. Provision has been made for permanent shading by planting a tree of *Grias cauliflora* (Alligator

(Pear) between every two coffee plants, and a tree of *Cassia siamea* every thirty feet. The coffee plants are put out 9 feet apart, it being intended to manure, water, and cultivate as highly as possible. 72 Alligator Pears, 30 Breadnut *Brosimum alicastrum*), and 9 plants of *Cassia* have been used for shading purposes.

Coffea stenophylla planted at the same time as the *Coffea Liberica* has not grown anything like as well, but I propose to put a few plants lower down the economic grounds where the soil is better.

Several varieties of Coffee seeds received from Mr. Thomas Christy have germinated and are now almost ready to plant out.

Sugar Canes.—The young canes have all been carefully attended to and have made very fine growths. Increased interest is taken in the numerous varieties, and there is a large demand for tops. 3,360 tops have been distributed and some of the older varieties distributed from the Gardens are well spoken of. The trials of canes in different parts of the Island show that canes can be obtained to suit almost any district; the Salangore is highly spoken of by the people of the Brandon Hill district; Caladonian Queen is preferred by Colonel Kitchener for growth in Westmoreland; Lahina by Mr. Mitchell of Amity Hall, Vere; Po-a-ole is thought by Mr. Harry Cork of Burlington to be the best cane for his district in Portland,—it is largely grown at Worthy Park, and is spoken of by Mr. Scarlet as growing well and making a fine grade of sugar.

During the coming year it is intended to put out a duplicate lot of plant canes; and next year we shall be in a position to test the juice from first ratoons; and from plant canes.

Grape Vines.—Nearly the whole of the plants started to grow fairly well, but were attacked by swarms of May Bugs, which not only ate off the young leaves and tender shoots of the vines which had made growth at the time of the attack but also ate the undeveloped buds of the vines which had not started to grow, killing some of the vines entirely. Some of the vines however put out good strong growth with good bunches of fruit, these latter had to be removed as it was found that the ripening of them would exhaust the vines. The Madeira vines from Dr Graham have not grown well. During this year all the vines which made good growths last year will be allowed to fruit.

Pines.—Experiments in planting and manuring are being carried out, and also on various types of suckers.

Bananas.—The suckers of *Musa sapientum* var. *rubrum*, have grown very vigorously. *Musa Banjoo* planted alongside has also grown well and is now shooting. *Musa Martaban* and *Gundy Banana* have not as yet shown signs of fruiting. A further plantation of 10 rows of the Common Banana has been made, 15 plants in each row, for the purpose of testing various manures, the land has been dug up properly to a depth of 15 or 16 inches, freed from stumps and stones, and the plants are being kept well watered.

Colocynth.—Six plants of this were received from the Hill Gardens during the year of which two died. Four plants yielded half a bushel of fruit, from these a quantity of plants has been raised which will be planted on ground prepared in the same way as for the Bananas and the produce will be prepared for market. This is the first time the land has been dug up, and the thorough preparation of it is very la-

borious work, the removal of stumps and stones alone being very difficult, but the planting of the ground with any future crop will be much easier.

Oranges.—The budded orange plants by the glass house have borne fruit this year which was exhibited at the Agricultural Show. Several thousands of bitter oranges and lemons have been planted out preparatory to budding them.

Papaws.—The small plantation of Papaws was very successful, and ten acres more have been planted. It was found that the planting of Corn among the young papaws was very helpful to them and the whole ten acres were planted with corn. There was a very large preponderance of male trees—in some parts of the plantation as many as nine trees out of twelve in a single row turning out to be male trees.

The best method of planting Papaws is to raise the young plants in beds and as soon as they are three inches high, transplant into bamboo joints, in which they can be kept until they are nine inches high, when they must be transplanted to the open ground. In dry districts like Hope they will require abundant watering, irrigation twice or thrice a week being absolutely necessary. In wet places no doubt they can be grown with little or no water. I tried sowing seeds at stake and also transplanting directly from the beds to the field. Neither plan is so good or so economical as the one mentioned above. Papaws require good rich deep soil well cultivated; even then many of the plants, just as they should commence to bear, suddenly fail, the plant ceases to grow, the youngest leaves turn yellow and fall off. The plant is a very unsatisfactory one to attempt to grow on a large scale in dry districts like Hope.

Sisal Hemp and Ramie.—With these there is nothing further to report, except perhaps to remark that the former is polling very rapidly. The raising of Ramie from seeds is a tolerably easy matter. The seeds being very minute requires protection from heavy rains. The young plants are also very easily damaged by heavy rains, but after they reach a height of three or four inches they are very hardy. The Ramie plants at Hope produce seeds very freely. It is however not recommended to plant seedlings but rooted cuttings taken from the base of the growth at a depth of about two or four inches below the ground. These are planted just below the surface of the soil, and the soil being good and the weather favourable, they will grow to a height of two or three feet in less than two months. The easiest and most successful plan of planting Ramie has been found to be to form beds four to five feet wide with intervals between of about 15 to 18 inches, then put the cuttings in about 9 inches apart. Labourers can then pass along the intervals and weed the beds without tramping down the soil in which the Ramie is planted—a very important point, as the young plants do not thrive nearly so well in tight soil.

MISCELLANEOUS.—The correspondence at Hope still continues to be very heavy, 3,267 letters have been received during 1895, and 2,868 despatched.

A new stable is badly required for the mules, as we have three times as many mules as stalls.

Part of the old house needs repairs. A new seed house, as mentioned in my last report, is badly needed.

ROADS, FENCES.—The road from the front gate to the Superinten-

dent's house has been repaired throughout, and six chains from the nursery to the East Indian section. A circular piece of road has been provided for the convenience of turning carriages opposite the large Royal Palm. The length of road repaired is 56 chains and has been raised over a width of 12 feet, an average of 3 inches this operation entails much labour. The operation will however soon have to be repeated, the traffic over this piece of road now being considerable.

The fences are nearly all now in good order, a new iron gate was put in place of the old wooden one near the conduit. The admirable gate posts are the product of the Teak plantation in the Gardens; these, set in cement, bid fair to last for a great number of years. 78½ chains of fence were repaired during the year, good growing posts of Hog Plum have mostly been used, nearly all these are growing and will render the repairs to be done this year very little.

ORNAMENTAL PLANTS.—*Roses*—The rose garden has been kept in good order; this is necessary, as the quantity of wood required from which to make cuttings is very large, and the demand is increasing; the area is the same as in last year's report.

The ornamental border of the large lawn has also been planted and kept in good order. The following plants have been remarkable for their beauty:—

Seedling Cannas: one with a fine spike of red flowers; several fine dwarfs of the Madame Crozy type; also a yellow spotted one.

Cannas from Kew:

Alphonse Lorenze

Charlotte Rothschild.

Madame Crozy.

The first is a very handsome dark flowered Canna with flowers of the best type with a good spike and large handsome dark foliage.

The second has flowers of the best type, colours red with a deep yellow band, also a fine spike, foliage green.

Madame Crozy is deep orange with a yellow band, many of the seedlings are quite as good as this.

Solanum Wendlandianum received from Kew, a climbing plant, native of Costa Rica, has made very rapid growth and flowered well. The flowers are in large cymes, each flower being about 2½ inches across, the cymes being often 8 or 9 inches across, the colour a very delicate lilac blue.

The following plants from Kew have also flowered for the first time and have proved themselves valuable acquisitions:—

Tecoma Mackenii

Pergularia odoratissima

Thunbergia grandiflora, a pure white one.

Vitex trifolia.

Allamanda Williamsii

The following desirable foliage plants have also been received and are growing well:—

Chickrassia tabularis, from Kew, a plant with very pretty pinnate leaves, the points of the young leaves being pink,

Thuja compacta and *Euonymus japonica*, from Messrs. Reasoner, Florida.

Strobilanthes Dyerianus from Kew.

The plants of *Camoensia maxima* have not been a success, one of

them only has grown at all well, this one having made a growth of about 10 feet, but has not flowered.

The plants of Mountain Pride (*Spathelia simplex*) have grown very well and will probably flower next year.

The palms and other plants put out in the tropical African section have all been kept well watered and otherwise attended to and are making very satisfactory growth.

Bougainvillea spectabilis flowers continually and is universally admired.

Ipomeas of different varieties, foremost being a splendid blue one, have made a lovely show.

The lawns have been kept in perfect order by weeding and mowing.

Mention should also be made of *Bignonia venusta* and *Beaumontia grandiflora*, the first growing on the Superintendent's house, and the second on a fence just in front.

POT PLANTS.—The collection of pot plants has been kept in good order as evidenced by the display of plants at the Agricultural Show, when a tent 40 by 20 feet was filled with a good display of plants, mostly from Hope. The Cannas in pots made a very grand display. Begonias, Palms, Dracænas, and the Tree ferns being the other most important plants exhibited.

The collection of Orchids at Hope is now a large and valuable one; the recent additions from Kew Gardens, Messrs. Veitch, Judge Nathan, and Trinidad Gardens being extensive and varied and are now nearly all growing nicely. The following noteworthy orchids have flowered, those marked x for the first time:—

- Angræcum eburneum, var. virens
- x Cattleya guttata, var. Leopoldi
- x Laelia sp.
- x Dendrobium pendulum
- Catasetum macrocarpum
- Epidendrum atropurpureum
- E. paniculatum
- E. Stamfordianum
- x Cattleya Skinneri
- x C. Bowringiana
- C. labiata, var. Gaskelliana
- C. labiata, var. Mendellii
- x Dendrobium formosum, var. giganteum
- x D. Phalaenopsis
- D. fimbriatum, var. oculatum
- D. Pierardi
- D. Farmerii
- D. nobile
- D. densiflorum
- Laelia anceps
- Coelogyne ovalis
- C. speciosa
- C. blaccida
- Rhynchostylis retusa, var. praemorsa
- Aerides multiflorum
- Stauroopsis lissochiloides
- Oncidium Cebolleta

- x *O. luridum* (scented variety from Trinidad)
 - O. ampliatum*
 - O. altissimum*
 - O. Papilio*
 - O. Kramerianum*
- x *Lycaste aromatica*
 - Angraecum sesquipedale*
 - Scuticaria Steelei*
 - Selenipedium caudatum*, var. *roseum*
- x *Cypripedium Leeaanum*
- x *Bifrenaria aurantiaca*
 - Bulbophyllum Careyanum*
 - Coryanthes* sp.
- x *Dendrobium Draconis*.

Perhaps the finest show of all the Orchids was made by the native *Broughtonia lilacina* (*Laeliopsis domingensis*) of which large masses were covered with flowers.

The Cannas in pots have made a nice show, with ten and twelve spikes of flowers on some of the plants. The better varieties are very showy, and if these plants are well cultivated, there is no better class of plants for pot culture in the tropics. The tree ferns are in good order.

The Bermuda Lilies have done very well in pots and have also proved themselves well suited for pot cultivation in the tropics. Palms, native ferns, *Dracenas*, etc., help to make the Garden attractive.

Fern House.—The Fern House is in good order, nearly all the ferns growing well, and the creepers on account of being continuously pruned have not again become so heavy as to injure the growth of the ferns in the house.

HOPE INDUSTRIAL SCHOOL.—During the year a change of Mastership of the school has taken place with beneficial results; the new master is an agricultural enthusiast and helps to instil into the boys an interest in the science.

The tuition in the Garden has been practically on the same lines as last year.

PLANTS DISTRIBUTED.—*Sold*.

Economic Plants;—

Liberian Coffee	...	...	17,470
Oranges	...	...	6,441
Kola	...	...	3,770
Cocoa	...	...	1,692
Fruit Trees	...	...	794
Nutmegs	...	...	397
Shade Trees	...	...	248
Eucalyptus	...	...	117
Grape Vines	...	...	37
East Indian Mangoes	...	...	26
Breadfruit	...	...	8
Various	...	...	606

31,605

Ornamental Plants :—

Shrubs	...	...	1,558
Crotons	...	...	1,357
Roses	...	...	1,072
Palms	...	...	1,017
Climbers	...	...	327
Ferns	...	...	171
Various	...	...	1,453

 6,955
Free Grants.

Eucalypti	...	...	1,478
Teak	...	...	238
Cassia siamea	...	...	118
West India Cedar	...	...	111
Mahogany	...	...	94
Mahoe	...	...	10
Various Trees	...	...	522
Cocoa	...	...	325
Liberian Coffee	...	...	245
Rubber Plants	...	...	172
Logwood	...	...	36
Cane tops	...	...	359
Shrubs	...	...	471
Crotons	...	...	355
Palms	...	...	113
Roses	...	...	51
Various	...	...	122

 4,820

Total number of Economic Plants distributed 35,313

“ “ Ornamental “ “ 8,067

“ “ Plants “ “ 43,380

The following have also been sold :—

1,330 Ears of Corn.

1,309 Cabbages.

529lbs. of Tomatoes.

22½lbs. of French Beans.

CASTLETON GARDENS.

The following Report is by the Superintendent, Mr. W. Thompson :—

The usual attention and labour have been given to the walks. The heavy rains have caused much extra work in the way of replacing the gravel that had been washed off them. The narrow walk leading into the rose-garden has been made five feet wider.

Most of the walks on the economic side of the gardens have been made three feet wider.

Two hundred feet of two inch planking have been bought out of the item for general upkeep and used for bridging over most of the gutters that pass under the walks.

The lawns have been well attended to in the way of billing, weeding, cleaning leaves off, etc.

The beds and borders have been gone through and most of the old wornout, half dead shrubs have been thrown away; most of the other shrubs have been replanted and young plants put out. All the ground has been well dug and manured with what manure could be had. All the old stumps about the garden have been dug out and the holes filled with soil.

Much labour has been spent on pruning shrubs and trees so as to let in light and air.

Several old trees that were abundant in the garden, and were encroaching on smaller and more valuable trees, have been cut down. The pruning and thinning done in the past year has made a great improvement to the Garden in every way; it has also opened up several more good views.

About 700 plants of all kinds have been planted out within the past year. The most prominent are:—

The Durian (*Durio zibethinus*)

Artocarpus Lakoocha

Bougainvillea spectabilis

Beaumontia grandiflora

Norantea guianensis

Spathodea campanulata

Tecoma serratifolia

Medinilla magnifica

Bigonia venusta

Antigonum leptopus

Allamanda (varieties)

Quisqualis indica

Attalea grandis

Eucalyptus of various kinds.

Two beds of Ramie have been planted out; 30 Logwood plants have been planted in suitable places about the grounds.

The Rose-garden has been trenched and manured and some dozen of roses planted out. The big creepers have been taken off the arches in the rose-garden and climbing roses put on them instead. A border in another part of the garden has been trenched two feet deep and planted with roses, these are making good growth.

A large demand is made on the garden for young roses. The average quantity of roses has been sent out this year. The roses here are limited in variety, and it is important that the number of kinds should be increased.

A good large number of the best kinds of roses have been planted out in order to get plenty of rose wood in future.

The remainder of the palms that were in a poor condition have been trenched about their roots and manured and are beginning to look all the better for it.

Seeds of 30 new kinds of palms have been imported from France and will be planted out during the coming year.

Several flowering creepers have been planted so as to run on trees in prominent parts of the gardens. These climbers will make a good and natural effect in a short time.

Several trees with showy flowers have been planted about the gardens and grounds so as to show from the road.

Several clumps of the common bamboo on the economic side of the garden have been cleared away. This work has been laborious and expensive but has made a wonderful improvement on this side of the garden. The presence of the bamboos there with their roots spreading further every year hindered the economic plants from making proper growth but they have made a good start to grow, and about another two acres of good land are available to be used for economic plants.

The rubber trees that were planted in the Liberian Coffee ground, and were almost at a stand-still have grown over 3 feet since the bamboos have been taken down. Several young rubber plants have been planted out.

The Liberian Coffee is in the best of condition. The young plants that were planted out 18 months ago have made a good growth. The crop has been heavy the past year and 47 bags of coffee for sowing have been sent to Hope Gardens, together with some thousands of seedlings.

The Orange trees have done well since they have received more air and light, and are now doing well. The trees have been well attended to in the way of trenching and manure.

All the seeds that could be gathered of the large Imperial Lemon have been sown.

The new Coffee (*Coffea stenophylla*) that was planted last year has made a good growth, but it does not grow as fast as the other kinds in a young state.

A young plant of the Durian has been received, planted out and is doing well.

Most of the trees about the nursery have been pruned so as to let in more light to the plant-shed and rose beds. The rose beds have been made on the opposite side of the nursery.

The seed garden I formed last year has been given up to the Public Works Department for a Police Station and another seed garden has been formed on the economic side of the gardens.

The oldest *Amherstia* has flowered well this season, two younger plants have flowered this season, one very old tree that has had the bush cleaned away from around it, has also made good growth and has flowered. Ten young plants of the *Amherstia* have been sent out this year.

The palm seeds of *Borassus flabelliformis* that were planted two years ago have not done at all well. The plants of the West Indian Dragons Blood (*Pterocarpus Draco*) that were planted out last year have grown well.

The *Victoria regia* has been in flower for the last six months. Several new kinds of water Lilies have been imported from France. The bulbs have made good growth and should make a good show the coming year.

Two acres of bush land have been cleaned and planted with grass for cutting to feed the mules. The old pastures have had the usual billing and cleaning.

Several new orchid baskets have been made and the orchids repotted. Many orchids have been gathered from the woods and established on trees in the gardens. A few orchids have been added to the stock of imported orchids. One of the large palms at the main gate has been very much blown on one side.

Four new seats and two new tables have been made for the gardens. Mangosteen has fruited well this year and a large number of seeds have been sown.

The Public Works Department have enlarged the two old tanks so as to hold 15,000 gallons of water.

Out of the garden grant I have added 450 feet of one inch piping, 12 taps and 12 forty gallon casks. The piping and casks have been fixed about the nursery so as to facilitate watering the plants in the nursery and seed beds.

Out of the garden grant a new potting shed has been bought and reerected; it is 30 feet long and 12 feet wide, also two new plant sheds 30 feet long by 4 feet wide.

The old potting shed, 10 feet by 10 has been erected in the mule pasture.

The number of visitors is increasing, on several days during the past year there has been from 50 to 100 visitors in the Garden at a time.

Stones in large quantity have been taken out of the river where visitors bathe, and a new walk has been made along the river.

The Kola trees that have been opened up have made good growth and are fruiting this year.

There have been 1,043 letters received and 1,530 despatched.

There have been 1,000 more plants sold from the Garden this year than last, altogether 26,157 plants, and 47 bags of Liberian Coffee valued at £216 15s. 8d.

Plants Distributed.

Plants sold :—

Shrubs and trees	...	...	1,392
Palms	...	...	655
Roses	...	...	580
Foliage plants	...	...	374
Miscellaneous	...	...	88
Kola and Nutmegs	...	...	995
Liberian Coffee	...	...	2,083
Cocoa	...	...	670

Total number of plants sold	...	...	6,837
Realising	...	...	£82 5 C

Number of plants sent to Hope :—

Economic Plants	...	...	9,436
Shrubs trees and climbers	...	...	4,201
Roses	...	...	3,156
Palms	...	...	3,030
Fruit trees	...	...	107
Caladiums	...	...	36

Liberian Coffee seeds 47 bags.

Total number of plants sent to Hope 19,962 and 47 bags of Liberian Coffee valued at £134 10s. 5d.

To King's House Garden, 180 Roses and 100 Palms valued at £3 16s. 8d.

To Hill Gardens, 36 Roses, valued at 12s.

KING'S HOUSE GARDENS AND GROUNDS.

The following Report is by the Superintendent, Mr. E. Campell :—
Notwithstanding the unusual drought which prevailed for several months of the year the Garden, is in its usual good form.

Incessant watering was necessary, and I am able to state that none of the plants under cultivation have died.

The avenue borders, having become too crowded with Aralias, it has been thinned throughout. A length of four chains long was also dug up, made to a level with the road, trenched two to three feet deep, well manured, and replanted.

All the Aralia edging around borders and rose beds towards the west entrance gate have been removed.

A heavy mulching of stable manure was put on the whole of the borders, and they had a deep forking, frequent weedings, and the necessary pruning.

In the Rose Gardens all the inferior roses have been dug out, and better varieties, obtained from Hope, supplied in their places. The several beds were also well manured, forked and weeded regularly.

A number of small beds have been made near the top Rose Garden and about the lawn, and were planted with Zinnias, Balsams, Lilies, *Amaryllis carinata*, &c.

The lawns had the necessary frequent mowing, rolling and weeding; the verges were cut, &c.

Twenty-four square chains, or nearly two and a half acres, have been planted with Bahama Grass: of this, seventeen chains of the ground was prepared during the present year. The grass has grown well and there will soon be an established lawn.

Two new Lawn Mowers have been bought; one of these machines is of the better class, it was imported from Messrs. Ransomes, Sims and Jefferies, England.

Several of the commoner trees about the Garden, have been cut out.

Several tree-roots, causing unevenness on the walks, have been dug out, the hollow places filled up and gravel put on.

All the plants in pots, grown for house decoration, have been repotted, including the ferns.

The orchids were also remounted in new baskets, blocks, pots, &c. A good many of these flowered.

The pastures have been cleaned twice, the weeds were hoed up and not billed as formerly.

Ten acres of the high bush, north-east, and adjoining No. 2 pasture was also cleared for a new pasture.

The pines were taken up, as they had become overgrown, the land well ploughed, and replanted.

200 feet of piping was laid down to carry water along the long outer walk. This part of the Garden is not yet supplied with water, and it is very much required. To complete the service several hundred feet more of pipes are wanted.

Six new garden seats have been put in the Garden by Public Works Department.

Twelve chains of new wire fencing have been fixed, enclosing the new pasture; and a good portion of the older fences around the grass-pieces, common pastures, &c., repaired.

The main entrance drive had been kept regularly cleaned, edges straightened, &c., but some parts are beginning to get very much worn down and will require remetalling soon.

The *Amherstia nobilis* is planted out in a permanent place near the dining room, and it flowered this year producing three racemes of its handsome flowers. The plant was trenched and well manured during the year.

The Grape Vines, 12 in number, were attended to. A trench three feet wide and three feet deep was dug all round them and it was filled up with rich manure and good soil. This was done in the Autumn.

In February they were pruned and heavy mulching of goat and horse manure put on. They are now flowering well and a better crop is expected.

A small vegetable garden has been made and some vegetables—tomatoes, onions, cucumbers, carrot, &c., planted in the month of November on trial.

One hundred plants of *Ficus Benjamina* were propagated and sent to Hope, also 500 pine apple suckers.

A good deal of other miscellaneous work has also been done, such as the daily sweeping and cleaning up around the premises and drive, removing hundreds of cart loads of rubbish, billing about Bungalow, out-buildings, &c., gathering flowers for house and table decoration,, attending to the pot plants and Orchids in the house. The Superintendent was also engaged in collecting specimens of plants growing in the Liguanea plains. The Superintendent's house is in very bad repair and requires attention.

A small barrack, or quarters for a few of the permanent workmen is much wanted.

PARADE GARDEN.

The following report is by the Superintendent, Mr. John Campbell:—

During the year the garden operations have been carried on with the strictest economy to keep within the vote allowed for maintenance. The beds and borders were well manured several times during the year and forked repeatedly. The plants have been pruned, trees divested of dried branches, verges and edges cut and trimmed. The borders and beds are in good condition. Particular attention has been paid to keeping the garden as clean and tidy as possible, but it is impossible to do so as the garden is such a thoroughfare. A thousand plants have been received from the Hope Gardens which have been planted out in the borders. They have taken and will be an improvement when established. Two new beds have been added to the Garden, one of roses, and one of annuals. The plants of *Euphorbia* which was planted along the aqueduct through the garden have grown well and have improved the appearance.

I am sorry to report that in consequence of the large concourse of people who visit the garden at night and will not keep to the walks and avenues but pass through the garden from all angles, the lawns are nearly all destroyed. It is necessary that they be enclosed and some restrictions adopted that the people keep to the walks and avenues.

It would be an improvement to have the bridges over the aqueduct built of concrete as it would be lasting and have a better appearance.

The garden benches have been repaired but require painting, the Band Stand also requires painting.

Misdemeanours relative to the Garden Regulations have been summarily dealt with at the Police Court.

BATH GARDENS.

The following Report is by the Overseer, Mr. A. H. Groves :—

The principal work performed in this Garden has been in cleaning, trenching, forking and removing of parasites from the trees. The walks have also been regravelled.

I am glad to report that the "Manilla hemp" is looking well since the application of ashes to its roots, and I am sure the "Amherstia" is safe to grow.

A few nutmeg plants have been propagated in bamboo pots.

I must add, that on the whole, the garden has become quite attractive in appearance, the flowers and crotons looking well, and the garden nice and clean.

I am preparing a tank for a plant of the water-lily.

REPORTS ON FREE GRANTS OF PLANTS.

Dr. E. R. C. Earle, Buff Bay Hospital.—In answer to your note of enquiry re the plants supplied by you for the Buff Bay Hospital last year, I have the honour to state—

	Of the Crotons sent, 38 have grown well
	5 alive, but not so healthy
	4 are dead
Palms	8 are growing well
Shrubs	13 do. do.
	3 are dead
Rose Plants	6 growing well
	1 alive but not healthy.

—
78
—

All these 78 were planted: the balance were dead in the pots before I could arrange to plant them. The result appears to me to be very satisfactory.

Dr. R. G. S. Bell, Dry River Hospital.—I am pleased to be able to report that the plants have taken and are growing well with the exception of eighteen. These were destroyed by ants. The Eucalyptus and the Cassia particularly are growing well; and if you could send me a few more Eucalyptus plants I should be greatly obliged.

Inspector McCrea, Chapelton.—The plants are doing very well indeed and already make a good show in front of Station. Several of the Hibiscus and Eucalyptus are three feet high and the former are all in blossom. I have never seen plants thrive so well in so short a time.

Mr. Cyril Thompson, Clerk to Mayor and Council, Kingston.—In reply to your Memo. I have to state the few plants from the Gardens for the Night Shelter are getting on nicely.

Mr. J. Elliott McCrea, Buff Bay.—I have to report favourably on the 24 plants given to me last April for the Buff Bay Court House Enclosure and Yard; they are all alive and growing nicely and give to the place a nice pleasing look.

Mr. D. Sanftleben, Port Antonio.—I regret the delay in replying to your memorandum of the 1st May last; a delay which has been caused by my having to refer to the Officers in charge of the plants for report, and to my having been absent for the last three weeks.

Gayle.—Three of the plants died shortly after being put in the ground, but the remainder are doing extremely well.

Easington.—Six Eucalyptns were supplied, but only one is alive now. The others are doing very well indeed.

Port Antonio.—Only six of the plants supplied for the Court House are now alive. I am inclined to attribute the failure of the others to the position of the place, which exposes the plants to the sea breeze and salt air.

Rev. W. S. Taylor, Enfield.—Owing to the drought last year about 12 of the plants died. The rest are growing well. The roses flowering; Crotons, etc. green and healthy looking, give a charming appearance to the Church Yard.

Rev. W. J. Maund, Bath.—When I left Port Royal last month all the plants you kindly sent me were doing well. The Church certainly looks very much better since the advent of the plants.

Rev. A. A. Hedmann, Clifton.—Though the severe drought which came immediately after the planting out of the Free Grant of Plants from the Botanical Gardens has destroyed some of the more delicate plants, yet a good many have grown very nicely. The Eucalyptus plants have all grown and some are over 6 feet in height. The St. Michaels Church Yard is looking very pretty with the beautiful ornamental shrubs which have been planted out and are now in a flourishing condition.

Rev. J. J. Kendon, Linstead.—All the Crotons are growing well. Though only 9 months since planted they are about 2 feet 6 inches high and spreading nicely. They are admired by everybody, of the Palms one died. The 4 Eucalyptus (*citriodora*) plants are 12 feet high and doing well. Besides the free grant of plants we have raised and planted out 300 Crotons about half of which were from cuttings kindly given from the Kingston Gardens. We shall be thankful for a further supply of cuttings for another Churchyard soon.

REPORTS ON ONIONS.

His Honour I. R. Reece, Pedro.—I have obtained splendid returns from this seed. The Red produced onions of fair size 6 to 9 ounces; the white onions were of small size; both of excellent flavour. These seeds were the best I have ever seen. They produce strong seedlings, none of which were lost. The seedlings were divided into two sets. One set was planted in an open bed, *i.e.*, a bed exposed to the sun all day, the other in a bed on which only the afternoon sun could be obtained. The onions planted in this latter bed were far superior (both in point of size and flavour) to those planted in the former. A quantity of the white onions (of small size) were pickled, and are quite equal to the small onions of Bermuda treated in a similar manner.

Mr. Alex. Hopwood, Brown's Town.—The crop of onions raised is very satisfactory; although the entire lot did not give large bulbs, the proportion of good marketable onions which I got amply paid for the cultivation.

Dr. C. T. Dewar, Duncans.—The seeds germinated well but many died off after a week or so. Those that matured were good and equal to the usual shop onion. I think the next lot of seed will do better as the place they were planted in was very hot and dry and this can be avoided in future.

Mr. A. C. Martin, Cross Keys.—Onion seeds sown on 17th September, 1895, in land manured by sheep. Seedlings thinned out and transplanted, November 11, 1895, in a bed measuring 18 feet x 24 feet, in rows 18 inches apart (12 rows to bed). 69lbs. well cured onions of good size and flavour gathered from end of February to 15th March, 1896. Rainfall from date of sowing seed till gathering of crop, 32·83 inches, as follows:—

	Inches.
September 17th to 30th	1·82
October	17·13
November	4·10
December	No rain
January, 1896	4·76
February	1·22
March to 15th	3·80

I gave away a portion of the seeds to Mr R. W. Miles, Stines Hope, and Mr. H. C. Sturridge, Mandeville.

Inspector McLeod, Montego Bay.—The Bermuda onion seeds you kindly gave me were excellent, and all the seeds I sowed in November germinated. My garden here is in the town, and as I could only find room for a couple of beds of onions, I sowed the seeds in boxes and transplanted them into beds when about 3 inches high; they all bulbed and many of the bulbs weighed 6 to 7 ozs. each. I gave some of the seeds to a Corpl. at Maroon Town and he grew some larger onions than I did. I sowed the balance of the seeds in February, but few germinated. I took the crop in a few days ago and the bulbs were less than half the size of the first lot. This may be attributable to the seeds having been kept too long, but I rather think the dry weather and heat of Montego Bay retarded their growth.

Mr. A. Byron Ventresse, Bethel Town.—I regret being unable to give exact date of planting of Bermuda onion seeds kindly supplied by your department in 1895. The ground was prepared on the ruins of an old house. Elevation about 1,600 feet. A bed 10 feet square was sown closely following directions in November, 1895, Bulletin; in addition seeds were also planted in two boxes, from which the vacant spots in the bed were supplied as all the seeds did not seem to grow well. The onions fully matured in March and the last were taken up about the 8th April. By keeping a careful account of weight the bed 10 x 10 yielded 50lbs. of good marketable onions. Some of the largest were quite eleven inches in circumference and 6 ozs. in weight. Only ordinary pen manure was used. The flavour and edible qualities of the onions were quite equal to what we have often had in Bermuda where the same variety of onions was grown.

Mr. Thos. Mair, Stony Hill.—From the onion seed supplied by you last year, we had a return of from 14 to 16 lbs. of good onions, some of the bulbs being about the size of an ordinary hen's egg. The

quality was good. I think the results of the trial may be considered a success.

Mr. H. Demetrius, Cold Spring.—I have been successful in growing (here at an altitude of 4,000 feet) two crops from the seeds supplied. One planted shortly after receipt turned out very well, and the others planted in February last are bearing even better. I sowed in shallow trenches 6 ft. apart and thinned out and earthed up as they grew. Soil, clay and sand, former predominating, dressed with stable manure and wood ashes. Judging from my results would say January to February and June to July would be about the best months for sowing in similar localities to this.

Mr. B. S. Gosset, Halberstadt.—I sowed the Bermuda onion seed at Halberstadt at 2,400 feet above the sea, and got a fine crop of medium sized onions some weighing nearly a quarter of a pound, but most taking eight to the pound. I had previously sown a bed of large white queen onions which I have grown from 1 lb. to 1½ lb. at Farm Hill at 4,000 feet but they did not turn out well at this elevation not averaging as well as the Bermuda onions. I gather from this that the Bermuda onions suit best for a warm dry climate like the Port Royal Mountains while the larger kinds of English onions are best for the Blue Mountains where the climate is damper. I have still a bed of white Bermuda onions to take in which, though much washed by the heavy rain in February, promises to do well.

Mr. Stockhausen, Ulster Spring.—The Bermuda onion seed sent me was sown on 14th December; they turned out fairly well. I find that the red ones turned out best, the bulbs were well formed, 7 weighing a pound.

HOPE GARDENS—Elevation, 600 Feet.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a. m.	3 p. m.	7 a. m.	3 p. m.	Max.	Min.	Range.	7 a. m.	3 p. m.	7 a. m.	3 p. m.	
1895.	In.	In.	°	°	°	°	°	°	°	°	°	
April	29.27	29.29	71.2	82.3	86.5	62.5	24.0	65.0	70.6	81	69	4.18
May	.25	.25	73.4	82.0	87.0	67.1	19.9	70.0	75.3	90	79	5.32
June	.29	.30	74.7	85.6	89.2	69.7	19.5	71.6	74.5	90	70	1.69
July	.29	.32	73.8	86.2	90.3	69.2	21.1	70.6	77.2	90	73	2.37
August	.23	.26	73.6	85.6	91.0	69.5	21.5	69.9	77.5	87	76	4.41
September	.20	.22	73.4	82.9	88.3	69.9	18.4	70.9	78.0	93	85	4.42
October	.17	.17	73.2	82.4	86.4	70.0	16.4	71.4	78.0	93	87	13.76
November	.20	.21	70.5	79.1	85.0	67.3	17.7	68.5	76.0	91	90	7.08
December	.19	.21	67.9	80.6	83.6	64.4	19.2	66.2	74.4	91	79	1.38
1896.												
January	.24	.26	65.5	80.5	85.1	64.4	20.7	63.3	74.1	90	79	1.85
February	.27	.28	67.2	82.0	84.8	64.1	20.7	66.1	75.1	96	78	3.75
March	.24	.26	66.0	82.0	86.7	62.9	23.8	64.3	79.4	93	90	0.77
Means	29.23	29.25	70.8	82.6	86.9	66.7	20.2	68.1	75.3	90	79	50.98
						76.8						Total

CASTLETON GARDENS—Elevation, 580 Feet.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point		Humidity		Rainfall—Inches.
	7 a. m.	3 p. m.	7 a. m.	3 p. m.	Max.	Min.	Range.	7 a. m.	3 p. m.	7 a. m.	3 p. m.	
1895.		In.										
April	29.60	29.59	68.2	79.8	84.3	65.6	18.7	66.0	71.0	91	74	2.59
May	.60	.59	72.9	79.6	86.0	66.9	19.1	70.3	74.2	90	82	9.03
June	.63	.62	72.7	85.0	89.3	67.7	21.6	69.7	73.1	90	69	3.73
July	.65	.64	70.4	84.2	89.3	67.1	22.2	69.1	73.4	96	69	3.29
August	.58	.58	70.2	82.8	88.5	66.4	22.1	69.4	73.2	96	71	17.98
September	.56	.54	70.9	81.4	88.3	67.9	20.4	69.3	74.8	93	82	7.51
October	.51	.49	70.6	81.3	86.9	68.1	18.8	69.8	73.2	96	76	12.79
November	.56	.54	68.2	78.3	83.4	65.1	18.3	67.4	75.4	95	90	14.11
December	.58	.56	68.4	75.8	80.9	63.9	17.0	67.1	73.4	96	90	10.52
1896.												
January	.63	.61	65.1	77.1	80.9	61.5	19.4	64.3	69.9	96	79	12.33
February	.63	.61	64.4	77.7	81.3	62.2	19.1	62.7	68.5	96	73	8.68
March	.61	.61	63.8	80.1	83.8	61.3	22.5	62.8	70.5	96	71	6.27
Means	29.59	29.58	68.8	80.2	85.2	65.3	19.8	67.3	72.5	94	77	108.88
						Mean 75.2						Total

KING'S HOUSE GARDEN—Elevation 400 feet.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a.m.	3 p.m.	7 a.m.	3 p.m.	
1895.	In.	In.	°	°	°	°	°	°	°	°	°	
April	29.76	29.70	71.6	83.6	88.2	64.9	23.3	67.0	71.8	84	67	2.50
May	.73	.71	74.5	83.5	89.0	66.6	22.4	70.7	75.6	87	76	5.60
June	.76	.72	75.2	87.2	91.5	68.1	23.4	71.4	77.3	87	72	0.45
July	.75	.70	74.7	85.9	92.5	68.1	24.4	70.2	73.6	84	68	0.13
August	.69	.64	74.0	87.9	91.2	68.0	23.0	69.1	73.9	84	63	2.30
September	.64	.59	74.1	86.8	92.6	68.5	24.1	70.6	75.3	90	67	2.00
October	.62	.60	73.4	84.8	89.5	67.9	21.6	71.1	78.6	93	82	11.30
November	.78	.74	70.9	83.6	87.4	65.0	22.4	68.4	76.4	90	76	4.14
December	.78	.74	70.3	83.5	87.5	63.8	23.7	66.0	74.3	87	72	0.88
1896.												
January	.83	.79	67.2	82.9	86.2	60.7	25.5	64.4	72.7	90	71	1.50
February.	.86	.82	68.2	83.9	87.9	61.1	26.8	63.7	72.6	87	69	4.85
March	.84	.81	67.3	85.9	88.1	60.1	23.0	62.9	73.8	87	67	0.75
Means	29.75	29.71	71.7	84.9	89.3	65.2	24.1	67.9	74.6	87	70	36.40
						Mean:						Total
						77.2						

INDEX.

	PAGE.
Agricultural Education, P. G. Craigie on ...	13
Agricultural Students ...	276
Alfalfa, Nitrogen in ...	117
Alkaloids of Kola ...	157
Analysis of cotton fibre ...	125
" of cotton seed ...	125
" farmyard manure ...	59
" oil cake, cotton ...	127
" soils under cane ...	54, 55
" sugar cane ...	51, 52
Anti-Malarial Tree ...	232
Aulacaspis, (Rose Scale Insect) ...	259
Arsenic, White ...	11
Asterolecanium (Fringed Scale Insect) ...	8
Atriplex ...	169
Banana natural paper ...	224
Baker, L. D., on Oranges ...	97
Bananas ...	296
Barbados Agri. Gazette on Cane varieties ...	183
Bath Garden ...	307
Beaumontia grandiflora ...	19
Beggar-weed ...	172
Beetles, Trap for ...	161
Behrens, Dr. on Micro-organisms of Tobacco ...	248
Bermuda Lily ...	292
Bignonia magnifica ...	19
" venusta ...	19
Bitter Wood as an Insecticide ...	12
Bougainvillæa ...	19
Bowrey, J. J., on Pine Apple ...	236
Bucher, Dr. E., on Logwood ...	181
Budding Orange Trees ...	122
Canes, Report on, by T. Kemp ...	206
Cane varieties ...	183
Carbolic Acid as an Insecticide ...	12
Castleton Gardens ...	301
Castleton Gardens, Plants in flower and fruit ...	22, 48, 71, 95, 116, 143, 167, 192, 216, 240, 264
Catch Crops amongst Oranges in Sicily ...	200
Caterpillars, Plague of ...	233
Ceropegia ...	171
Chemistry of the Sugar Cane ...	49
China Grass ...	270, 290
Cinchona ...	269
Citrate of Lime in Sicily ...	229
Citric Acid ...	98
" " in Sicily ...	229
Citron from seed ...	173
Citrus, from seed ...	145, 153
Citrus Trees, Pruning ...	7
" " Green Dressing for ...	7
Chionaspis (Snow Scales) ...	256
Cocoa, Curing ...	15
Cockerell, T. D. A. on Coccidæ ...	8, 256
Coccidæ or Scale Insects ...	8, 256
Coffee, Notes on Laborie ...	41
Coffee-pulpers for settlers ...	125
Colocynth ...	296
Cotton, cultivation of ...	124
" Analysis of fibre ...	125
" " of oil cake ...	127
" " of seed ...	125

II

	PAGE.
Cotton Seed Oil	127
“ Oil Cake	127
“ Inagua	129
“ Sea Island	129
“ Turks Island	131
“ Egyptian	130
Cradwick, W. on care of young Grape Vines	121
“ “ cultivation of tomatoes	61
“ “ curing cocoa	15
“ “ planting ramie	134
Craigie, P. G. on Agricultural Education	13
Cultivation of Oranges in Sicily	193, 226
Dairy Industry of Denmark	98
Desmodium	172
Dendrobium formosum	65
Diaspis	257
Duerden, J. E. on Insecticides	10
Duerden, J. E. on a plague of caterpillars	234
Dunlop Bros., on Ramie	74, 75, 76
Education, Agricultural, P. G. Craigie on	13
Essential oils of Citrus in Sicily	230
Eucalyptus Oil in Yellow Fever	19
Experiment Stations	266
Ferns of Jamaica 20, 45, 66, 93, 110, 141, 162, 188, 211, 236, 260	
Fodder Grasses, Tropical	25
Forestry	149, 159, 161, 175
Forests, Relations of, to surface of Country	159
Free Grants	307
Gathering Oranges in Sicily	202
Georgeson, C. C. on Dairy Industry	98
Gosset, B. S. on Coffee Pulpers	135
Grafting Oranges in Sicily	195
Grape Vines	296
Grape Vines from Persia	270
Grape Vines, Young, Directions for care of	121
Grapes for U. States Market	123
Grasses, Tropical Fodder	25
Green Dressing for Orange trees	7
Greg, P. H. on Micro-organisms of Tobacco	248
“ rum aroma	1
Guinea Grass	35, 42
Herbarium	285
Hill Gardens	268, 289
Honduras Sarsaparilla	117
Hope Gardens	271, 293
Hope Industrial School, Ramie	73, 132
Howardia (Burrowing Scale Insect)	256
Industrial School	272
Insecticides	10
Iris	18
Irrigation of Oranges in Sicily	201
Jaffa Orange	259
Jamaica Ferns 20, 45, 66, 93, 110, 141, 162, 188, 211, 236, 260	
Jamaica Weed	172
Janman, G. S. on Jamaica Ferns 20, 45, 66, 93, 110, 141, 162, 188, 211, 236; 260	
Kemp, T., Report on Sugar Canes	206
Kerosene Emulsion	11
Kilmer, F. B. on alkaloids of Kola	157
Kilmer, F. B. on Kola	136
Kilmer, F. B. on preparing Kola	17
Kilmer, F. B. Pharmacological Notes on Kola	208
King's House Garden	305

	PAGE.
Kola alkaloids of	157
“ cultivation of	16, 136
“ preparing for market	16
“ pharmacological notes on	208
Krichauff, F. on Dairy Industry	88
Kumquat from seed	174
Lawson, G. B. on Pasteurisation of Milk	63
Lawson-Scribner, F. on Desmodium	172
Lecanium (Shield Scale Insect)	256
Lemon from seed	173
Library	286
Lignum Vitæ	161
Lime from seed	174
Lime, necessity for, in soil	241
Lime, Wild	18
Logwood	179
London Purple	10
Mandarin Orange from seed	174
Manuring Orange trees	202
Melaleuca leucadendron	232
Micro-organisms, and tobacco	248
Milk, Pasteurisation of,	63
Mueller, Sir F. von, on an Anti-malarial tree,	232
“ “ on salt bushes,	169
Nephrodium, 20, 45, 66, 93, 110, 141, 162, 188, 211,	226
Nephrolepis,	260
Nitrogen in Alfalfa and Stable Manure,	117
Odontoglossum crispum,	253
Oil, cake from Cotton	127
Oil, Cotton Seed,	127
Olives,	270, 289
Oucidium ampliatum,	65
Onions,	308
Orange, Bitter, for grafting,	62
Orange Garden,	270, 290
Oranges in Sicily, catch crops,	200
“ “ citrate of lime,	229
“ “ citric acid	229
“ “ cultivation,	193, 226
“ “ essential oils,	230
“ “ gathering,	202
“ “ grafting,	195
“ “ irrigation of,	201
“ “ manufactured products,	227
“ “ manuring,	202
“ “ packing,	203
“ “ planting out,	197
“ “ pruning,	201
“ “ salted fruit,	231
“ “ trimming,	201
Orange, Jaffa,	259
Orange Trees, Budding,	122
“ Green Dressing for,	7
“ Pruning,	7
Orange, reproduction from seed,	145, 173
Orchid for naturalisation in Jamaica,	253
Orchids in the Gardens,	65
Orchids List of, grown in Gardens,	82
Ornamental plants in Gardens	19, 171
Orris Root	18
Orthezia (Lamellated Scale Insect)	9
Packing Oranges in Sicily	203
Papaws	297

IV

	PAGE.
Paper, A natural, ...	224
Para Grass, ...	36, 42
Parade Garden, ...	272, 306
Paris Green ...	10
Pasteurisation of Milk ...	63
Pieræna excelsa ...	12
Pine Apple, Analysis ...	236
" Manure for ...	236
Pharmacological Notes on Kola, by F. B. Kilmer	208
Phipson, T. L. on Chemistry of Sugar Cane,	49
Planting out Oranges in Sicily ...	197
Popular Lectures ..	278
Premiums for cultivation ...	161
Products manufactured, of Citrus and Sicily	227
Pruning Orange trees ...	7, 201
Pulpers, Coffee for Settlers ...	135
Radclyffe, D. Edwards, on Ramie ...	78, 80
Ramie, directions for planting ...	134, 297
" Dunlop Bros, on ...	74, 149
" in Jamaica ...	73, 149
" irrigation ...	156
" manure ...	151
" planting ...	154
" Radclyffe, D. E. on ...	78
" ribbons at Hope Industrial School	132
" Soil and climate ...	151
" Subra Fibre Co. on ...	80
" United States ...	151
Reproduction of Orange from seed ...	145, 172
Rhedia lateriflora ...	18
Rothrock, Dr. J. T. on Forestry ...	159
Rum, Aroma in ...	1
Sale of Government Land to Settlers ..	138
Salt Bushes of Australia ...	169
Salted fruit of Citrus in Sicily ...	231
Sarsaparilla in Honduras ...	117
Scale In ects ...	8, 256
Scharschmidt, S. T. on a natural paper ...	224
Seed, Orange from ...	145, 173
Soil Ferments important in Agriculture ...	2.7, 241
Stable Manure, Analysis of ...	59
" " Nitrogen in ...	117
Stephens, J. A. on Notes from Laborie ...	41
Subra Fibre Syn. on Ramie ...	80
Sugar Cane, Chemistry of the ...	49
Sugar Canes ...	296
Sugar Canes, Report on, by T. Kemp ...	206
Teak ...	175
Thomson, Robt. on Odontoglossum ..	253
Tillage, Utility of ...	241
Tobacco and Micro-organisms ...	248
Tomatoes, Cultivation of ...	61
Trifoliate Orange from Seed ..	174
Trimming Orange trees ...	201
Tropical Fodder Grasses ...	25
True, Dr. A. C. on Experiment Stations ...	266
Vanilla ...	42
Van Winkle, A. on Oranges ...	98
Vines, Directions for care of Young Grape	121
Webber, H. J. on Orange from seed ...	145, 173
Weed, Useful ...	173
Wild Lime ...	18
Wiley, Dr. W. H. on Soil Ferments ...	217, 241
Yellow Fever, Eucalyptus Oil in ...	19



BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

Elementary Notes on Forestry

P R I C E—Three pence.

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

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APPENDIX I., 1896.

Vol. III
App. I.

ELEMENTARY NOTES ON PLANTING AND CARE OF WOODLANDS, CHIEFLY FROM SCHLICH'S MANUAL.

By W. Fawcett, Director of Public Gardens and Plantations, Jamaica.

(Reprinted from HANDBOOK OF JAMAICA FOR 1896.)

UTILITY OF WOODS.

JAMAICA was, at the time of its discovery by Christopher Columbus, the "land of woods and streams." If attention is not soon paid to the creation and preservation of woods, the island may soon be described as a "land of sterile hills and rushing torrents."

The surface was then completely clothed with a variety of trees of all sizes and ages:—on the highest elevations yacca and soap wood; lower down juniper cedar, bilberry, mountain guava; still lower, common cedar, mahoe, santamaria; lower again, breadnut, ramoon, bullet trees, lancewood, bitterwood; at low elevations *lignum vitæ*, yoke wood, dogwood, fustic, cashaw, ebony, mahogany; and along the sea-coast, mangroves, buttonwood, sea-side grape, and yellow-flowered mahoe.

The trees grew on from youth to maturity without interference from man, favoured by soil and climate, attaining their greatest height and bulk in fertile situations. At the time of a hurricane a few would be blown over, letting in the sun on the ground covered thick with the decay of leaves that had been falling for centuries; the absence of dense shade would allow seedlings to spring up thickly, and re-clothe the open space with a fresh growth of trees. The soil was constantly improving; whatever was taken out of it by the growth of the trees was returned again in the gradual fall of the leaves; the roots penetrated far and wide through soil and subsoil, letting in air and water, which with the help of decaying matter constantly brought more of the soil into a condition fit for plant food. At the same time the soil could absorb and hold for some time the greater part of the rain, allowing it to find its way into the earth, percolating through rocks perhaps for miles until it appears again weeks or months later at lower levels in never failing springs.

At length civilised man appeared, and settled in the land. Nature has been lavish as a mother in her gift of forest produce, man is the spendthrift child that takes the free gift, as it would air or water, and not only uses it, but squanders it, destroying it ruthlessly without let or hindrance, and so causing an increase of 2 or 3 degrees in the summer temperature, a decrease in the rainfall, torrential flows of rain with constant washing away and deterioration of soil.

Forests in some countries so covered the land that they have been looked upon as an unmixed evil to be almost entirely destroyed before any progress can be made in agriculture. This is a correct view with proper limitations, and even in some parts of Jamaica, for instance on the northern slopes of the Blue Mountains, it would be advantageous to make extensive clearings under judicious management. But in most parts the utility of woods preponderates over any ill effects.

"The various ways," says Schlich, "in which forests exercise an influence in the economy of man and of nature may be summarised as follows:—

- “(1) Forests supply timber, fuel and other forest produce.
- “(2) They offer a convenient opportunity for the investment of capital and for enterprise.
- “(3) They produce a demand for labour in their management and working, as well as in a variety of industries which depend on forests for their raw materials.
- “(4) They reduce the temperature of the air and soil to a moderate extent, and render the climate more equable.
- “(5) They increase the relative humidity of the air and tend to reduce evaporation.
- “(6) They tend to increase the rainfall.
- “(7) They help to regulate the water supply, ensure a more sustained feeding of springs, tend to reduce violent floods, and render the flow of water in rivers more continuous.
- “(8) They assist in preventing land slips, avalanches, the silting up of rivers and low lands, and arrest moving sands.
- “(9) They reduce the velocity of air currents, protect adjoining fields against cold or dry winds, and afford shelter to cattle, game and useful birds.
- “(10) They assist in the production of oxygen and ozone.
- “(11) They may under certain conditions improve the healthiness of a country, and under other conditions endanger it.
- “(12) Finally they increase the artistic beauty of a country.

“Whether, and in how far, these effects are produced in a particular country depends on its special conditions. As regards the direct effects, enumerated under 1, 2 and 3, the following considerations are of importance deciding whether existing woodlands should be preserved, or new forests created:—

- “(1) The position of the country, its communications with other countries, and the control which it exercises over other countries.
- “(2) The quantity and quality of substitutes of forest produce available in the country.
- “(3) The value of land and labour, and the returns which land yields, if used for other purposes.

“(4) The density of population.

“(5) The amount of capital available for investment.

“A country so situated that the importation of wood and other forest produce is comparatively easy and cheap (sea-bound, traversed by navigable rivers coming from countries which are rich in forests, or intersected by numerous railways and other means of communication), or which has control over other countries, as for instance colonies rich in forests, can dispense with extensive forests. In a country which is rich in coal, lignite or peat, the production of firewood is of subordinate importance. Where iron and other substitutes for timber are available in sufficient quantity and at a low rate, forests are not required to the same extent as in a country which does not enjoy such advantages. Where land under field crops yields, even if forest produce is imported, a higher interest on the invested capital than under forest, the latter would, in this respect, be undesirable. If the population of a country is very dense and all land is required for food, forests would be out of place. Where, on the other hand, waste lands exist, which are not required or unsuited for field crops, and where the population is at the same time in want of additional work, it may be advisable to create forests so as to increase the returns from surplus lands, and to provide occupation through the operations connected with the administration of the forest, and the industries which the existence of forests tends to create.

“In considering the advisability, or otherwise of afforesting a country with special reference to the indirect effects of forests, the most important points are in its climate and configuration. The nearer to the equator, the more important becomes, as a rule, the forest question, and the further removed from it, the less important. While forests may in a hot country, with distinct wet and dry seasons, be absolutely necessary for the mitigation of extreme heat and dryness during certain parts of the year, and the regulation of the flow of water in springs and rivers, they may be injurious in a northern country which is already too cold and damp. Similarly, a continental country may require forests, while a sea-bound country may be better without them, as far as climate considerations are con-

cerned. A mountainous country is much more in need of forests than a low lying country, on account of their beneficial action as regards landslips, avalanches, the carrying away of debris, the silting up of rivers and lowlands, sudden floods, and the sustained feeding of springs. As regards the protection against strong winds and shelter to cattle and useful birds, forests act beneficially in any country."

Whatever may be the ultimate policy of the country on the question of Government forests,—a subject which involves the financial considerations of a large annual expenditure,—private land-owners will always care to plant a few trees for the sake of ornament; some too will find the question of fuel an important one, others that it is cheaper to grow their own lumber, others again may consider that it is wiser to improve the quality of the soil of portions of their estates by growing trees, than to leave it to gradual deterioration.

Trees growing in woods require different principles of treatment from those grown only for ornament or for their fruit. The treatment of woods on a rational basis constitutes the art of *Sylviculture*; whilst the cultivation and care of individual trees in a garden, or scattered in clumps over an estate, forms the minor art of *Arboriculture*.

FOOD OF TREES.

Certain physical and chemical conditions are necessary for the well-being of plants, and as the strength of a chain is measured by that of its weakest link, so the development of a plant is governed by that factor which is at its lowest point.

The action of warmth and of light are essential factors of a physical nature in the growth of trees, and those of a chemical nature are carbonic acid, oxygen, and the water which dissolves the mineral plant food in the soil.

The effect of temperature may clearly be seen in Jamaica on ascending from sea-level to various heights. Cashaw, mahogany, lignum-vitæ grow at the lowest elevations, cedar at mid-elevations, and Blue Mountain yacca at the highest altitudes. An extreme fall of temperature in Florida killed thousands of orange trees.

Light is necessary for the splitting up in the substance of the leaves of the carbonic acid of the air, taken in through the breathing-pores, —and in fact it is necessary for the whole nutrition. The intensity of light that is essential varies not only for different species, but also for the same species under varying conditions of soil and situation. Look at a tree growing in poor soil, it has smaller leaves and a less dense crown of foliage than another growing in the rich soil at the bottom of a valley. Trees growing in shade have leaves adapted to the small amount of light they receive, and in thinning woods care must be taken that such trees do not too suddenly receive more stimulus in the way of light than the leaves are at first capable of answering to, and thus disease be induced.

Carbonic Acid is taken into the leaves from the air, and decomposed under the action of light, forming carbon compounds which are used up in the growth of the plant,

Oxygen is always plentiful enough in the air for the purpose of respiration by the leaves, but the roots of plants also require oxygen in the soil. Soil itself cannot be fertile unless it is well aerated, and is frequently improved merely through being kept open and porous by the roots of trees.

Nitrogen is essential to the formation of the albuminoid substances of plants. This substance is derived from the ammonia and other nitrogenous compounds produced by the decomposition of decaying vegetable matter which compounds may also be carried into the soil from the atmosphere by rain, or it may be derived direct from the air by certain plants. The importance of forests in improving the soil is due not only to the aeration of large masses of the soil by the roots but chiefly to the supply of humus or leaf-mould yielding nitrates to the soil.

Water is necessary not only as a direct food, but as dissolving the food contained in the soil. What is not required in the formation of the tissue of plants is transpired or evaporated by the foliage into the atmosphere. The amount necessary varies according to the species, and for one and the same species according to the nature of the soil and climate. The finer particles of the soil, and the larger the amount of humus the greater is the capacity for retaining moisture.

Other important soil-nutrients, are lime, potash and phosphoric acid.

SOIL IN RELATION TO WOODLAND GROWTH.

Soil is due to the decomposition by various agencies of the rocks forming the crust of the earth. A distinction is made between the soil or surface-soil and the

sub-soil, the latter being the intermediate stage between the rocks and the soil, and as yet not sufficiently decomposed to form soil capable of supporting plants. Shallowness of soil or a deficiency of water or food-supplies in the soil are at once evident from the stunted appearance of trees, generally accompanied by an abnormal development of the root system. A very remarkable instance of this is seen in the Cashaw,* the "Mesquite" of Texas and New Mexico, the condition of which affords almost certain indications in those regions of the depth of the water-level; when it attains the dimensions of a tree, the water-level will be found within 40 or 50 feet of the surface; when it has the appearance of a good bush, within 50 or 60 feet; when the stems are only 2 or 3 feet high, the roots have had to descend more than 60 feet. So that a fairly correct estimate of the depth and quality of soil may be formed from considering the height of the trees, the development of their crown of foliage, and the condition of the underwood and bush which cover the soil.

The chemical composition of the soil is not of such importance in woods as in Agriculture, for trees take up only about half the mineral food demanded by agricultural crops, as is shown in the following table:—

Average of	Total quantity of ash.	Silica Si O ₂ .	Potash K ₂ O.	Lime Ca O.	Magnesia Mg O.	Phosphoric Acid P ₂ O ₅ .	Sulphuric Acid SO ₃ .	Other constituents.
Mixed agricultural crops	235	37	78	43	17	28	11	21
Woodland growth—timber and leaves	126	29	11	62	10	8	3	3
Woodland growth—timber only	19	1.6	4	9	2	1.4	0.4	0.6

It will also be seen from the table that in woods where the leaves drop and decompose, returning their constituents again to the soil, the demands upon the soil are very small indeed as compared with crops.

But of the sum-total of the factors which go to make up a fertile soil, its physical condition,—depth, porosity, consistency, etc., is of far greater importance generally than the chemical composition.

SEED.

QUALITY.

In using seed for the propagation of trees, it is important to use only seed of the best quality. The chief point in estimating the quality is its perfect ripeness, but its goodness also depends on its weight and size, its age and origin.

Ripeness. If the seeds are not quite ripe, the greater number do not germinate; the seedlings are weak; the plants are never as strong as those from ripe seeds, being more liable to attacks from insect pests and fungoid diseases all through their life, and many die before reaching maturity.

Size and weight. In selecting seeds of any particular species, the largest and heaviest seeds only should be sown; as a larger percentage germinate, and the seedlings are stronger, getting a better start in life, which generally gives the plant throughout its life a great advantage over plants from small light seeds.

Age. Seeds germinate most readily the sooner they are sown after becoming quite ripe. It is an advantage that they should germinate quickly after sowing, for they more quickly escape attacks of ants, birds, and other dangers, and have a start over weeds. Besides, seeds lose their power of germinating, more or less

* *Prosopis juliflora*, DC.

soon, according to the species, and the longer they are kept the smaller the percentage that grow. If seed has to be stored, it should be carefully dried, either in the sun or in a dryer, kept free from moisture, and prevented from getting heated by placing it where it can get air, and where it can be turned over occasionally.

Origin. The vigour of seeds, and of the resulting seedlings, depends generally on their being the offspring of healthy trees in the prime of life which have attained their main height and full crowns of foliage, and often more especially on the fact of the trees growing on favourable soil and in a suitable climate.

Testing seeds. The quality of seeds can very often be fairly tested by putting them into water, when only those that are well developed sink; those that float should be rejected.

When the percentage of good seeds is required accurately, 100 seeds in number may be taken at random, placed on the earth in a flower-pot, and covered with moss. The flower-pot should be put inside a larger one containing water, and placed in the dark; as the seeds germinate, they are removed and the number noted. Or, they may be placed between two pieces of damp flannel which are connected with a dish of water.

CONDITIONS OF GERMINATION.

Water. The most important condition for the successful germination of seeds is a constant but moderate supply of water. The soil, also, should be loose enough, naturally or by preparation, to allow the roots to spread easily.

Depth. Some seeds will only germinate on the surface of the ground, when shaded by short grass, others require only the slightest covering of earth, and others again germinate best when buried at various depths according to the species. The seed can be covered, when sown broadcast, by raking, hoeing, or by scattering fine earth on it.

Time. Seeds vary very much in the time they take to germinate. The seeds of the Mangrove germinate in the pod, those of the Naseberry Bully Tree as soon as their fruits fall from the tree, those of Juniper Cedar only after months, whilst some other seeds take years to germinate. In order to hasten the germination, various expedients have been adopted, such as soaking in water for lengths of time ranging from an hour to several weeks, filing the hard seed-coat, etc.

RAISING PLANTS FROM SEED.

It may be possible sometimes to transplant seedlings from existing woods, but as these are generally found in parts which are thickly stocked, they are not well developed, and do not yield good results.

It is much better to raise plants on a large scale in regular nurseries. The most suitable soil is a sandy loam of good depth, and well worked; if too rich or too damp, seedlings will lose vigour when transplanted into less fertile ground. The site should be as near as possible to the centre of the area to be planted. It is important that it should be where water can be led on from a spring or can be easily brought into the nursery. Irrigation channels between the beds are the best method of watering. The nursery should be kept quite free from weeds.

The area of the nursery depends on the species, the method of treatment, the number of plants, whether they are pricked out or not, and the age at which they are finally removed. For raising two-year-old seedlings of Scotch Pine or Spruce, the area of the nursery is usually about $\frac{1}{3}$ per cent. of the area to be annually planted at 4 feet apart; if the two-year-old seedlings are pricked out, and remain for another two years, the nursery should comprise at least 4 per cent of the area to be planted annually.

The seed-beds should be laid out about 4 feet wide and of the requisite length, with pathways between. The seeds are sown in rows from 6 inches to a foot apart. The young seedlings generally require shading, fronds of fern stuck into the seed-bed answer the purpose; or screens may be made of laths with spaces between, or of osnaburgh stretched on a rectangular light frame,—and fixed a few inches above the surface.

In some cases the seedlings are taken direct from the seed-bed to the forest; in others they are transplanted once or several times in the nursery before they are finally put out. The former are called "seedlings" the latter "transplants."

Seedlings which are to be planted out must be grown with plenty of room in the seed-beds, so that they may develop properly; plants which are to be pricked out in the nursery may stand closer together in the seed-beds.

In France a plan for inducing a dense growth of lateral roots in seedling oaks, has been found successful,—it is to spread the acorns over a layer of broken stone, cover them with as rich a soil as possible, and water them well. Another plan is to pinch off the plumule or first bud of the seedling, 5 or 6 days after it appears so as to throw all the energy of growth into the root.

Pricked out plants are generally placed in rows, called nursery lines. The soil devoted to them must be carefully prepared, though not perhaps quite to the same extent as that of seed-beds.

Seedlings should be pricked out while young, sometimes when only a few weeks old.

When the object is to produce large and strong plants, they may be pricked out a second or even a third time, after an interval each time, of one, two or more years.

Plants may be pricked out at any time, provided it is done carefully and rapidly; when the soil is fairly moist; and during showery weather, else the plants may have to be watered.

The distances between the nursery lines and between the plants in the lines depend on the size of the plants, their more or less rapid development, and the time which they are to remain in the lines. Ordinary two-year-old seedlings of Pine which are to remain for two years in the lines, may be placed from 3 to 6 inches apart in the lines with a distance of 6 to 12 inches between the lines.

The pricking out can be done in a variety of ways according to the description of plants. The more usual methods are, either to make a separate hole for each plant with a planting peg, a small hoe or a garden trowel, or to open shallow trenches, into which the plants are placed at the proper distance apart. In either case the roots should be placed in a natural position and the soil well pressed around them.

Transplants are much superior to seedlings, especially in unfavourable localities; their root-system is fuller and more compact, and they are altogether better developed.

PLANTING.

The first consideration in planting is to interrupt as little as possible the process of growth.

Two general rules should always be borne in mind:—(1) the plant should be placed in the ground to the same depth as that at which it stood in the nursery; (2) the roots should not be crowded together but be placed in a natural position.

In the majority of cases the plants should be placed flush with the ordinary surface of the ground; but sometimes they must be placed in pits dug out below the surface, where for instance the ground is sloping and hoeing the weeds at first soon levels the surface, or when the climate is dry and hot; on the other hand in wet swampy soil on a level surface they should be planted on mounds.

In planting with balls of earth, care should be taken that the plants are not too large, otherwise the roots will project beyond the ball and be destroyed in transplanting; again, it is essential that there should be no vacant space between the ball and the soil where it is planted, which often occurs even after careful planting, when the soil is stiff and shrinks.

If the planting is without balls of earth, great care has to be taken with the roots. If the soil be rich and fairly open, the hole may be made just large enough to hold the roots placed as they spread naturally, but if the soil be stiff, the hole should be made larger and deeper so as to loosen and work the ground, and make it easier for the roots to spread in starting. The soil taken out of the pit should be placed in two heaps, the top good soil being kept separate from the indifferent lowest soil.

In placing the plant in the hole, it should be held so that the root system is in a natural position, the good soil is then gradually filled in about the rootlets, at first pressed down gently, then more firmly, and at last pressed firmly with the foot.

The plant should be held in position by a boy, whilst a careful man fills in the earth.

ORNAMENTAL PLANTING.

Planting trees for the sake of adorning a house, a garden, or an estate is an art which is deservedly on the increase in the Island. Addison, in the *Spectator* says: "There is, indeed, something truly magnificent in this kind of amusement. It gives a nobler air to several parts of nature; it fills the earth with a variety of beautiful scenes, and has something in it like creation. For this reason the pleasure of one who plants is something like that of a poet, who, as Aristotle observes is more delighted with his productions than any other writer or artist whatsoever. Plantations have one advantage in them which is not to be found in most other works, as they give a pleasure of a more lasting date, and continually improve in the eye of the planter. When you have finished a building, or any other undertaking of the like nature, it immediately begins to decay on your hands; you see it brought to the utmost point of perfection and from that time hastening to its ruin. On the contrary when you have finished your plantations, they are still arriving at greater degrees of perfection, as long as you live, and appear more delightful in each succeeding year than they did in the foregoing."

Clumps of trees should be so planted that the larger trees are in the background, while smaller trees with flowers or coloured foliage are in front. They should be dotted about the grounds, giving effective variation in colouring, and in light and shade. Careful grouping is requisite near the house, which should be shut off from sight from some points of view, and from other places set as in a frame with trees and a bright flower garden in front. But if trees are planted too near a house, they produce dampness, shutting out sun and air, and the roots undermine the buildings. But while the trees should be so grouped that from various spots all round they appear to set off the dwelling and enhance its beauty so also the position of the clumps must be arranged, taking the house itself as the centre, so as to form foregrounds or middle distances to the views, or to provide a shelter against prevailing winds, or shade protecting from the afternoon sun.

If an avenue is to be formed, it should be made all of one kind of tree, and they should be planted at regular intervals. An avenue should move in a gentle curve from the entrance gate with clumps hiding the house, until it bursts upon the view at close quarters.

WOODS.

Woods are as a rule naturally composed of several different species of trees, when they are called "mixed" woods, though it sometime happens that the soil and climate are so suitable to one particular species that it grows to the exclusion of others, when such woods are called "pure" woods.

Both kinds are formed by foresters according to circumstances. The hills of Hong Kong for instance are planted with a single species of pine tree, *Pinus sinensis*, Lamb.

The chief reason for planting pure woods, is that they are easier to manage, as only the requirements of a single species have to be considered by the forester.

But it is not all trees that are suitable for this purpose, and as a rule only such are chosen as possess dense crowns, shading and preserving the soil, and increasing its fertility by the humus formed by the decaying leaves. In Europe the Beech is considered to improve the soil in the highest degree, for beech wood produce a thicker layer of humus than woods of other species. Such species are called "ruling" species as distinguished from "dependent" species. But there are many trees which do not possess a dense leaf canopy, and are yet capable of preserving the fertility of the soil for some time, because under their half-shade, mosses grow which protect the soil quite as well as a thick layer of leaves.

There are many localities in which the soil will not suffer through imperfect cover, namely if it is deep, and kept moist by rainfall or ground water; and sometimes it is even advantageous to have an imperfect cover, viz. in marshy spots. If the trees are to be cut early, a pure wood sufficiently covers the ground as the crowns are lower, and the crop is denser.

In mixed woods, that are planted, there may be a mixture by groups, where a group of one species alternates with a group of another species; or there may be a mixture by single trees when each tree of one species alternates with a tree of another species.

The mixture may also be permanent, or for a time only, when for instance it is necessary to protect a tender species against drought by a hardy and fast growing species.

Permanent mixed woods have certain advantages over pure woods.

(a) Whenever the area to be planted is of any considerable extent, and in the hills of Jamaica, even if such area be of small extent, there are many variations of soil and situation; and in order to utilise the soil in the most economical way, each small spot should be planted with a species which suits it.

(b) There are comparatively few species of trees that are suitable for pure woods. Many most valuable timber trees are not dense enough in the crown to preserve the soil, and only make fine boles giving large-sized timber when they are planted with others which bear a dense mass of foliage.

(c) Many species suffer less from injurious influences, such as wind, insects, fungi, if mixed with other species.

Shallow-rooted species are not so easily thrown by wind if intermixed with deep rooted trees. What Fream says of agricultural crops is applicable also to woods. "Side by side with the excessive, or exclusive, cultivation of one kind of plant, the pests—whether insects or fungi—which prey upon the plant may be expected to become more abundant, for they find their victims literally crowded together, and therefore extremely accessible." For instance, in Hong Kong the pure woods of *Pinus sinensis* were threatened with extermination by an insect pest which would not have been so dangerous in a mixed forest; and as another illustration, the leaf-fungus that destroyed the coffee in Ceylon would probably not have done so much damage if the fields had been in smaller patches separated by woods or shelter belts of tree.

FORMATION OF MIXED WOODS.

In forming a mixed wood, the most numerous trees should be shade-bearing, that is, have dense crowns giving ample shade and plenty of fallen leaves, so improving the soil.

Different species of shade-bearing trees may be grown together, provided they grow at about the same rate; or when the slower-growing species is protected against the quicker growing by giving them a start or by allowing it to form the great majority of the crop and later by lopping or cutting out the other species of trees threatening to suppress it.

Shade-bearing trees may be mixed with light demanding thinly-foliaged trees, if the latter are of quicker growth, or are given a start, and are less numerous than the shade-bearing trees.

Two are more light-demanding species should not be planted as a mixture without shade-bearing trees, as the soil deteriorates; except in very fertile spots, or in places with such poor soil that nothing else will grow, or when the timber is cut at short intervals, or when one species is used to protect another slow growing species.

The species are to be mixed by groups or by single trees according to circumstances. Two shade-bearing species growing at the same rate may be mixed by single trees, unless the soil, etc., varies, suiting one species in one place and another in another. The least numerous species are, as a rule, to be introduced individually, unless the quality of the soil is variable, so that patches here and there specially suit one particular class of tree.

SYLVICULTURAL SYSTEMS.

There are several methods of making, renewing, and tending woods which are adopted according to varying circumstances, whether the forest is intended for large timber and renewed by seedlings, or to be cut at short intervals as coppice, or a combination of both, and whether the new wood is created on a clear cutting or under the shelter of existing trees.

Where a wood is formed in a clear cutting in high forest, the young trees are all about the same age and height, and as soon as the branches meet they form a continuous leaf canopy overhead so that the sunlight reaches only the upper parts of the crown. This favours the quickest growth in height and formation of clear boles without branches. If the trees are judiciously thinned so that they are encouraged to grow almost to their full height, and then thinned strongly to allow of the full development of their crowns, they will ultimately increase in diameter, and form long clean boles of considerable thickness,—the best condition for timber.

Sometimes instead of making a clear cutting, some of the old trees are left to shelter the seedlings which either spring naturally from the seeds that have dropped from the mother trees, or have been transplanted from nursery beds, or

the natural is assisted by the artificial regeneration. The few mother trees that are left to shelter the young trees, have this term of years of free development allowed by which large and valuable timber is produced.

This plan may be worked by clearing a large area of all but a sufficient number of mother trees; or it may be done by dealing only at first with groups of trees scattered here and there, and when these have been renewed, dealing with other groups; or it may be worked by the removal of single trees or small groups selected here and there over the whole forest.

By this last method less clean and shorter boles are produced than under the first plan, but it is more suitable for hilly districts, as rain water is retained more effectively, and there is less liability to landslips.

When fire-wood or small timber only is required resort is had to the coppice system in which when the tree is cut down, it sends out shoots from the stool.

Sometimes the coppice system is used for an underwood, with an existing over-wood of high standard trees. In this case the over-wood should consist of trees with thin crowns, and the shade should be evenly distributed.

ARTIFICIAL FORMATION OF WOODS.

The formation of a wood may be

- (1) artificial, by sowing and planting, or
- (2) natural, through seed, shoots and suckers, or
- (3) a combination of methods.

DIRECT SOWING.

The seed may be sown directly on the area which it is proposed to stock. In this case only a moderate amount of propagation can be given to the seed in the ground and the more it is well to select hardy species which thrive easily, and especially those with large seed.

The trees in a forest should be close enough to give proper shelter to the soil, and prevent growth of bush and weeds, and yet sufficiently far apart to allow them to attain their proper development. The distance apart however which suits seedlings is too close when they have grown into trees, and it is therefore usual to strike a mean, and sow or plant at such distance that in from 5 to 10 years a fair cover shall be established over-head. This consideration determines the quantity of seed sown per unit of area, combined with a knowledge of the nature of the soil, which requires less or more according as it is good or indifferent; a knowledge of the mode of growth of different species, less seed being required if the seedlings are of quick growth at first; of the dangers to which it is liable from birds, etc. For instance in Europe it is usual when sowing broadcast to use 550lbs. of Oak seed per acre, 150lbs. Beech seed, 25lbs of Elm, 6lbs. of Scotch Pine.

PREPARATION OF SOIL.

The soil, as a rule, requires preparation before sowing. The bush, weeds, leaf-litter must be first removed by cutting, drying and burning, unless they can be dealt with in the loosening of the soil by the hoe, etc., for the reception of the seed.

When the soil is ready, the seed should be distributed as evenly as possible, by allotting a certain quantity of seed to small sections of the whole area.

Broadcast sowing over the surface of an area can only be recommended when the soil requires no cultivation, or where it is possible to raise one or more field-crops to repay the cost of cultivation.

Sometimes, in order to reduce the cost, the sowing is restricted to portions of the area to be stocked, and this method may also become necessary over uneven ground. These partial sowings may take the form of strips of seed beds ranging in width from 1½ to 3 feet, alternating with unsown strips in width from 3 to 6 feet. The width of the sown strips depends chiefly on the degree to which the unsown strips are likely to be overrun by weeds, and on the rate of height-growth of the trees during early youth, the greater the former, and the slower the latter, the broader should be the sown strips.

Instead of strips, it may be more advantageous on uneven and rocky soil to sow in patches.

PLANTING.

Instead of sowing directly on the land to be stocked with trees the method

may be adopted of forming the wood by means of plants raised elsewhere. This method is to be preferred when there is danger of the young plants springing from seed sown on the ground, being choked by quick-growing weeds.

Only healthy, vigorous plants should be used, with a compact root-system and a well developed head. There is more chance of success when plants are transferred from a poor to a rich soil, than vice versa, and from high to low altitudes, and from open to sheltered situations.

The best age for planting out varies with the species. Some tropical species grow so fast that the most suitable age for transplanting is when they are only a few weeks old. In Europe most trees are planted out when they are from 2 to 4 years old.

Transplanting is at best a violent operation, causing injury to the root system and an interruption of growth. If possible, the root-system should be completely imbedded in a ball of earth, when the plant is moved, but at any rate, the roots should be disturbed as little as may be; and the most favourable season chosen.

The distance at which plants should be put out is governed chiefly by the principle that the cover overhead should be established within a period of from 5 to 10 years. Young small plants should be planted closer than old and large ones.

The following distances are recommended :-

For Shade-bearing Trees

Class of Plants.	from	to
	ft.	ft.
Seedlings under 3 in. high ..	1 × 1	2 × 2
Small transplants, from 1 to 2 ft. high ...	2 × 2	2½ × 2½
Stout transplants, from 3 to 4 ft. high ...	2½ × 2½	4 × 4

For Light-demanding Trees.

Class of Plants.	from	to
	ft.	ft.
Seedlings (Scots Pine, Larch) under 8 in. high ...	1½ × 1½	3½ × 3½
Medium transplants, from 2 to 4 ft. high ...	3½ × 3½	5 × 5

The object of the plantation must be considered, whether timber or firewood is to be produced; whether pieces of large diameter or long boles are desired, etc.

The distribution of plants over the area to be stocked may be done irregularly by selecting spots by the eye at an average distance, or regularly according to geometrical figures, of which the more common are the equilateral triangle, when the planting spots are at the three corners of the triangle; the square, four plants being placed at the four corners of the square; equidistant lines or rows, in which case the plants stand at shorter intervals in the lines than the distance between the lines; the quincunx form, which is a modification of the square, there being a plant in the middle of the square as well as at each corner.

PROTECTION OF PLANTS IN TRANSIT.

"During transit, plants must be protected against drying up, and this refers more particularly to the root system; a few minutes of exposure often suffices to kill the finer roots.

"Ball plants possess already a good protection in the lump of earth in which the roots are imbedded. For transport occupying not more than one day, the balls should be packed close together to prevent their drying up, and the earth from being shaken off. Only in rare cases are such plants carried over long distances, the cost being too great.

"Plants without a ball of earth should be at once protected. This is best done by dipping the roots immediately after lifting into soft mud, which forms a thin

layer over them; the plants should then be tied together in bundles of convenient size. For transport over short distances, which occupies not more than one day, the bundles should be placed in baskets, wheelbarrows, carts or waggons, according to circumstances, the roots being surrounded by, or imbedded in moss, grass, or earth. If the weather is dry and the sun shining, some cover may also be provided, to prevent the drying up of the foliage. The moss or grass used to cover them should be well moistened, and this process may be repeated from time to time during transit.

“If the transport extends over several days, further precautions are necessary. The small bundles are, in that case, bound together into large packages, by arranging the plants so that the roots are all on one end, well wrapped in wet moss, grass, &c., and then secured by withes. The whole package is covered with matting. In the case of small or middle-sized plants two layers are packed together with the roots in the centre and the crowns outwards on both sides. Plants packed in this manner keep fresh for a week, provided they are so packed that no heating takes place.

“On arrival at their destination the plants should be at once unpacked, and either planted out, or bedded in earth until they can be planted. The imbedding is best done by arranging the small bundles in trenches and covering the roots and part of the stem with moist soil. If necessary, shelter against the sun or dry winds may also be provided, and the plants may be watered.”

NATURAL REGENERATION OF WOODS.

The formation of a new wood may be effected in a natural manner by allowing the seed to fall from the trees on suitable ground, and by giving the seedlings proper room to grow and develop.

If the soil is not in such a condition that the seed will generate readily, it must be prepared by removing weeds or excess of vegetable covering, and working the soil by hoeing. The old trees must be thinned out to give room for the young growth, leaving a sufficient number as a cover overhead.

Only a limited number of trees are necessary to afford shelter to the young crop and to the soil, and these should be evenly distributed over the whole area, and be selected and marked from the beginning. The rest should be removed gradually, for if the selected shelter trees are suddenly brought from a crowded into a comparatively open position they would be blown over by the first strong wind, or disease would be induced by the fact that the leaves would not be able to react to the greater stimulus of more light. For these reasons the cuttings preparatory to the year during which the trees seed abundantly, may range over several years. In the case of open woods and deep-rooted species only one cutting may be necessary, or even none at all.

As it is usually uncertain when there will be a seed year in a forest, the preparatory cuttings must not be brought to completion too soon so as to open out the old wood too early, and the final cutting should only take place when it is certain that the seed can be depended upon.

The important question at this stage is the density of the shelter-wood which remains after the final cutting has been carried out; and various circumstances must be considered.

The shelter-wood should afford protection against the drying up of the soil, cold winds, and growth of weeds; if any of these dangers exist, the shelter-wood, or such portions of it as may be necessary, must be kept dark.

The nature of the species is very important in considering the density of the shelter-wood. Tender species, especially those of slow growth during youth, require a dark shelter-wood; hardy, light-demanding, quick-growing species a much lighter one.

The shelter wood is removed when it is no longer required to protect the young growth against various dangers and to preserve the activity of the soil until the new crop can so act. Whether the removal takes place by one or several cuttings depends on various considerations; for instance whether the soil is properly covered with humus and conserves a suitable degree of moisture; whether weeds will not choke the seedlings if the cutting is too severe; whether a free admission of light is necessary for the new crop from the first, or only after a short time.

Instead of conducting the regenerating process uniformly over a whole wood, some foresters divide up the area into a number of narrow strips, each strip about the height of the trees but of any length that may be convenient. These

strips are taken in hand, one by one, but generally three are under regeneration at the same time, the middle one being in the seeding stage, another in the preparatory thinning stage, and the third in the final removal stage. As soon as one strip has been completely regenerated, a fresh strip is taken in hand, and so on until the process is gradually extended over the whole wood. The operation should generally commence on that side of the wood which is opposite to the prevailing direction of the wood.

Again, another plan is to take in hand, to begin with, certain limited groups scattered over the wood. When these have been regenerated, a second set of groups is taken up, and so on, until the whole area has passed through the process. Or, this plan may be so modified that where the first groups have been regenerated, they are gradually enlarged by dealing with successive narrow bands around them, and this process is continued until the several groups merge into each other.

The time when the different parts of the wood are taken in hand depends upon the following considerations :—

In almost every mature wood groups of young growth are found, and when these are healthy and capable of developing into full-sized trees, in spite of having stood for some time under the shade of the whole wood, they are taken as the nuclei of the first regeneration groups. The old trees standing over them are removed when no longer required, then the groups are enlarged by gradually cutting away the immediately adjoining trees in narrow bands.

Many old woods are naturally of uneven age. In such cases the oldest parts are first taken in hand followed by the next age gradation, and so on. Or certain parts have thinned out naturally, followed by an interruption of the leaf canopy; and these should be first attacked.

Instead of working by groups or strips, there is a method, the "selection system," by which "regeneration goes on in all parts of the forest, by the removal of the oldest, largest, diseased or defective trees, wherever they are found. No part of the forest is ever at rest; advantage is taken of all seed years for the restocking of small holes cut into the cover here and there by the removal of one or a few trees. Of the large quantities of seeds which fall annually or periodically to the ground, only a small portion finds conditions favourable for the development of young trees; the latter are found chiefly in those parts where old trees are standing, or where the cover has been interrupted. Here little groups of seedlings spring up, which must be assisted by cuttings, either final or intermediate, to afford them the necessary light. Such cuttings are the only regeneration cuttings made under the system." This system is perhaps the best adapted for use at first in Jamaica as a commencement of forest management.

TENDING OF WOODS.

Woods require constant tending from their earliest youth to full maturity. The most favourable conditions must be secured for growth and for the full development of individual trees during the struggle for existence. It is necessary above all to preserve the fertility of the soil by maintaining a continuous covering of foliage overhead, and it is also necessary to provide for the attainment by certain trees of their utmost capacity in the formation of valuable timber by removing other trees which would interfere with this object.

During Early Youth woods require a certain amount of protection against external dangers. The spread of fire from neighbouring districts must be guarded against, and a good plan is to clear a broad line all round over which fire cannot pass.

Shelter trees are necessary to protect the plants against drought. If a young wood has been formed before the removal of the whole of the mature trees already existing on the spot, these will probably form sufficient protection; but, if not, or if the wood has been formed in cleared areas, shelter is provided by planting out species as *nurses*, that are quick-growing and possessed only of a thin crown of foliage. They may be evenly distributed over the area, or planted in alternate lines.

The effects of winds are often disastrous, and wherever they are likely to damage the young growth, shelter-belts or wind-breaks should be established beforehand.

If high weeds and bush are capable of being utilised for shelter over cleared

areas, they may be utilised for that purpose, if proper precautions are taken that they do not choke the young trees.

Both insects and fungi are liable to attack young trees, and watch must be kept against both kinds of pests. It may even be necessary to destroy infected or sickly plants.

Whenever blanks occur through the failure of plants, they must be filled up without loss of time so as to preserve the density most favourable to the well-being of the wood. If young plants are only a few years old, the same species may be used; but if they are of that age that it is not likely they will be caught up by those of the same kind, a quicker growing species must be used, or one that can bear the shade of the surrounding saplings.

If the trees are found to be too thinly scattered over the area to be regenerated a quick-growing and thinly-foliaged species is planted amongst them which stimulates their development.

Sometimes the young seedlings are too crowded, when they are the result of direct sowing or of natural regeneration. If no action is taken, they become half choked, and those that survive grow up weedy and scarcely able to bear their own weight. Some must be removed, and the best plan is to cut down the weakest close to the ground. If this operation has been unavoidably delayed until the wood is 10 or 15 years old, the utmost caution is necessary in slowly and gradually thinning out the weakest; otherwise those that are left may lean over and eventually fall. The best method to adopt is to cut narrow strips through the thicket, so as to allow the plants along the edges of the strips to grow with more vigour.

After Early Youth. When the period of early youth is passed, and the normal density of canopy has been attained, many dangers are no longer to be feared and the forester has to attend more particularly to the development of the trees so as to produce timber of high technical utility.

While constantly maintaining the canopy of foliage overhead, it is necessary here and there to remove trees. Some have sprung up of undesirable kinds; others are sickly through unfavourable soil, or injuries received through either such accidental causes as wind, or through the attacks of insects or fungi; others again are dying or dead. These must all be cleared away, to prevent crowding of the selected trees, or to remove all breeding-places for insect pests and germinating beds for fungoid diseases.

When the object in the management of the wood is to produce valuable timber which splits well and has few knots, it is necessary that the trees should not retain their lower branches as they do when growing in the open, but have long clean boles. When a close canopy of foliage is maintained the branches more or less die off and sooner or later drop to the ground, and this process is the more thorough in proportion as the species is unable to bear shade. It is frequently necessary therefore to artificially remove dead, and even green branches.

Pruning. Pruning may be necessary when a valuable species is outgrown by another, which should not be removed altogether, but may have some branches cut away; or when a coppice under high standard trees requires more light.

There is however a danger in pruning off green branches, as the wound offers a good germinating bed for the spores of fungi which cause decomposition and lessen the value of the timber. If the tree is growing vigorously and the cut does not exceed about 3 inches in size, it will heal naturally.

The branches should in all cases be cut off close to the main stem, but without injuring the bark. Heavy branches should first be cut off some distance from the stem, and then by a second cut, the remaining stump should be removed, to insure the production of an even cut and to avoid tearing the bark of the main stem.

Wounds which are so large that they are not likely to be closed over by the growth of the bark must be covered over with a coating of tar made sufficiently fluid by the addition of oil of turpentine.

THINNING.

In all naturally formed woods there is crowding, and consequently a struggle for existence amongst the trees. The same struggle takes place in artificially formed woods, for close planting is adopted in order to have a continuous canopy of foliage for the preservation of the soil and for the development of the trees in height. Some of the trees outgrow the rest, and are called the *dominant* trees. Between and below these are others that have only their leading shoots in enjoy-

ment of light, these are *dominated* trees; others are so *suppressed* that they are actually deprived of direct light, and eventually die. Even the dominant trees are not all able to develop to the fullest extent, and form good timber; and therefore the forester has to *thin* the wood before the trees grow weak and lanky, and provide a suitable growing space for them. The following table may be taken as an illustration of the increasing amount of space required for trees as they grow older. It is the result of statistics collected in the Black Forest for mixed woods of Spruce, Silver Fir, Scotch Pine, and Beech :—

Age of wood in years.	Number of trees per acre.	Mean growing space per tree in square feet.
20	3,960	11
40	1,013	43
60	449	97
80	346	126
100	262	166

“ A tree growing in a free position, in complete enjoyment of vertical and lateral light, will develop a full crown and root system, and lay on a maximum of volume. This is no doubt a great point, but it is counterbalanced by serious drawbacks :—

“ In the first place a wood grown in this fashion does by no means always produce the greatest volume per acre, as the total production is represented by the average volume per tree multiplied by the number of trees per acre. Although each tree in a crowded wood, has a smaller volume than one grown isolated, yet owing to the greater number of trees per acre, a crowded wood may have, and generally has, a greater total volume per acre than one in which the trees grow isolated. Secondly, isolated trees are liable to suffer in height-growth and in straightness. In the third place, such trees are frequently covered with branches low down, and in consequence they produce less valuable timber. In the case of Conifers the timber is also liable to be of an inferior quality, owing to the greater breadth of the concentric rings. Last, but not least, open woods cannot preserve the fertility of the locality; hence they are only admissible on fertile localities, or special measures must be taken to preserve the fertility of the soil.

“ These considerations govern the most profitable growing space in any particular case. It is conceivable that under certain conditions the correct policy is to remove all dead, suppressed, and dominated trees, and even a portion of the dominant trees, while in others the dominated and even suppressed trees may have to be carefully husbanded, so as to realise the objects of management in the highest possible degree.”

The forester, in judging of the amount of thinning required, besides giving full weight to the objects of management, the density of the crop, and the age of the wood, has also to take into consideration the species, for light-demanding trees must have more space than shade-bearers, and also the character of the locality. “ The average growing space per tree is greater in old woods, in the case of light-demanding species, on good soil, and in low elevation, than under reverse conditions.”

Dead trees should be removed at every thinning, as they are a constant source of danger from harbouring insects and developing fungi; and *suppressed* trees should also as a rule be removed. The *dominated* trees should be retained for a time if they are necessary for the purpose of preserving a complete leaf-canopy. But in time even some of the *dominant* trees will have to be removed, as soon as they begin to interfere with each other's proper development, or if they are liable in a mixed wood to suppress a tree of another species which has to be preserved for the sake of the mixture.

With such a tree as the Cedar, on fertile soil, it will be advisable, as soon as it has attained its principal height-growth to select the most promising trees, isolate these by thinning heavily, at the same time establishing an underwood of a shade-bearing species. As soon as the underwood is so far advanced as to be capable of protecting the soil, another thinning completely isolates the trees, leading to a great extension of the crown and a consequent large increase in the diameter of the tree. As the crown expands, more thinning can be made.

CUTTING AND SEASONING TIMBER.

The best time in the year for cutting timber is at the period of least growth, before the time of active growth commences again; it seasons better then, as the cells are not so full of sap, which induces fermentation and consequent decay in the cut timber.

Wood, when freshly cut, contains generally about 45 per cent. of water, and a part of this is dried off in seasoning.

Percentage in weight of water in round wood from young trees, at different periods after cutting.

Kinds of Wood	6 mo.	1 year.	18 mo.	2 years.
Beech	30.44	23.46	18.60	19.95
Oak	32.71	26.74	23.35	20.28
Fir	33.78	16.87	15.21	18.09
Pine	41.49	18.67	15.63	17.42

It appears from this table by F. B. Hough, that there is nothing gained in dryness by keeping after eighteen months; but English shipwrights prefer to keep large timber for 3 years to season.

If the carriage alone has to be considered, or even the use as fuel, it is evident that it is very economical to attend to seasoning.

Laslett states: "My experience of the approximate time required for seasoning timber under cover, and protected from wind and weather, is as follows:—

Pieces 24 ins. and upwards square, Oak, require about 20 mths. Fir 13 mths.

Under 24 ins. to 20 ins.	"	"	22	"	11	"
" 20 16	"	"	18	"	9	"
" 16 12	"	"	14	"	7	"
" 12 8	"	"	10	"	5	"
" 8 4	"	"	6	"	3	"

"Planks from one-half to two-thirds the above time, according to the thickness.

"If kept longer than the period named, the thin fine shakes which first open upon the surface during the process of seasoning will open deeper and wider, until they possibly render the logs unfit for conversion. If however the logs be reduced to the scantlings required after partial seasoning and then further allowed to dry, they will not be liable to tear open so much, but by sinking gradually will retain a more solid form, and be less objectionable to the eye when placed in position."

If possible freshly cut timber should be placed in running water, which partly dissolves out the sap, and the timber then dries more readily and seasons more effectually. It is therefore advantageous to float the wood in rafts, but if the timber is left too long only partially submerged, there will be deterioration at the line of flotation. Sea-water acts even better than fresh water; and sometimes small timber is even put into tanks with salt water or lime water. Boards require only about 7 days of such "curing." This process is especially valuable when the wood is young and soft.

In the process of seasoning, as the water dries out, the wood shrinks, and cracks, the cracking taking place along planes radiating from the centre to the bark. The younger wood contains more water than the old wood, and therefore the cracks are wider at the circumference than in the heart wood.

Newly felled timber should not be left on the ground, where instead of drying, it will absorb moisture from the soil, but it should be raised some inches off the ground.

The more slowly timber dries, the less it cracks, therefore the seasoning should be done in the shade where there is no exposure to drying winds. If no other shade is available, branches of trees should be strewed over the top.

The cracking of timber at the ends may be prevented to some extent by pasting heavy paper over the ends, or by painting with diluted muriatic acid neutralized with lime.

Hardwoods season more slowly and therefore crack less, than those of light open grain.

Timber of well-matured growth should be sawn up immediately when felled, and then seasoned. If logs be reduced to scantlings after partial seasoning, and then further allowed to dry, they will not have such wide cracks. When boards are cut green, shrinkage from loss of water is greatest in the youngest wood. If the boards are cut in planes radiating from the centre of the tree, there will be extra thickness in the part near the centre. If the boards are cut in planes at right angles to rays from the centre, warping takes place, the contraction being strongest on the side furthest from the centre of growth.

When timber is sawn, it should be carefully stacked under cover to season, and free access of air allowed.

Many processes have been from time to time invented to prevent decay of timber, which is due to the action of fungi or bacteria. The easiest plan is to have the outside charred and so prevent the attacks of microbes. For posts which are to be placed in the ground, it is advantageous to slowly scorch the outside, and then they may be dipped into tar, or painted with three or four coats of the same material. Railway ties are improved in durability by charring. A process for the preservation of timber was patented in France, by which a jet of burning gas was directed by means of a tube over every portion of the surface, and this applied to timber for naval purposes was said to have been successful.

The principle of preserving timber by means of impregnation is to expel the sap and afterwards to fill as far as possible the wood-cells with some antiseptic substance.

Lime is one of these substances that preserve the tissues. Slacked lime is mixed with water in a tank till it is quite thin. Any seasoned timber may be placed in this for a number of days—about seven, if the scantling is small, such as boards, up to three weeks for large timber.

A solution of common salt may be used in the same way, but the time required is only about half as long.

Creosoted wood is timber which has been saturated with creosote in a tank.

Colonel Haskin has lately invented in the United States a process which is called "vulcanising." It consists in placing the timber by small waggon-loads in an air-tight retort, and subjecting it to the high pressure of superheated air, the temperature of which varies from 300° to 700°. Ordinary wood requires about 8 hours exposure, hardwoods from 10 to 20 hours. The wood is found not only to be preserved against decay, but it has become harder and stronger.

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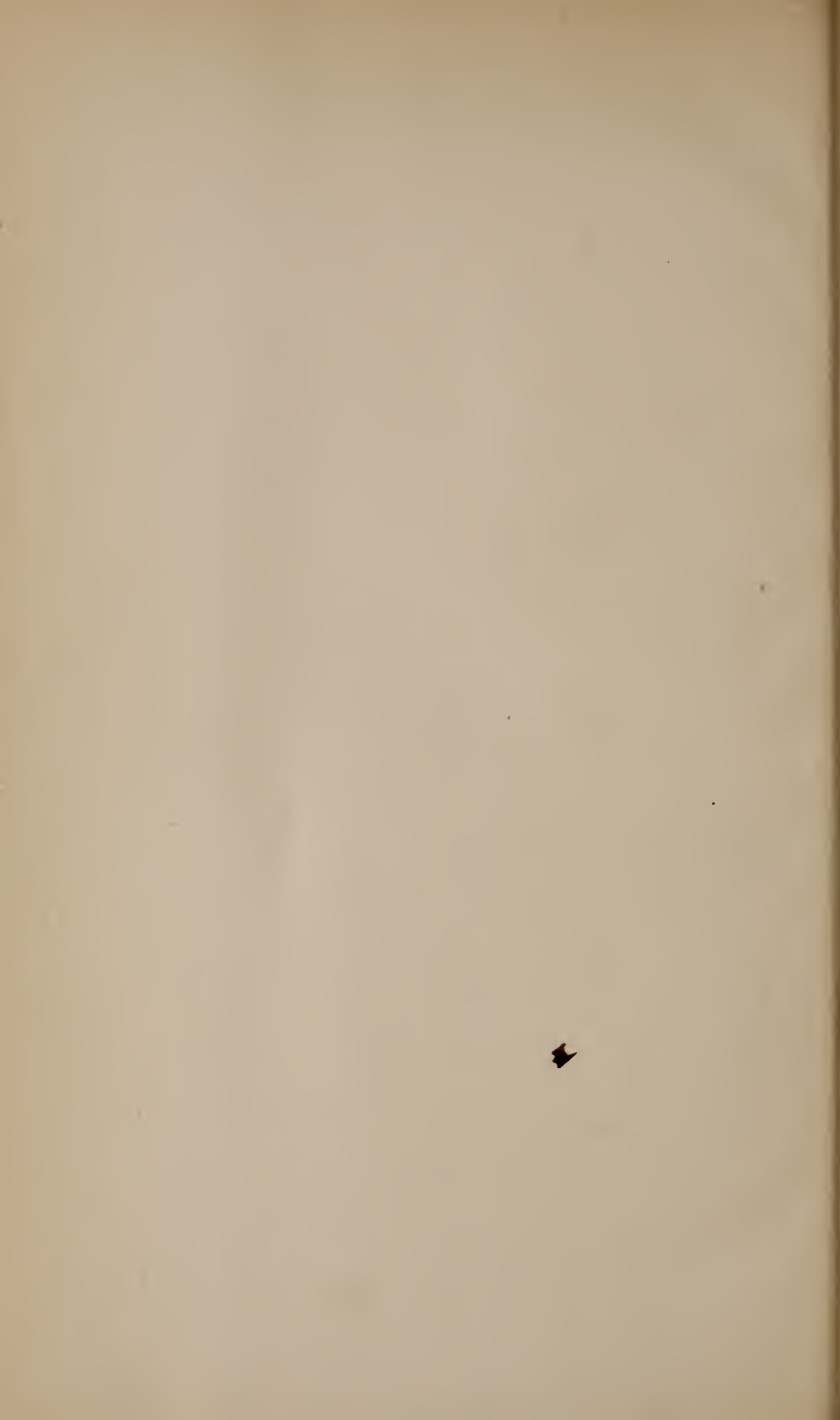
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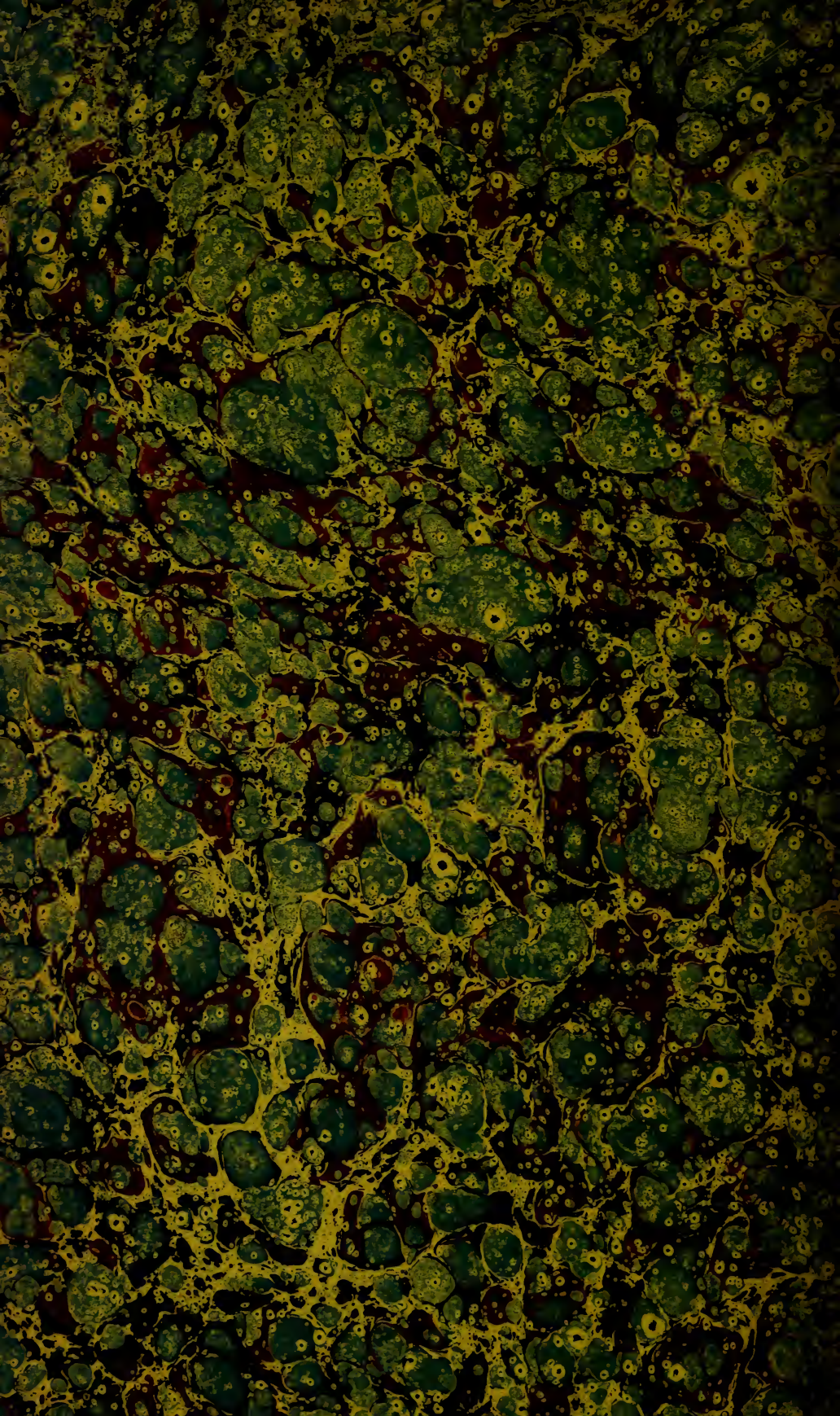
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