
The Agricultural Department, Dominica

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unsuitable climatic conditions, or overbearing. Inoculation results indicate that *Phoma* by itself is by no means an aggressive parasite, and there is, further, no Uganda evidence of such a *Phoma* disease of coffee as that described by Dowson in British East Africa.* The recommendations made with regard to the coffee dieback with which *Colletotrichum* and *Phoma* are implicated consist of measures designed to produce a healthy and resistant tree.

Phoma on Hevea.—The only other species of *Phoma* found on a plant of economic importance is *Phoma heveae*, Petch, which occurs on *Hevea* branches, apparently without causing any harm.

VI.—THE AGRICULTURAL DEPARTMENT, DOMINICA.

A. KEYS.

We have received the following interesting account of the development of the Agricultural Department, Dominica, from Mr. A. Keys, the Assistant Curator of the Botanic Gardens, Dominica, who was sent out from Kew in the early summer of 1919 (K.B. 1919, p. 237).

We are glad to be able to publish this useful record, especially as it enables the valuable and devoted labours of Mr. Joseph Jones to be more fully appreciated. Mr. Jones left Kew to take up his appointment as Curator of the Botanic Station, Dominica, in March, 1892.

It may be said in connection with the Agricultural Department of Dominica that, since its humble beginning as a Botanic Station 28 years ago, its progress has been rapid and its functions useful. Further, it has taken into account every important section of agriculture constituting the work of a department worthy of the name; always with due regard to the requirements of this wonderful Island.

In giving a few notes of things "past and present" relative to the Gardens and their surroundings, it will be as well to start with the Botanic Gardens proper which gave birth to the present Agricultural Department.

THE BOTANIC GARDENS.

The Botanic Gardens, Dominica, might well be described as a miniature Kew: their object is the same in the sense that they were established to further the interests of agriculture, and their position amongst other gardens of the West Indies is comparable to that of Kew in Europe; but they do not possess a herbarium and cannot boast of glass houses or museums.

The Gardens in Dominica, like most others of their kind can only rank as an "outpost" or a link in the chain of establishments

* Dowson: A new disease of coffee; Leaflet No. 1, Div. of Mycology, Dept. Agric. B. E. A., October, 1917.

reaching out from Kew to the farthest ends of the Empire, each one of which serves a similar purpose within its own particular sphere. Kew—the “mother” of all the smaller establishments—stands supreme. It occupies a central position, and is suitably equipped for a far wider range of activities, keeping the smaller gardens in touch with one another, and helping them out of such difficulties as establishments on a less pretentious scale are sure to encounter.

Much might be said of the relations which have existed between Kew and the “outposts” since its very beginning, but to most of us the excellent results that have accrued from this intimate connection are well known, and one has only to look back on the modest beginning of the Rubber, Cinchona, and other important crops initiated by Kew, and which to-day rank amongst the most important and flourishing of all tropical enterprises, to appreciate the true value of the work that has been accomplished.

Then again Kew has sent out her “sons of the soil” to play their part in this important work, and from all accounts one might safely say that “they have done well.”

It is hoped that the following short account of the history and progress of the Botanic Garden, Dominica, from their commencement in 1889 up to the present time, will serve as an example and show the interesting developments and the results possible of attainment with proper care, foresight, judgment, and perseverance, coupled with such valuable assistance as Kew alone is able to give.

The first steps towards the establishment of a Botanic Garden proper in Dominica were taken near the close of the year 1889, when Mr. Charles Murray of the Edinburgh Botanic Garden was appointed Curator.

In 1890 Mr. Henry F. Green of Kew succeeded Mr. C. Murray, who had been transferred to Grenada, and it was to Mr. Green that fell the work of beginning the laying out of the grounds of the present garden.

But, like his predecessor, Mr. Green was not destined to remain in Dominica; in 1892 he resigned and was succeeded by the present Curator, Mr. Joseph Jones of Kew, who, since his appointment in that year, has laboured without intermission and to-day can look back over 28 years’ endeavour, the early stages of which must have called for much “spade work” to bring the department to its present state of beauty and utility.

Mr. Joseph Jones, as is usually the case with men who achieve great things, is exceedingly modest, and those who seek an account of things as they were in the early days need not refer to the excellent official guide of the Garden prepared by him, for they will be disappointed therein.

Beyond a short history of the Garden, nothing will be found in its pages to throw light on the formidable task and the difficulties that must have been encountered in the work of converting a rough piece of ground into a Botanic Garden.

Details of this kind, recounting the struggles of one who set out to make the best of things, must be patiently waited for until they fall unconsciously, one by one, from the lips of him who so modestly tries to hide them.

One instance may be mentioned where an interesting fact was revealed to me in this manner. This happened whilst discussing with Mr. Jones the merits of a large *Bougainvillea*, when I noticed, hidden beneath the bush, a huge stone measuring about 6 square feet. This, I was informed, was one of the many stones that were found on the ground when the Government bought the site, and had been preserved as a relic of those days; the others having been blasted out and used in the building of the wall that now separates the Garden from the public road, running from the Emsall Gate to the Curator's Gate, a distance of several hundred yards. This gave me ample proof of the original state of the ground, over which now stretches a beautiful lawn and, where the depth of soil has permitted, large trees are in a flourishing condition.

Contrary to what might be expected succulents do remarkably well in that Garden considering the heavy rainfall, even in this part of Dominica, which averages for the last 28 years over 78 ins. per annum. Up in the interior the precipitation may be as much as 300 ins. per annum !

A plant of *Cereus peruvianus* is now 35 ft., and, strange to say, withstood the hurricanes of both 1915 and 1916; it gives some idea of the success attending the cultivation of succulents in Dominica.

The situation of the Garden may be said to be ideal, for it stands on a comparatively flat piece of ground distant about 500 yds. from the sea, and immediately under the precipitous Morne Bruce.

The area of the Garden is approximately 42 acres, exclusive of nurseries, and a lime experiment station and other grounds, to be referred to later.

The Morne Bruce cliff, which rises to a height of 300 ft., gives to the Garden a wonderfully picturesque setting, and with its two spurs projecting at each end into the Garden forms a charming amphitheatre of greenery. This half circle takes in the whole of the eastern boundary and affords protection from prevailing winds.

During the flowering periods of native and exotic trees which have been planted up this slope, the colour effect produced by the mixture of these with shrubs and bushes of various shades of green, together with palms and bamboos waving to and fro in the breeze, presents a picture of rare beauty. It is difficult to describe the beauty of this slope. At the time of writing this the date-palms, with their greyish-blue* leaves and half ripe

* Owing to the bloom, which gives to the leaves a decidedly greyish blue tint the writer had some difficulty in recognising the trees after having seen date-palms in Egypt.

yellow fruits, stand out in wonderful relief from the different shades of green, as do also the specimens of *Livistona chinensis* and *Washingtonia filifera*. The latter tower about 80 ft. in the air!

In addition to the contrast afforded by the palms with their masses of dead leaves neatly clustered round the base of the "head," the beautiful Bougainvilleas greatly enhance this wonderful blend of colour.

Ornamental Section.—The Garden is divided into two parts. That part known as the ornamental section is marked off from the economic section by a low wooden fence and occupies most of the flat land.

The lawns are extensive and well kept; the main lawn, which is used for cricket and boasts a pavilion, being over 2 acres in extent. Bounding this lawn on three sides are huge specimens of the Saman tree, (*Pithecolobium Saman*), on which are growing native and exotic orchids.

To complete the square on the east side of the lawn a border of mixed low-growing ornamental shrubs was planted instead of continuing the tall Saman trees, for this side of the lawn faces the forest-clad mountains of the interior, which give a distant background of great natural beauty.

The collection of flowering trees and shrubs, palms and other ornamental plants such as *Pandanus* spp., Bamboos, Conifers, succulents, &c., includes all the best and most showy kinds.

Such handsome trees as *Baikaea insignis* and *Steriphomia paradoxa* adorn the lawns. The collection of palms includes over 100 species!

A row of Cohune palms (*Attalea cohune*), planted near one of the gateways, have grown to a height of 40 ft. and attract a good deal of attention.

Palms have been planted singly, in bold mixed groups, and to form vistas.

The Talipot palm (*Corypha umbraculifera*), of which there are several specimens in different stages of growth, stands out distinct from all other palms that have been planted singly. The palms that have been planted in vistas include *Pritchardia pacifica*, *Raphia vinifera*, *Oreodoxa oleracea*, and *Caryota urens*.

The vista formed of the *Caryota* includes plants of all ages and stages of flowering, and is of special interest to those who know of the peculiar flowering habit of this palm. On reaching maturity it throws out an inflorescence from the top of the tree, continuing downwards from each axil, until the palm is exhausted, and dies. For the most part, with the exception of large trees, planting has been done in the group system.

Among those plants that have been so planted may be mentioned various Crotons, Hibiscus, and Pandanus; *Duranta Plumieri*, *Golpimia brasiliensis*, Gardenias, Tabernaemontanas, Aalias, and other plants.

Bougainvilleas, as well as the handsome climber *Norantea guianensis*, have also been planted in beds and kept trimmed to

give a dome-shaped appearance. The latter plant is particularly attractive during March and April, when it throws out spikes of red flowers, the spikes measuring in length from 2 to 4 ft.

Among the trees planted singly are included several timber and other trees which give excellent shade, but do not possess much value in floral beauty. They have, however, their place in the collection and add charm to the grounds.

Included among these trees are species of *Ficus* such as *F. elastica*, *F. Vogelii*, *F. altissima*, and *F. Benjamina*.

These trees, which have now reached huge dimensions, are growing here and there throughout the grounds, and afford excellent shade during the heat of the day to those who feel disposed to use the seats placed thereunder.

Flowering trees and shrubs such as *Amherstia nobilis*, *Saraca indica*, *Swartzia grandiflora*, *Tabebuia pentaphylla*, *Alstonia scholaris*, *Cananga odorata*, *Butea frondosa*, *Colvillea racemosa* and *Melaleuca Leucadendron*, along with several species of *Brownea*, *Ixora*, and *Bauhinia*, are among the best and do remarkably well.

Among the most important trees and shrubs grown on account of their ornamental fruits may be mentioned "The Sausage Tree," (*Kigelia pinnata*); *Dillenia indica*; "Jack Fruit," (*Artocarpus integrifolia*); "Cannon Ball Tree," (*Couroupita guianensis*); "Velvet Tamarind," (*Dialium guianensis*); *Kopsea fruticosa*; and *Carissa Carandas*.

Poinciana regia, and several species of *Cassia*, as well as *Lagerstroemia Flos-Reginae* and *L. indica*, and its variety *alba*, all have a place in the collection and give a wonderful display of colour in their respective seasons.

Creepers do exceedingly well and beyond keeping them in proper limits are left to take care of themselves. They include: *Bearmontia grandiflora*, *Camoensia maxima*, and *Aristolochia gigas* var. *Sturtevantii*.

Catalpa longissima, a West Indian tree, is used in these Gardens for creepers to grow upon and seems particularly well adapted to carry and display the Bougainvilleas.

In addition to the many varieties of the purple Bougainvillea, *B. laterita* (terra cotta) and a new introduction from Brazil by Mrs. Butt of a gorgeous free-flowering species, named after that lady, are also plentiful and thrive equally as well as the more common type.

Of the Conifers, *Juniperus bermudiana*, *Cupressus glabra*, *Pinus bahamensis*, *Araucaria Bidwillii* and *A. brasiliensis* do the best.

Economic Section.—On entering this section one's attention is attracted on all sides by the wonderful collection comprising most of the principal economic plants of the tropics.

Even the Date Palm of the sandy deserts, and the "Shea Butter Tree" (*Butyrospermum Parkii*), of Africa—probably the largest specimen outside that continent—are represented here.

The Citrus beds contain all the best kinds of oranges, Tangerines, Grape Fruits, Shaddocks, Pomelows, Lemons and Limes.

Several kinds of Coffee are grown, the two principal Vanillas, Cola nuts, most of the recognized rubber trees including the Landolphias, Nutmegs, Cinnamon, Camphor, Mangoes, Mangosteens, Durians, and other trees and plants of medicinal or other use to man.

Cocoa covers about $7\frac{1}{2}$ acres of ground and is planted in $\frac{1}{4}$ acre plots, each of which receives different treatment in the two series of manurial experiments started in the years 1900 and 1907 respectively. Some of the plots occupy flat land, whilst the others are situated on the Morne Bruce slope.

This slope is typical of the rugged character of the land on planter's estates in different parts of the island, and on this account was selected for some of the plots to ascertain the manurial requirements of cocoa growing elsewhere in similar situations; as well as for comparing the results with those obtained from the plots on level ground.

To skim over things, as one must needs do in a paper of this kind, scarcely does justice to such an important part of agriculture as manurial experiments prove to be. It may, however, suffice to mention here that the experiments have been splendidly conducted and records carefully kept. At the time of writing the results of 20 years' work on the manurial experiments of cocoa are about to be published in the Annual Agricultural Report, and to all those who are interested in this crop they should furnish much valuable information.

Apart from the interesting results, these experiments have the additional merit of being the only ones of their kind conducted over such a long period of years.

It may be interesting to mention under this head that the crops from the cocoa plots, lime experiment plots, together with miscellaneous fruits and spices from other economic plants in the collection are a source of considerable financial support to the Department.

The receipts under the various heads for the year ended March 31st, 1920, were as follows :—

						£	s.	d.
Limes	-	-	-	-	-	625	6	7
Cacao	-	-	-	-	-	395	14	2
Nutmegs	-	-	-	-	-	15	12	10
Cola Nuts	-	-	-	-	-	12	8	1
Plants	-	-	-	-	-	113	7	2
Fruit	-	-	-	-	-	26	12	7
Vegetable seeds	-	-	-	-	-	13	16	9
Cassia Pods	-	-	-	-	-	10	7	11
Miscellaneous	-	-	-	-	-	7	13	6
						<hr/>		
						£1,220	19	7
						<hr/>		

NURSERIES.

The raising of plants at cheap rates to supply the needs of planters constitutes the work of this important and useful branch of the department. Here the planter can obtain at a small cost all the plants he may require for his estate, and is thus saved the trouble and inconvenience of having to provide them for himself.

To the new planter in particular these nurseries are of special value, for he is able to obtain a supply of young plants at any time to plant up his newly cleared forest land, which means a gain to him of at least 12 months in the case of lime plants, and nearly 2 years should he decide on budded trees of either Citrus or Cocoa.

With a steady increase in the demand for plants it became necessary in 1907 to extend the nurseries by taking in the only available piece of ground, which is situated on top of the Morne, and using it solely as a lime nursery; keeping the main nursery situated on a level with the Botanic Garden for budded Citrus, Sugar cane, Rubber, Coffee and miscellaneous stock, and such lime plants as might be required to supplement the principal supply at the Morne to meet the requirements of planters. The total area of these two nurseries is a little over 6 acres, in addition to which there is a shaded nursery where Cocoa, Nutmegs, and choice fruit trees such as grafted Mangoes, Mangosteens, Durians, &c. are grown in bamboo pots.

Near by stand two glass-roofed propagating houses with open sides used for raising seeds of a delicate nature and seeds which, if sown in the open ground, would be devoured by rats and birds.

The shaded nursery referred to above is of the ordinary type used in the tropics, consisting of a light frame work of wood, with a covering of wire netting, over which creepers are encouraged to grow to provide the necessary shade; the whole structure being supported by posts placed at regular intervals.

It may be mentioned that a section of this nursery is always kept stocked with large specimens of palms, flowering trees and shrubs, and economic plants growing in boxes ready to plant out in the places of those that may be blown down by a hurricane.

It is difficult for anyone to imagine the damage that can be wrought by a hurricane until he has seen the after-effects, or worse still, experienced one for himself.

The hurricanes of 1915 and 1916 did considerable damage. Apart from damage done in other parts of the island, where in some cases the tops of dense forests were blown away and huge trees and boulders washed down into the sea, the collection of trees in the Botanic Garden was so smashed up as to make the place almost unrecognisable to anyone who had seen it a few hours beforehand. So great was the damage that a special vote of money had to be expended in clearing up the grounds. In the Lime Experiment Station a whole series of experimental

plots was completely wiped out, many of the lime trees being carried away by the flood, whilst others were deposited on adjacent land.

In connection with nursery work in the tropics, the humus question demands careful attention. With the strong rays of a tropical sun beating on exposed land the humus of the soil is soon destroyed, and in order to prevent this it becomes necessary to provide a covering of mulch consisting of dried grass and leaves. The mulch not only serves as a covering, but eventually decays and thereby increases the humus content of the soil.

The nursery beds adjoining the Botanic Garden receive most of the cut grass from the lawns as well as leaves and other vegetable matter; whilst those at the Morne are supplied with dried grass from surrounding waste patches of land.

The method followed here where lime seedlings are grown on the same piece of land year after year is as follows:—the beds and the paths running between them are made the same width, the path being filled with cut grass which eventually decays; the following year the paths, in which the grass has been trampled under foot and thereby converted into a more or less decaying mass, are dug up and converted into beds, the beds of the previous year being made into paths. In this way the ground serving as paths for one year receives a good dressing of organic matter, and is rested for a period of 12 months.

In order to show the extent of the nursery work, a table of the yearly distribution of plants from 1905 to 1920 is given below:—

1905-6	-	-	65,731	1913-14	-	-	58,198
1906-7	-	-	83,000	1914-15	-	-	67,042
1907-8	-	-	53,855	1915-16	-	-	65,700
1908-9	-	-	67,596	1916-17	-	-	53,640
1909-10	-	-	79,009	1917-18	-	-	45,518
1910-11	-	-	69,295	1918-19	-	-	32,609
1911-12	-	-	76,363	1919-20	-	-	55,837
1912-13	-	-	75,146				

The average annual sale of plants during the above period is 63,236. In normal times, however, taking the period from 1905-6 to 1914-15, the average annual sale of plants was 69,523. During the war, as the above figures show, the annual sale of plants gradually decreased owing to the absence of many of the planters from the island who left to join the army.

In addition to nursery plants there is also a considerable distribution annually of seeds of rubber, coffee, green dressings, fodder grasses, shade trees, papaws, and vegetables.

Agriculture : Influence of Nursery Work.—Apart from supplying the immediate requirements of planters there has always been the experimental side of the work for the future improvement and welfare of the island.

Past experience of the coffee industry in Dominica, when this crop occupied a similar position to that of the Lime of the

present day, has shown that the practice of planting one crop to the exclusion of all others is one to be avoided. Up to that time limes, the present staple crop, had not been thought of in Dominica; indeed, sugar seems to have predominated after the failure of the coffee crop, and limes only came in gradually with the decline of the sugar industry, when beet began to take an important place in the world's supply of sugar, and the price of this commodity fell below the cost of production.

The agricultural history of Dominica from the coffee days shows that the dangerous policy of placing all one's eggs in one basket was adopted. And bearing in mind how much the future welfare of the island may depend upon securing suitable alternative crops and thereby avoiding a repetition of such a disaster as overtook agriculture in the coffee days, the importance of this nursery work will be understood.

Of late years cocoa planting has been encouraged by the department and every attempt made to extend its cultivation to districts which, prior to experimental work commenced on this crop, were considered unsuitable.

The superior Criollo type refuses to thrive in any part of the island, but it has been shown, after much pioneer work on the part of Mr. Jones in the budding and grafting of cocoa, that a good medium grade of cocoa can be grown in any part of the island, where cocoa might reasonably be expected to thrive, by grafting the Forastero type on the hardy Calabacillo stock. The Calabacillo type of cocoa in itself yields a very inferior grade of produce, but its immunity from disease, as well as its indifference to soil and climatic conditions, makes it invaluable as a stock for grafting; as by this means a medium grade of cocoa can be grown in places where the Forastero on its own stock would give poor results, and where the superior Criollo would possibly fail altogether.

Experimental onion growing was started a few years ago with a view to encouraging the cultivation of this crop to supply local needs. As an inducement to get planters and others to take an interest in this departure from orchard cultivation, seeds were imported from Teneriffe and sown in the nursery and the seedlings distributed free of charge.

Since the commencement of the experiment the demand for seedlings has rapidly increased. Following the lead of a successful grower several other planters have now come forward and placed definite orders with the Department for the purchase of onion seed to make them independent of the limited distribution of seedlings. Onions have become a remunerative crop, and local needs having now been satisfied, it is gratifying to note that another item has been added to the list of exports.

BUILDINGS.

All the buildings, with the exception of stables and cart sheds, are situated near the Curator's office. In the Curator's office

space has been allotted to accommodate a very comprehensive and useful library.

Adjoining the office is a small but well equipped laboratory. Near by stands the class room, Foreman's house, tool and packing houses, potting shed, two propagating houses and a fumigator; the latter being used for imported seeds and plants which, when necessary, are brought straight from the Customs house and fumigated before the importer is allowed to take possession.

A few yards further away is situated a meteorological shed, and a cocoa drying house. The latter is of the ordinary type with sliding trays and a furnace to supply artificial means of drying when wet weather necessitates the trays being pushed back under cover. A considerable quantity of cocoa, nutmegs, and cola nuts, passes through this house in the course of a year.

AGRICULTURAL INSTRUCTION.

The present day system of agricultural training takes the place of the more elaborate provision of 20 years ago, when a grant of money from the Imperial Government allowed of from 20 to 25 boys being trained and accommodated in the old military buildings at the Morne. In those days the pupils, under the charge of an Agricultural officer of the Department, were fed and clothed and schooled in general agriculture, as well as in subjects of an elementary education, for which a schoolmaster was employed. Field work commenced at 7.30 a.m. and at 11 a.m. the boys were brought in and placed under the care of the schoolmaster until 4 p.m. when all instruction for the day came to an end and the boys were encouraged to take part in games and sports organised by the officer in charge.

It is interesting to record that at that time pedigree animals were kept for stud purposes and the care of these animals together with school gardens, and bee-keeping formed part of the boy's agricultural training.

The stock included :—

Horses, Donkeys, Cows, Sheep, Goats, Pigs, Rabbits, and Poultry.

The grant made by the Imperial Government for the upkeep of the Morne school was withdrawn in 1910, and, as the local Government was not in a position financially to take over the school and continue the good work on a similar scale, it became necessary in that year to dispose of the stock and close the buildings. The need of a system for training the youth of the island in agricultural methods after the closing of the Morne school was met by the local Government in 1911, when a small class room was erected in the Botanic Garden, and six boys were admitted as pupils for a period of two years. This system of training started in 1911 is in force at the present time.

When new pupils are required to take the places of those who have completed the course, an advertisement is inserted in the

local papers inviting candidates to present themselves at a competitive entrance examination, which is held by the Superintendent of Agriculture at the Botanic Garden. The pupils are then examined in the elementary subjects of a seventh standard public school, whereby some idea of their fitness to receive the agricultural course of training is fairly well ascertained.

The field work performed by the boys is of a light but useful nature, consisting of: Pruning lime trees, dressing wounds; mixing and applying insecticides and fungicides; sowing green dressing seed; budding limes; applying manures; pollinating vanilla flowers; planting nursery beds; potting cocoa, &c.

Practical demonstrations on tapping *Hevea brasiliensis*, and preparing rubber are also given. During their course of instruction in practical agriculture, the pupils are always under the supervision of an officer of the Department.

The subjects of class instruction are :—

Air and Water.

Soil and Drainage.

Manures.

Pests and Diseases of Plants.

Agricultural Botany.—Pollination and Fertilization, Elementary Physiology, pruning, grafting and budding, and other means of propagating plants.

Economic Botany or the cultivation and preparation of the principal economic products of the tropics with special reference to the West Indies.

The object of the agricultural training given to pupils is to fit them for taking up positions either as overseers or managers on planters' estates.

Many of the boys are the sons of peasant proprietors, and very often after completing the course of instruction at the Botanic Garden they return home and help their parents until old enough to take up planting on their own account.

Many such boys who have taken up planting have done remarkably well. The successful onion-grower referred to in a previous paragraph was at one time an agricultural pupil; to-day he is a prosperous planter, and a walk through his estate would convince the most sceptical of the benefits to be derived from a sound training in agriculture. Unlike many others, this planter believes in having more than one string to his bow, for in addition to Limes, Cocoa, Sugar, Coffee, Grape fruits, and Washington navel oranges; such crops as Maize, Onions, and French beans are also grown.

Other Efforts in connection with Agricultural Progress.—Since the inception of the Agricultural Department its energies have been directed to aiding all sections of the planting community.

With regard to instruction in agricultural matters, a Prize Holding Competition to encourage peasant holders was started in 1908. Cocoa was the principal crop grown.

Keen competition was shown amongst the peasants for the first year or two, but gradually their interest declined and fell off altogether in 1913.

With a depletion of the staff during the war, the Department was not in a position to make further efforts towards helping peasant holders, and now that the Lime Experiment Station has become established and very little time and opportunity is available for this kind of work, it has become a difficult matter to deal with; especially when such schemes involve close watching and frequent visits entailing considerable time upon tedious journeys over difficult country.

Courses of reading and examinations in practical agriculture were established under the direction of the Imperial Department of Agriculture for the purpose of enabling overseers on estates and others engaged in the practice of agriculture to acquire knowledge that would be useful in connection with their practical work. The scheme was successful and did much good until agriculture along with other industries was upset and disorganised by the war.

Now, when the war is over, high wages paid in America and elsewhere have had the effect of drawing away from the island many of the returned soldiers and efficient agricultural workers. Consequently the reading courses are still in abeyance and likely to continue so until those concerned show a desire to take advantage of an opportunity of extending their knowledge and fitting themselves for more remunerative positions.

Agricultural Cadet training.—The training which has been given for some years in Dominica and other West Indian islands received a set back in this island at the beginning of the war when the Science Master left the Grammar School.

This system of training is of a much higher grade than that of the ordinary agricultural instruction given to the sons of peasant holders, requiring, as it does, that those boys who wish to become Cadets must receive their education at the Grammar School.

Latin and Science are two subjects between which boys can make their choice after they have reached an advanced stage. Naturally those boys who intend taking up agricultural work select the science training under the Science Master, and thereby get a thorough grounding in such subjects as Chemistry, Botany, &c.

The science training given at the Grammar school is thus part of the cadet system, for as soon as the boys have completed their work at school they enter the Botanic Garden for a period of 12 months to gain an insight into the practical side of agriculture. By special arrangement a cadet may be allowed a further period of 12 months in the Garden if he so desires.

Laboratory Work.—The purpose for which this section of the Department was established has been well served since the erection of the laboratory in 1910.

The idea in fitting up a local laboratory in the Garden was to enable the Department to deal with the analysing of Lime juice, milk and other food stuffs, soils and manures, &c.

The gradual increase in the number of samples sent in for analysis shows that the Government laboratory in Antigua is gradually being relieved, so far as Dominica is concerned, of such work as might be safely and efficiently dealt with locally, with a saving of time and postal expenses.

The laboratory in Dominica, it should be mentioned, does not interfere in any way with the central laboratory in Antigua—supported by the Imperial Government for research work in the Leeward Islands—in regard to the more important chemical investigations. All important matters are still submitted to the Government Chemist in that island and only such work as is shown above has been undertaken locally.

MORNE BRUCE LANDS.

Leaving the Botanic Garden and proceeding along a zigzag path, well protected from the sun by overhanging bamboos and native timber trees, the top of the Morne Bruce cliff is eventually reached.

Having arrived at the top one receives as a reward for the strenuous climb a refreshing breeze from the direction of the Windward coast—a pleasure which the people of the town of Roseau can only experience on the hill tops, for rarely does the wind blow in from the sea on the Leeward side, where Roseau and the Garden are situated.

At this point, looking up the Roseau Valley, the winding river can be seen making its way down from the rugged country above; whilst looking out towards the sea one views immediately below the full expanse of the Garden.

Between the Garden and the sea the red-topped houses and the steeples of churches peep out here and there from among the trees.

The contrast here is very striking; for down below we have the Garden representing purpose and order of things, and up in the country above, in the opposite direction, a wonderful scene of natural beauty.

Keeping straight along the edge of the cliff on the left hand side is a collection of Eucalypts, which numbered seventy-two species prior to the hurricanes of 1915 and 1916; now, however, after the havoc then wrought the number of species is reduced to about fifty.

The Morne Bruce lime nursery already referred to is situated next to the Eucalyptus plot.

Adjoining this nursery is a piece of ground 2 acres in extent planted in Coconuts, Cocoa, Limes, Camphor, and Rubber,

(*Hevea brasiliensis*). Experimental tapping of the latter is being carried out at the present time.

On the right hand side of the road leading from this point to the Lime Experiment Station stands the Curator's house and Government cottage.

Before reaching the Lime Experiment Station the road passes under an avenue of Date and Coconut palms, and leads into a grass square on each of the four sides of which stands an old military building. These buildings have been used for many purposes since the military vacated them, including those of Reformatory School, Poor house, Isolation Hospital, and latterly as the Agricultural School already described.

Continuing along the road the Lime Experiment Station comes into view on the right. Standing on the road—only a few feet wide—which may be described as the crest of the ridge separating the Roseau valley from the valley in which the limes are growing, one obtains not only a good view of the Experiment Station below but also of the scenery of the rising land beyond.

As a rule the peaks of the tallest mountains are buried in the clouds, but on fine days, especially in the evenings, they stand out well defined against the clear sky.

LIME EXPERIMENT STATION.

The area of the Lime Experiment Station is approximately 25 acres exclusive of the lower part of the valley near the sea, which is also Government ground and will be taken into cultivation gradually and planted with limes. In addition to Limes, Camphor, Coconuts, Grape fruits, Shea Butter trees, and green dressing crops are also grown.

These crops, however, do not take up much more than 9 acres of land; whilst the growing of green dressing crops is essential for mulching purposes in connection with the manurial experiments.

The mulch crops are grown on shallow patches of land near the mulch plots of each of the series of experiments, and they serve two purposes, viz.—supplying mulch to lime trees and demonstrating to planters how shallow patches of land in the vicinity of lime cultivations may be utilised.

The Lime Experiment Station has been in existence for seven years. Started in 1913 it took the place of a rather unsatisfactory system of experiments that had been in vogue on several estates in different parts of the island since 1901.

The need of undertaking experiments in the cultivation and manuring of limes had long been recognised; but no useful attempt was made to meet this need until 1913, when it was found that the many pickings involved, labour troubles, and inadequate supervision on estates stood in the way of accurate records being furnished. It became evident that the problem could only be solved by bringing together the whole of the plots

into one area, and conducting the experiments on sound lines under the direct management of the Agricultural Department. Fortunately the Government possessed land suitable for this purpose in the valley beyond Morne Bruce within easy reach of the Botanic Garden. This land is sloping in character and typical of conditions of large areas where lime cultivation in the island is carried on.

A distinct advantage which enabled experiments to be commenced almost at once was the existence on this piece of land of a considerable number of lime trees that had been planted in the year 1893 by the boys of the Reformatory school at Morne Bruce.

From the time of planting in 1893 the lime trees were properly cared for until the closing of the institution in 1895, when they were abandoned and allowed to become overgrown with bush a condition which lasted until 1913, the year the Agricultural Department took over the land for experimental purposes.

Naturally the trees were found to be poor in condition and attenuated in appearance, but it was seen at the time that with a certain amount of trimming and proper attention given to drainage, they would soon pull round and develop into good healthy bearing trees.

Faulty planting necessitated many of the trees being permanently removed, whilst in some places fresh trees had to be planted to make up the plots with trees planted at suitable and equal distances apart.

All this had to be done before the plots could be lined out and manurial treatment commenced. Meanwhile, a patch of old pasture land near by was being planted with young limes and marked off into eight $\frac{1}{4}$ acre plots; the object being to duplicate with the young cultivation the experiments carried on with the older trees, thus confirming or otherwise the results. Further, it was hoped that the results would show to what extent old lime trees were capable of responding to manurial treatment.

It was intended that the experiments should be conducted in two series :

- Series 1. With old trees (8 plots).
- „ 2. With young trees (8 plots).

The scheme of manuring is outlined below :—

1. Complete manure.
2. Control—no manure.
3. Mulched with grass and leaves.
4. Nitrogen only (Sulphate of Ammonia).
5. Nitrogen only (Dried blood).
6. Phosphate only (Basic Slag).
7. Potash only (Sulphate of Potash).
8. Phosphate and Nitrogen (Dried blood and Basic Slag).

These experiments were continued satisfactorily and a record of yields of the old trees, (series 1), kept until 1916, when the

hurricane of that year completely destroyed several of the plots and left others so badly battered that this series had to be abandoned.

The young trees in Series II. more or less escaped any serious damage, as at this stage of their growth they had not attained to a height of more than 2 or 3 ft.

The damage caused by the hurricane necessitated a reorganization of the plots, and in 1917 the present system of experiments was laid out.

They are conducted in three series of 5 plots each :—

Series I. Original (Young lime trees).

„ II. Duplicate „ „ „

„ III. Triplicate (old trees found on the land).

The following treatment given to the five plots in series I. is repeated in series II. and III. :—

Plot 1. Complete manure (Dried blood, Basic Slag, Sulphate of Potash).

„ 2. Control—no manure.

„ 3. Mulch—Lemon grass and leguminous prunings at the rate of 5 tons per acre.

„ 4. Nitrogen and Phosphate (Dried blood and Basic Slag).

„ 5. Nitrogen and Potash (Dried blood and Sulphate of Potash).

The area of each plot is approximately $\frac{1}{4}$ of an acre. The trees are planted along the middle of a bed; there being 3 beds of eight trees, making a total of 24 trees to a plot. Each plot is divided from the next by a deep drain; and all such drains lead into a main drain, at the end of the plots, running at right angles.

Reliable and useful results from these experiments cannot be expected for some time to come. It would appear, however, that nothing short of a complete fertilizer can be expected to give satisfactory results; and further observations may show that mulch, such as cut grass and bush, will, when applied every second year alternating with a complete fertilizer, become an important consideration in every practical scheme of plantation manuring.

In addition to the main experiments other plots have been kept under observation since 1916, most of the trees having been planted in 1914. The most important of these consist of three plots planted with budded limes.

Plots A. and B. consist of ordinary spiny limes budded on sour orange stock, whilst plot C. is planted with the spineless* type also budded on the sour orange stock.

* This spineless variety was discovered up in the interior by Mr. H. F. Green, of Kew, in 1890–92, when curator of these Gardens.

Compared with the ordinary spiny type its fruits are much smaller, and the bearing qualities of the tree are less prolific.

On the other hand, the rind of the fruit is much thinner than the ordinary lime, and the juice is more plentiful and much clearer, and it contains fewer seeds.

Although these three plots have undergone various treatments, the results of which are given below, the main object in planting budded trees was to ascertain whether, when budded on the sour orange, they could, by reason of the long tap root sent down by this stock, withstand the hurricanes through being more firmly anchored in the ground.

Another interesting matter was that of finding a stock immune from the *Rosellinia* root disease. Further it was hoped that the tendency to early bearing, which is characteristic of budded plants, might prove an advantage over the ordinary seedling which takes at least four or five years to come into bearing. As regards the immunity of the orange stock from attacks of *Rosellinia* disease, and the bearing qualities of the budded lime, (spiny type) no definite conclusions can be drawn at present to show whether or not these trees can be recommended for general planting.

The treatment given to these three plots commenced with the actual planting, when some of the holes were made with dynamite, and the others were made with the spade.

The results of the two methods compared showed that there was nothing to choose between one and the other. These results, being contrary to experience elsewhere with dynamite, led to the belief that the failure must have been due to the moist and compact nature of the soil, and that the use of dynamite on such lands only tends to further compaction.

Good results, it is reasonable to suppose, can only be expected on land where the shattering effect of dynamite will loosen the surrounding soil and make way for the penetration of the young roots, therefore it is not likely that the use of dynamite will meet with much success in Dominica.

The next phase of the experimental work on these plots yielded interesting and useful results: two of the three plots were planted with green dressing crops: one with Horse Beans, (*Canavalia ensiformis*), and the other with *Tephrosia candida*; the third plot being left bare except for the weeds and grass which were kept cut at regular intervals.

The object of this experiment was to show to what degree these crops would help in the development of the young trees by affording a ground covering from the strong rays of the sun, and acting as lateral protection from prevailing winds.

Observations made on lime cultivations by the Department, extending over a good number of years, have shown that the lime tree has a critical period in its lifetime, commencing at the time of planting in the field and continuing up to the third year.

During this period unless proper attention is given, the health of the tree may become impaired to the extent of permanently weakening its constitution, and very often at this stage scale insects and other pests appear.

An annual application of 2 lbs. of organic nitrogen per tree, in addition to green dressing crops, constitutes the treatment

that should be given during this period, and is mentioned here as having some bearing on the results of the experiments under consideration; for these three plots received the complete treatment necessary to bring the plant through this stage, with the exception of plot C. which received the fertilizer only.

The following table will show the results obtained :—

	A.	B.	C.
	Grown with Horse Beans.	Grown with <i>Tephrosia</i> .	Grown without Green Dressing.
	*Calculated yield in barrels per acre.	Calculated yield in barrels per acre.	Calculated yield in barrels per acre.
1917-18	34	33	24
1918-19	72	139	54

* One barrel = $4\frac{1}{2}$ cubic ft. capacity.

It will be seen that the yield obtained from the plot of trees grown without green dressing compares unfavourably with those grown with Horse Beans and *Tephrosia*. Another interesting point worthy of note is the great increase in yield of B. over A. in the second year of bearing.

This may be due to the better protection afforded by *Tephrosia* which grows to a height of several feet, whereas the Horse Beans rarely attain to a height of more than 2 ft. The fact that *Tephrosia* is much slower in its growth from seed than the Horse Beans may account for the yields of A. and B. being about equal in the first year of bearing, when at that stage the *Tephrosia* would be in a more or less weakly condition, and would not give such effective protection as would the more sturdy growing Horse Beans.

When it is remembered that the ordinary seedling tree does not commence to bear until the fourth or fifth year, and even then only a few fruits are to be expected, the above results may be considered as remarkable instances of early bearing and, clearly demonstrate one of the advantages in planting budded trees.

Limes, unlike most other fruits, instead of being picked from the tree, are allowed to ripen and fall to the ground, when they are collected into baskets and conveyed to the mill.

The fruit collected from the plots in the Lime Experiment Station are deposited in heaps in front of the plots from which they have been collected, and after being carefully measured and the yields recorded are carted to the Bath Estate, the property of Messrs. Rose & Co., Ltd., to whom they are sold.

The present yield of limes from the whole of the Experiment Station is approximately 2,000 barrels per annum. As the newly planted land comes into bearing this figure should rise to between 3,000 and 4,000 barrels per annum, and later on with all the trees in full bearing between 6,000 and 7,000 barrels may be expected.

Some time in the near future it may be possible to deal with these limes in the factory which is now in course of construction in the Experiment Station. Such a factory will become an essential part of the experiments in connection with the lime industry, and may be expected to help the planter to solve a few of the difficulties that still remain to be overcome in regard to the manufacture of lime products.

Experimental work in the factory conducted in conjunction with field operations might bring to light a better means of working and improving the present lime industry, and show a more economical and profitable method of dealing with the lime from the time the tree leaves the nursery bed until its products are ready for the market.

VII.—KIKUYU GRASS.

(*Pennisetum clandestinum*, Chiov.)

O. STAPP.

In 1911 Mr. J. Burt-Davy received from Mr. David Forbes of Athole, Amsterdam, Transvaal, a single root of a peculiar grass which he had collected on the shores of Lake Naivasha, Kikuyu, whilst hunting there, the grass having attracted his attention by the partiality which the wild game showed for it. The root was transplanted in one of the plots of the Botanical Station at Groenkloof, Pretoria, and soon established itself.* It has since flowered there regularly every year, but not seeded, the original plant and its descendants being apparently all functionally female.† In "The Farmer's Weekly" of March

* A preliminary note announcing the introduction of the grass was published in the Report on the Department of Agriculture, Union of South Africa for 1910/1911, p. 241. Here also appears the name Kikuyu Grass for the first time.

† A short article by Mr. Burt-Davy in the Agricultural Journal of South Africa, vol. ii., pp. 146-147, describes the experience gained with this grass in the Transvaal by them (1915), and deals with its uses and disadvantages. It also states the circumstances of its introduction, and that with some reserve it had been referred at Kew to *Pennisetum longistylum*.