

*IMPERIAL  
DEPARTMENT OF AGRICULTURE  
FOR THE WEST INDIES.*



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**REPORT**

ON THE

**AGRICULTURAL DEPARTMENT,**

**DOMINICA,**

**1917-18.**

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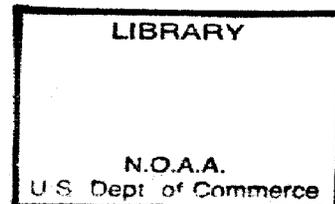
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## LETTER OF TRANSMITTAL.

*Commissioner of Agriculture—to Administrator, Dominica.*

No. D. 661.

Barbados,

Sir,

March 7, 1919.

I have the honour to forward, herewith, the Report on the Agricultural Department, Dominica, for the year ended March 31, 1918.

2. It is satisfactory to note that the Botanic Gardens are recovering from the effects of the hurricanes of the two preceding years, and that they are being enriched by the importation of desirable trees and plants from other tropical countries.

3. The successful experiments in onion growing, especially with regard to the production locally of onion seed, are likely to be of importance to the industry throughout the colony.

4. With regard to Dominica's chief industry, lime fruit and its products, it appears that the lime crop in the year under report is a record one.

5. The Report is interesting, and possibly even remarkable, for the general dissertation by Mr. J. Jones concerning the principles underlying the cultivation of limes: these remarks are in the nature of a treatise, embodying an experience extending over a considerable number of years, strengthened by knowledge gained in recent times through the establishment and working of the Lime Experiment Station, by means of which information of much value has already been obtained.

6. This Station leads one to reflect that much of the valuable information resulting from its work might have been obtained by lime growers on their own account; and that such results have not been recorded, even if they have been obtained, by individual lime growers, points to the necessity for systematic scientific planning and recording of work. Many attempts have been made to obtain results of this nature by co-operative working with lime growers, and the carrying out of experiments on estates: while some results have been obtained in this connexion, they are small in comparison with what has been achieved through the medium of a departmental station.

7. Some persuasion was necessary in order to obtain the means of establishing this station; they were not obtained without difficulty, and stress had to be laid on the point that probably it would be possible to derive actual revenue from the work which was projected. Stress had to be laid on possible immediate commercial gains, in order to obtain provision to enable the scientific officers to carry out work which they believed would result in the production of information which, in the near future, might be of great value to the lime industry, and which in the more distant future may be the means of securing the lime industry to the colony.

8. A valuable report by the Mycologist of the Imperial Department, on diseases of lime trees, is embodied in the report, and also a report of the Entomologist on methods of destroying boring insects attacking the puncheons used for the export of lime juice.

9. Mr. Jones's remarks as to the need of further extension of the Agricultural Department in Dominica deserve careful consideration.

10. The project of establishing co-operative Government factories for the purpose of dealing with limes grown by peasants seems to be a step in the right direction, as shown by results obtained on these lines in other colonies.

11. In spite of a very small staff, the Curator has evidently done much good work, on which he is to be congratulated.

I have etc.,

(Sgd) FRANCIS WATTS,

Commissioner of Agriculture  
for the West Indies.

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**STAFF OF THE AGRICULTURAL DEPARTMENT, DOMINICA.**

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\*Seconded for war work in England since May 1917.

# REPORT ON THE AGRICULTURAL DEPARTMENT, DOMINICA,

For the Year ended March 31, 1918.

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## Work in the Gardens, and Observations on Plants.

The work of this Department was hindered to a considerable extent during the period under review, owing to the absence of the Assistant Curator and Assistant Chemist, who left Dominica by permission and on leave in May 1917, to offer his services in connexion with the war. On his arrival in England the authorities of the Colonial Office would not permit Mr. G. A. Jones to join the Army, but caused his special qualifications in forestry to be utilized by the Timber Supplies Department of the Board of Trade, which is mainly concerned in supplying the Army with timber. At the end of March 1918 the Assistant Curator and Assistant Chemist was still employed in England, where he is likely to remain during the continuance of the war.

As it is impossible under existing conditions to obtain technical help, work in the laboratory had to be closed. Owing to lack of assistance, other departmental lines of work have been continued under difficulties, the existence of which must be held responsible for the brevity of the yearly progress report.

The Gardens, on the whole, are making a good recovery from the effects of the hurricanes of 1915 and 1916. Many large specimens, especially of fine flowering trees, were lost, and some years must elapse before the trees planted to take their place can again attain a good size, and reach the flowering stage.

It was necessary, in a number of cases in the Botanic Gardens, to place a young specimen in exactly the same spot as that previously occupied by another tree, possibly for twenty years or more. Under certain conditions, especially when the former trees possessed dense heads, and excluded all other vegetation from their shade, it is found difficult to get the young specimens to make a start. The cause of this infertility, which in India, with its dry continental climate, is said to be due to the accumulation of soluble salts in injurious amounts, was discussed in an editorial in the *Agricultural News*, No. 405, of November 3, 1917. Typical examples of trees which cause this infertility are the tamarind, bamboos, and palms. In the West Indies, with their wet insular climate, this barrenness is probably due to the exclusion of light and rain, which brings about a cessation or modification of biological activity in the soil.

WORK IN THE GARDENS AND OBSERVATIONS ON PLANTS.

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The weather conditions during the year were generally favourable. The wet season reached its culminating point in September, when torrential rains fell which caused some damage by wash in the Gardens, and also to lime and cacao cultivations on estates in the south of the island.

Specimens of trees forwarded to Kew during the year were few in number. Amongst these were the flowers and leaves of Laurier Isabelle and Laurier Noir, both well-known local woods, which were respectively identified as an *Acrolidium* and a *Nectandra*. The specific names could not be given in the absence of fruits of both trees. These are now required. Assistance in this matter from anyone having the trees under close observation would be appreciated.

Herbarium specimens of the Baba-ou-lé or Cap-la-hou, a tolerable yam which has proved of considerable assistance in eking out the food supply during the present scarcity, were submitted to Kew, and identified as *Dioscorea alata*, Linn. This plant is found throughout the island, being most abundant on steep hill-sides, from which places it attempts to spread to the more level lands occupied by cacao and lime cultivations. It has proved to be a useful plant when growing wild, but becomes a pest once it finds a way to cultivated fields. The climatic conditions of Dominica appear to be very favourable for it. It would be interesting to learn if this yam exists in a wild state in other West Indian islands having a climate similar to that of Dominica.

Tubers of a wild plant, known locally as 'Yam Poule', were forwarded to Kew, and identified as a *Dioscorea*, but there is some doubt at present in regard to the specific name. This plant is common in the forest. The Agouti (*Dasyprocta agouti*), a large rodent, is said to feed upon it. The tuber is hard after being boiled, and somewhat bitter, the latter probably being due to the upper part of the tubers growing above the ground. During recent times it is reported that very poor people have used this yam as food.

There being some doubt in the West Indian islands as to the correct botanical definition of the food-plant so largely grown under the local name of 'Tania', botanical specimens were submitted to Kew, and identified as *Xanthosoma sagittifolium*, Schott.

As there is considerable confusion in regard to the dasheens, eddoes, and taniae in these islands, it may be stated that in the case of the two first named, which belong to the genus *Colocasia*, the stalk joins the leaf-blade near the middle, and is designated a peltate or shield-shaped leaf. In the case of the tania, the stalk joins the blade at the lower margin, and this form of leaf is described as sagittate or arrow shaped.

Specimens of the Calalu plant, which is largely used in Dominica, were forwarded to the same authority, and found to be *Xanthosoma hastifolium*, C. Koch. In other parts of the West Indies the name Calalu is also applied to plants belonging to other genera.

A plant of *Amherstia nobilis*, received from the Botanic Gardens, Trinidad, in 1913, flowered in the Gardens for the first time. This is considered by many to be the finest of tropical flowering plants.

A very striking looking grass, which is found along the banks of the Roseau and Canefield Rivers, proved on examination to be *Arundo Donax*, which is so largely grown in gardens in European countries as an ornamental plant. It is usually found in association with the Roseau grass (*Gynerium saccharoides*).

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## DISTRIBUTION AND IMPORTATION OF PLANTS.

## Work in the Nurseries and Distribution of Plants.

There was a further falling off in the number of plants required for orchard work, a state of things which is to be expected under prevailing conditions.

It is hoped that, with the advent of better times, capital will again be found to continue the development of orchard cultivations in the island.

The number of plants sent out during the year was as follows :—

Limes	...	...	...	37,708
Budded Washington Navel oranges	...	...	...	117
„ grape fruit	...	...	...	24
„ limes	...	...	...	227
„ tangerines	...	...	...	14
Grafted mangoes	...	...	...	39
Cacao	...	...	...	1,050
Coffee	—	...	...	50
Vanilla	...	...	...	1,700
Eucalyptus	...	...	...	310
Shade trees	...	...	...	3,450
Nutmegs	...	...	...	36
Male bamboo	...	...	...	152
Miscellaneous	...	...	...	641
			Total	45,518

The following supplies of miscellaneous seeds, cuttings, and plants were also distributed :—

Vegetable seeds	...	...	...	2,514 packets
Onion seeds	...	...	...	24 lb.
Onion seedlings	...	...	...	5,000
Bengal beans	...	...	...	36 lb.
Horse beans	...	...	...	500 „
Tephrosia candida	...	...	...	25 „
Cane cuttings	...	...	...	32,000
Dasheen plants	...	...	...	11,000
Tania	„	...	...	500

### PLANT IMPORTATIONS.

Seeds of the Rambutan (*Nephelium lappaceum*), and the Longan (*Nephelium longana*) were received from Ceylon by way of Kew, but these seeds were found to be dead on arrival. Seeds of the first named were also received from the Botanic Gardens, Java, and in this case three seeds had commenced to germinate. These are being carefully tended.

The plants of *Feijoa Sellowiana*, called the Pine-apple Guava, imported during 1912, made steady growth, and are now bushes from 7 to 8 feet in height. Up to the present they have failed to produce flowers. It is evident that the climate is not altogether suitable for this species.

Two plants of Quebracho (*Quebrachia Lorentzii*), native to Argentina, mentioned in the last annual report as having been raised from seeds supplied by the Director of the Royal Botanic Gardens, Kew, were planted out, and these have made fair progress.

A Mexican fruit tree, *Cusiniroa edulis*, introduced six years ago, makes but poor growth in the Gardens. Specimens do much better in the stiff soils at Morne Bruce. None of the trees has flowered to the present. This species may ultimately prove of value for cultivation at considerable elevations.

A tree of the Tonka bean (*Dipteryx odorata*) is now established in one of the ravines, and fruits regularly. A few plants of this species have been raised, and distributed to planters. In course of time this tree, which thrives in sheltered situations, should become fairly common in the island.

## PLOT EXPERIMENTS.

The Gutta-percha tree (*Dichopsis Gutta*), which was received from Kew in 1913, remains in a dwarfed, unsatisfactory condition despite every effort to establish it.

In the Annual Report for 1911-12 mention is made of the receipt of seeds of two Mexican varieties of Avocado pear, one being of the thin-skinned purple type, and the other a thick and tough-skinned kind. Plants were raised, and these were increased in number by budding. The specimens in the Gardens are now of a good size, but neither of the varieties has fruited.

The Annual Report for 1910-11 contained a note on the three varieties of Indian mangoes obtained from Bombay, and presented to the Gardens by the Hon. Dr. Nicholls, C.M.G. One of these, the Alphonse variety, was destroyed in the hurricane of 1916. A few plants of this kind having been propagated by grafting by approach, it is possible to replace this variety in the Garden collection. The other two kinds, Daramia and Pairi, are now good sized healthy trees, but neither has fruited.

The four varieties of Indian mangoes introduced by the Department from the Botanic Gardens, Calcutta, have grown well, but no fruit has been produced to the present. Their names are Alphonse, Langra, Kheershapottee, and Bhadoorea. It may be mentioned that the variety Alphonse received from Calcutta, differs considerably in appearance from the one received from Bombay under the same name.

The varieties of mango named Haden and Mulgotha, presented by the United States Department of Agriculture, are also doing well.

## Plot Experiments at the Botanic and Experiment Stations.

### GREEN DRESSING TRIALS.

During recent years over thirty species of green dressings have been grown with a view to finding which are best suited as nurse plants in young lime cultivations. There are many kinds of green dressings, and all possess a value under certain circumstances, but the ideal nurse plant and soil enricher for young limes should be a biennial, with a bush-like habit, which would give a good cover, grow to a height of 4 or 5 feet, with a life of eighteen months or two years, or even longer. To possess seeds of a fair size, with good germinating power, which could be easily collected, is another desirable quality.

At present this ideal plant has not been found. The most useful grown in the Experiment Station have been the Tephrosias, particularly *T. candida*, which has afforded a good cover for a period of two years. The several species of Indigofera have also considerable possibilities in this direction. In both cases mentioned above, the seeds are small, and difficult to collect and clean. The Tephrosias are also very uncertain as regards germination. The Pigeon pea (*Cajanus indicus*) has its uses in this direction, but it is not sufficiently dense-headed to prevent the grass from growing below, though it weakens the latter considerably.

For covering the ground, several species of Mucuna and other peas and beans have been found suitable, but the tendency of this class of plant to climb and cover the young lime trees is a drawback in Dominica. Besides, lime plants require more than a ground cover. They need shelter, and this is afforded by the Tephrosias and Indigoferas, which attain a height of from 5 to 6 feet or more. The combination of ground cover and shelter is a great help to the limes at a critical period of their existence, that is, when between the age of two and five years.

For a ground cover, the Horse bean (*Canavalia ensiformis*) has proved very useful. It has been found to do best when sown with the rains in May. It then grows vigorously through the wet season, giving a fairly good cover until November. If sown at later periods of the year, it commences to flower and fruit early, which causes the foliage to remain thin and unsatisfactory. It can be grown at any season for the production of seeds. As a cover plant, the best results are obtained by sowing with the rains. The same remarks apply in the case of Tephrosias. The best results, both of germination and growth, are obtained by spring sowings.

It is generally held that the growing of green dressings amongst young limes on estates is too costly. To prepare the surface of the soil for the seeds does cost considerably more than an ordinary weeding, but if a good growth of Tephrosia follows, the planter is relieved of weeding for a period of eighteen months, during which time the soil is protected and enriched, and the plants nursed and kept in a healthy and growing condition.

Lime plants at the Experiment Station, with Tephrosia as a nurse plant, are, at four years from planting, from 12 to 14 feet in height, and are bearing heavily. Other plants of the same age, grown without green dressings, are only half the size, and not likely to fruit for some time.

It is clear that great advantages follow the use of leguminous plants with a bush-like habit in young lime cultivations.

Trials with new green dressings during the year were few. Seeds of the Sunn hemp (*Crotalaria juncea*) were received from St. Kitts. This plant grows and seeds well, but it is too short-lived to possess any considerable value in orchard cultivations. Towards the end of the year, seeds of *Crotalaria usamaroensis* and *Centrosema Plumieri*, were received from Java, and are now under trial.

Several sowings of *Hyoscyamus muticus*, a source of hyoscyamine, were made, but all resulted in failure. If the seed germinated at all, it must have damped off immediately.

Seeds of Egyptian clover (*Trifolium Alexandrinum*) were received from the Commissioner of Agriculture for trial. These also failed to germinate.

## Notes on Economic Plants.

### PLANTS USED AS SPINACH.

In the notes on local food-plants published in the last annual report, mention was made of several kinds used as greens or spinach. Herbarium specimens of a number of other plants also used for this purpose were collected, and forwarded to Kew for identification, and it is now possible to place on record a more complete list of native and naturalized species used locally for this purpose.

**DASHEEN** (*Colocasia antiquorum*, var. *esculentum*). The young leaves and leaf-stalks are used. The outer covering of the latter is removed before cooking, on account of its acrid character. The blanched shoots of this plant, obtained by growing the corms in the dark, are considered a delicacy in the United States, in the warmer parts of which the dasheen is now a largely grown and popular vegetable. The blanching of the shoots has also been tried in Dominica, and the result is very favourably reported upon as a vegetable.

**TANIA** (*Xanthosoma sagittifolium*, Schott). Employed in the same way as the above. The blanched shoots can also be grown and used in the same way as the dasheen. They are equally good.

**CALALU** (*Xanthosoma hastifolium*). The young leaves are used as an ingredient of the famous Calalu soup.

**INDIAN SPINACH** (*Basella alba*). This is an excellent green, and it is surprising that it is not more widely grown. The tender growing points, both leaves and stem, are used. It grows rapidly during the wet season. The plant may be grown as a climber, but probably yields better by being allowed to spread over the surface of the ground. It does best when grown under a light shade.

**EPINARD** (*Amarantus viridis*, *Amarantus tristis*, and *Amarantus spinosus*), all of which are common weeds, are the species utilized in Dominica.

**HERBE AMERE** (*Solanum nodiflorum*). The tops of this weed are largely employed. This plant is widespread, and particularly so on the sites of abandoned 'boucans'. It is regularly sold in the market.

## ONION GROWING.

HERBE COURESE (*Peperomia pellucida*), a common plant in damp shady places, Oreille Mulâtre (*Phytolacca rivinoides*), usually found in forest clearings, and the Pourpier (*Portulaca oleracea*), a weed widespread in dry and exposed places, are all used as greens to some extent, chiefly by old people.

## LEGUMES

During the year a collection of the legumes used by the peasantry was grown at the Gardens. The popular kinds are the black-eye pea, the bonavist, pois savon, pois chicque, red beans, and pigeon pea. Other kinds are grown in a lesser degree. In these—from the early maturing black-eye pea, which in the dry months ripens its seeds in eight weeks, to the pigeon pea which takes from seven to eight months to yield—the peasants of Dominica possess a wealth of legumes for selection and cultivation, which, with ordinary forethought, should make any shortage of these valuable foods an impossibility at any season of the year. Nevertheless, the cultivation of peas and beans is largely haphazard, and in consequence the yield is insufficient for the needs of the community.

It is stated, by those who know the labouring class well, that the growing and consumption of legumes was practised on a greater scale before the dasheen (a vegetable introduced about thirty years ago and largely grown and consumed during the past fifteen or twenty years) became the mainstay of the working people. If this is so, and it appears to be highly probable, it is to be regretted, both from a health point of view and also in regard to food supplies under present conditions, that these easily grown legumes are not produced and consumed on a larger scale. In the case of a people whose fish and meat ration is always low, and sometimes lacking for considerable periods, the reduced consumption of peas and beans in a diet largely consisting of starchy vegetables, may in time lead to serious consequences, unless indeed, as some think, the vitamins of fresh vegetables are able to supply the place of the proteids now thought necessary.

## ONION GROWING.

As far back as 1900, experiments in growing onions were conducted at the Agricultural School, both with Tenerife seeds and also with sets imported from Bermuda.

These trials continued until 1905, good results being shown both in the field, and in the shipments of the produce to New York.

The experiments failed to attract the attention of planters or small growers, and nothing further was attempted in this direction, until about three years ago, when Mr. E. J. Seignoret, on acquiring the Spring Hill estate, undertook onion cultivation. During three seasons this planter has been uniformly successful in raising onions, and each year sees an extension of the area under this cultivation, the success of which is now attracting the attention of others. The crop of onions raised at Spring Hill during the 1917-18 season weighed 15,000 lb.

While it is desirable that the cultivation of onions should be taken up on a considerable scale in Dominica, both for the local demand and for export, it is advised that beginners should experiment with small areas, say  $\frac{1}{4}$  or  $\frac{1}{2}$ -acre lots, in order to gain experience before undertaking the planting of larger plots. Small cultivations, such as onions, are exacting in their requirements, and unless the necessary attention is given at the right time, failure will result. The average Dominican, owing to his long connexion with lime growing, in which there is no cultural operation that cannot be put off until next week or next month, if desired, has become singularly unfitted for carrying on the work of small cultivations, the success of which entirely depends upon close personal attention, from the time of the preparation of the land for the seed until the marketing of the crop.

Judging by the early experiments, and also by the recent cultivation carried on by Mr. Seignoret, who has had the advantage of an agricultural training, it is now known that certain parts of the leeward coast of Dominica are well suited for

## LIME INDUSTRY.

onion cultivation. During the past season when, owing to war conditions, the seeds which are imported by the Agricultural Department did not arrive from Teneriffe until early in November, or two months late, the onions did remarkably well, while in the Northern Islands, owing to the late arrival of the seed, the crop partly failed.

The work which has been carried on shows that good onions can be produced in Dominica from Teneriffe seed under certain conditions. These have been found, on the whole, to store well, when it is necessary to await improvement in market conditions. Further, a proportion of these onions after being stored for several months, have, on being planted, produced seed—a rare event in the West Indies.

This matter of the production of fertile onion seed is very important, and one which needs further careful experiment.

The production of sets from Autumn sowings of seeds is also receiving attention with a view of there being stored for a time, and then planted with the rains during successive months. If such a course is found practicable—it has already given a measure of success—onions could be produced at several seasons of the year in certain localities in Dominica, if the work is conducted by clear minds and skilful hands.

Regarding manurial experiments, the Spring Hill experiments have shown that land receiving pen manure produced watery onions, the keeping qualities of which were indifferent. Land which received a dressing of wood-ashes produced good solid onions possessed of excellent keeping qualities.

## Progress in the Chief Industries.

### LIME INDUSTRY.

#### GENERAL CONDITIONS.

The crop for 1917, calculated in barrels of a capacity of 4.55 cubic feet, amounted to 396,092 barrels. This is a record output, being 5,000 barrels in excess of the crop of 1913, and 6,000 over that of 1915, the two previous best years. Compared with the year 1916, the increase amounts to 12,000 barrels.

The lime crop for the past five years, calculated in barrels of fruit, is recorded below:—

1913	...	...	...	...	291,000
1914	...	...	...	...	388,000
1915	...	...	...	...	390,000
1916	...	...	...	...	384,000
1917	...	...	...	...	396,000

The following table, calculated on the usual basis,\* shows the disposal of the crop under the various heads:—

Products.	Barrels of fruit.	Approximate percentage of total crop.
Concentrated juice	224,662	56.7
Raw juice	103,751	26.1
Fresh limes	41,243	10.4
Citrate of lime	26,068	6.6

Comparison with the figures of last year's disposal of crop shows that the proportion shipped as concentrated juice fell from 59.5 to 56.7 per cent., while the proportion of raw juice rose from 20 to 26.1 per cent. The export of fresh limes

\*Note.— Fifty gallons of concentrated juice represent 75 barrels of lime fruits: 7½ gallons of raw juice represent 1 barrel of lime fruits: 1 ton of citrate of lime is equivalent to 266 barrels of lime fruits.

## LIME INDUSTRY.

shows a slight improvement. Citrate of lime fell from 10 to 6.6 per cent. There was a further shrinkage in the business of pickled limes and lime juice cordial, only 368 barrels of fruit being needed to meet the requirements of both heads.

The weather conditions during the year were normal. Shipping facilities also continued good, opportunities for direct shipment to a home port being fairly frequent during the crop season, while communication with New York and Canada remained on the same footing as during pre-war days. Up to the close of the period under review the shortage of shipping had not been seriously felt in connexion with the transport of the crops of the island.

It will be observed that the lime crop has been practically stationary during the past five years. This unfortunate lack of progress is largely due to the effects of the hurricanes of 1915 and 1916, to the difficulty of obtaining supplies of concentrated manures, and the increasing cost of labour. In this connexion, the absence of a considerable number of estate proprietors of military age, who so patriotically offered their services to the Mother Country after the outbreak of war, must also be taken into account.

Opinions vary in regard to the present situation. Some consider it to be satisfactory in view of the formidable difficulties under which the industry has laboured during recent times. Others with perhaps a closer insight of the agricultural position, take a different view, and assert that the lack of sound methods which so often results in young, and what should be healthy trees falling into a state of fourth-rate cultivation owing to lack of effort, the present disposition of capitalists not to venture any more money in the industry, and the fact that some of the older estates are failing, are evidences that the stage of highest output has been reached, or nearly so, and that a decline may soon set in, unless new capital is attracted, and fresh areas quickly brought under cultivation.

There is no doubt that lime cultivation has suffered a succession of heavy blows during late years. Compared also with former times, the planting of new areas on estates has languished during the past two years. Peasant proprietors, who at one time planted extensively, have ceased their activities in this direction. It is somewhat doubtful if the losses sustained during the hurricanes have been more than barely made good by recent plantings. The serious times in which we are living appear to have arrested efforts, and to have almost brought about cessation of planting activity in the island.

The area under limes in Dominica, estimated at 6,000 acres, is sufficient to produce an annual crop of 600,000 barrels of fruit, calculated on the low return of 100 barrels per acre. Unless there is a general improvement in handling the situation, it is doubtful if that output will ever be reached from the area named. It is unfortunate that while young areas come into bearing each year, much of the older cultivation is allowed to fall into a poor condition. The greater returns, which all connected with the industry desire, can only be obtained by greater efforts on the part of the growers.

Some of the old plantations are now in a bad way, partly owing to age, but aggravated by several causes within the control of the planter. The attempt to renovate them by planting seedlings beneath the old diseased trees may not prove successful, as the young trees under such conditions are themselves apt to become diseased at an early age. It would be better to move to new lands, but when circumstances make it necessary to attempt to renovate old estates, heroic measures will probably have to be adopted to ensure success, such as taking blocks of from 10 to 15 acres in extent in hand, removing all the diseased trees, initiating a thorough system of drainage, and then planting the land in canes or other nurse plants for a year or more before the lime seedlings are placed out.

The importation of concentrated manures, which had been growing steadily for some years, has now practically ceased, owing to high prices and heavy freight charges. While it is an essential feature of successful management to manure lime fields annually, it has been pointed out in previous reports that if the money, which until recently was sent abroad for manures, could be utilized locally in making pen manure, applying mulches, and in growing green dressings, better and more lasting results would accrue to planters. Now that manures are practically unobtainable abroad, it is hoped that these local lines of treatment will be mor-

## LIME INDUSTRY.

generally adopted on plantations. The latter course means more work for planters; but its reward is a real improvement of soil conditions, and higher profits for the plantation.

In this connexion it should be borne in mind that a good system of manuring will always yield better results on thoroughly drained lands than on undrained areas. Good drainage is essential on all plantations, even in the driest districts. This fact is not yet sufficiently realized by planters; if it were so, there would be more evidence than exists at present of its application.

And in this important matter of manuring, the question of protection from the wind should not be overlooked. To obtain maximum results from the application of manures in orchard cultivation the land must be properly drained, and the trees adequately sheltered.

## LIME JUICES.

Concentrated juice.—The shipments during the past five years were as follows :—

1913	...	...	...	158,974	gallons
1914	...	...	...	148,179	"
1915	...	...	...	153,292	"
1916	...	...	...	152,603	"
1917	...	...	...	149,775	"

There is little to report under this head beyond the fact that the production of clean juice of a moderate concentration is steadily increasing in quantity. It is to be hoped that soon nothing but juice of a high quality will be made, even on the smallest estates. Only a little extra effort is required on the part of a few planters to complete the wished for improvement.

## RAW JUICE.

The export of this product constitutes a record, being over 1,000 gallons in excess of the shipments during 1915. The great demand is due to the requirements of soldiers and sailors on active service. The shipments since 1913 have been as follows :—

1913	...	...	...	336,728	gallons
1914	...	...	...	379,875	"
1915	...	...	...	777,064	"
1916	...	...	...	574,109	"
1917	...	...	...	778,133	"

## CITRATE OF LIME.

There was a further falling off in the production of this article, only one factory being engaged in turning out this product during the year. The following table gives the quantities exported during the past five years :—

1913	...	...	...	4,753	cwt.
1914	...	...	...	5,191	"
1915	...	...	...	1,102	"
1916	...	...	...	2,956	"
1917	...	...	...	1,960	"

## GREEN OR FRESH LIMES.

After the noticeable falling off in the shipments of limes during 1915 and 1916, it is pleasing to note some recovery during 1917, though the record export of this fruit during 1914 has not again been reached. The shipments since 1913 have been as follows :—

1913	...	...	...	43,832	barrels
1914	...	...	...	45,283	"
1915	...	...	...	41,494	"
1916	...	...	...	38,916	"
1917	...	...	...	41,243	"

## LIME INDUSTRY.

In the last annual report reference was made to the demand on the part of certain exporters for Government action, in order to prevent the shipment of inferior fruit. The subject was discussed by the Chamber of Commerce, and the Government offered to co-operate by enacting legislation to effect the object aimed at. The question was also critically reviewed in an editorial in the *Agricultural News* of July 28, 1917. The matter was then dropped.

The discussion had the effect of clearing away some misunderstandings. It is a mistake to suppose that the shipments of citrus fruits from British and American islands in the West Indies are in any way controlled or regulated by Government action. All efforts at improvement are the result of voluntary co-operative associations of those concerned, and it is on such lines that efforts should be made in Dominica to secure the continuance and expansion of the green lime industry.

## LIME OILS.

There was a falling off in the export of essential oil of limes, and an increase under the head of otto of limes. The latter was sold at a high figure throughout the year, but the amount produced cannot in any circumstances be very great. The export of these oils during a five-year period is as follows:—

Otto of limes.		Essential oil of limes.	
1913 ...	1,505 gallons	1913 ...	5,370 gallons
1914 ...	1,619 "	1914 ...	3,984 "
1915 ...	978 "	1915 ...	4,108 "
1916 ...	680 "	1916 ...	5,504 "
1917 ...	1,143 "	1917 ...	5,159 "

The production of lime oils forms a very important part of the trade of the island, their value during the year under review totalling £26,131. If the value of orange oil and bay oil is added, the total of the oil trade for 1917 amounted to the considerable sum of £28,406.

The exports of lime products during 1917 are as follows:—

Product.	Quantity.	Value,
		£.
Concentrated lime juice	149,775 gallons	58,366
Raw lime juice ...	778,133 "	65,546
Raw juice cordial...	469 "	103
Green limes ...	41,243 barrels	47,734
Pickled limes ...	350 "	350
Citrate of lime ...	1,960 cwt.	6,669
Essential oil of limes	5,159 gallons	17,900
Otto of limes ...	1,143 "	8,231
		<u>204,899</u>

The increase in values over the crop of 1916 amounted to £32,547.

## CACAO.

## CACAO

The decline in the export of cacao continued, as will be seen by the following table:—

1913	...	...	...	9,560	cwt.
1914	..	..	..	8,874	..
1915	...	...	...	10,810	..
1916	...	...	...	5,707	..
1917	...	...	...	3,169	..

Possibly the full effect of the hurricanes on cacao cultivation may have now been experienced, and from now on some recovery may be expected. But it is evident that the cacao trees lost will not be replaced, and therefore any return to the former output of 600 tons a year is not to be expected. Little attention is now given to this cultivation, and no new plantings of any extent are being made. Ultimately, cacao growing in Dominica is likely to fall to the level of a minor industry.

The figures showing the export of cacao during 1917 must not, however, be taken as a correct indication of the crop during that period. Circumstances arose which created a demand for this product in a neighbouring foreign island at highly remunerative rates, and the view is held that, in an endeavour to meet this demand, considerable quantities of cacao were despatched from Dominica without any attention being paid by shippers to the formalities and requirements of the Customs Department.

## MINOR PRODUCTS.

The quantities and values of minor products exported during 1917 are given below:—

Produce.	Quantities.	Values.
		£.
Oranges	533 barre's	407
Orange oil	321 gallons	1,035
Bay leaves	784 cwt.	732
Bay oil	120 gallons	508
Coffee	10 cwt.	41
Coco-nuts	133,234 ..	416
Hardwood	51,204 feet	397

## Work Connected with Insect and Fungus Pests and their Control.

The Mycologist of the Imperial Department of Agriculture arrived in Dominica from Barbados on June 28, for the purpose of investigating the prevalence of bracket fungi on lime trees. His visit extended over ten days. His report, which dealt with (1) bracket fungi on lime trees, and (2) the critical period in the development of young lime trees, was published in the *Official Gazette* shortly after it was presented. It is now reproduced for general information:—

### I. BRACKET FUNGI OF LIME TREES.

The fungi found occupying the stems and branches of the trees are to be regarded, according to my observations, as obtaining a foothold in the first place only on dead branches, and then functioning largely as saprophytes, and at most, in a certain type of cases, as weak parasites principally affecting the wood. The bark of dead or dying branches is usually found to be infected with smaller fungi, of which *Nectria* and *Stilbum* spp. are the most noticeable.

## INSECT AND FUNGUS PESTS.

'The damage done, however, arises almost entirely from the destruction of the woody framework of the tree, and not from any direct attack on the active tissues of the bark and young wood. The destruction is probably largely due to the mycelium of the bracket fungi in question.

'They are able to establish themselves on any dead stub left from the failure of a branch or from careless pruning, no matter how healthy the tree may be. But the subsequent progress of the infestation depends on the condition of the adjoining parts. In vigorous trees the decay is arrested when the living branch is reached. Even the wood shows considerable powers of resistance. It rots slowly where it is exposed, and unless the wound is trimmed so as to permit the bark to grow over it, there is produced in time an unsightly cavity, but the process is no more than goes on in any tree not carefully trimmed, and unless the wound is a particularly large one, it does not produce serious results for a long time.

'The less vigorous the tree, the less resistant is its wood to decay, and the extreme cases of fungus infestation are to be seen in fields where, after the trees have attained to a good development from the original humus content of the soil, or from the practice of a good system of manuring, the fertility of the soil has then been allowed to run out, and the trees are no longer sufficiently nourished. The policy of substituting sulphate of ammonia without any backing of humus-building material, for pen manure, mulch, and other organic manures, is clearly seen in some cases to have produced this effect. In other cases it has come about from complete neglect of manuring, combined with careless treatment of the soil in the way of ignoring drainage and, in some instances, packing it by the constant pasturing of cattle. As starvation takes effect, one or more sections of the trees begin to die back, branch by branch, and not only the dead, but the failing branches, become infested with fungi. The removal of the dead branches does little to arrest the process; the wood of the next larger branch or stem is usually already infected, and offers little resistance to the progress of decay. In the course of time the base of the tree is reached by way of the stem or stems involved, and permanent restoration is no longer possible. Growth is usually continued by suckers put out around the base, which may attain to a considerable size, and give the tree a renewed lease of life. In time, the rotting of the central part of the crown, due to the downward extension of decay from the original stem destroys the connexion between the suckers, depriving them of mechanical support, and leaving them with exposed wood on their inner sides in the neighbourhood of soil level. They are rarely able to establish themselves as permanent stems, and sooner or later, from the weight of the crop or the force of the wind, they fall outward or are broken off. The process of failure thus outlined is a gradual one, commonly extending over some years, and seems in consequence to be usually regarded with indifference until the end result appears. There is, even in the worst cases of this type seen in Dominica, no question of any quick destruction of trees, such as is produced by an active parasite like *Rosellinia*.

'It has been further noted, in cases where lime trees have been grown on poorish land and without manure, and have in consequence grown slowly from the beginning, that although they may develop dead branches in the course of time, their wood does not appear to be nearly so susceptible of decay as is the case with trees which have grown more quickly. The lime will often live and remain healthy for a long time under hard conditions, but seems to be particularly liable to suffer as a result of irregularities in the conditions. This should be kept in mind in constructing a policy for the distribution of the manure available for an estate.

'The remedial and preventive measures which should be adopted are clearly indicated. In fields where die-back is in evidence, or where small and scanty foliage shows that the trees are lacking in vigour, the first essential is to restore the fertility of the soil. If it has become consolidated, or is covered with a firm sod, it should be lightly forked; as much organic material as can be obtained in the shape of pen manure, mulch, cotton-seed meal, lime seeds, and sheep manure should be applied; the weed growth, if rank, may be cutlassed, and used as mulch towards the end of the wet season. Leguminous cover crops may be grown, if there is light enough for their development.

'At the same time the work of clearing the trees of dead and sickly branches should begin. Men who have received elementary instruction in this work should

## LIME INDUSTRY—THE DEVELOPMENT OF YOUNG TREES.

be kept to it as much as possible, and it will be necessary that a responsible person who understands the line of action should direct it. It is proposed to issue shortly from this Office a pamphlet setting out the main principles of tree surgery, such as are here involved. In outline they are as follows :—

‘(a) To cut back to a living branch or stem which seems likely to survive and to have vigour enough to cover the wound. The most frequent mistake made lies in not cutting back far enough; the upper dead portion of a branch is removed, a sickly lower section being left because it still has green leaves or carries a few limes. This in turn dies back, and the process is repeated. If at the first essay the cut is made behind the falling section, there is a prospect of stopping the die-back in one operation.

‘(b) To trim the wound so that it is as far as possible flush with the surface of the branch or stem remaining. Plain saw cuts rarely accomplish this, and they should be trimmed with a hatchet, a chisel or a cutlass into conformity. This usually means a bigger wound, but it is better to expose more surface which will easily cover, than to leave a projecting lip which is out of the circulation of the sap, and will probably decay.

‘(c) To protect the exposed wood from ants, wood-ants, and fungi, until the bark has time to cover it. Asphalt paint, resin-petroleum, resin wash, carbolineum, or ordinary white lead paint may be used for this purpose. The last mentioned is perhaps the least satisfactory. Coal tar should not be used on citrus trees; some constituent of it appears to penetrate the bark, and check the growth of the cambium. Cavities which cannot be cut out should be cleaned, dressed with carbolineum, and filled with cement to make a level surface for the bark to cover.

‘As already indicated, when decay has invaded the base of the tree, a permanent repair is no longer possible. The life of the remaining parts may, however, be much prolonged in many cases, if it is considered worth while, by cleaning and smoothing off the wood which remains sound, and coating it with a preservative. As the soil moisture hastens decay in this region, it is usually advisable to draw away the earth from the crown, and keep its neighbourhood clear of sheltering weeds.

## II. THE CRITICAL PERIOD IN THE DEVELOPMENT OF YOUNG LIME TREES.

‘In company with the Curator I inspected the lime experiment plots in the valley behind Morne Bruce. The plots at the head of the valley are at present in a very interesting stage. Their history is given in the recently issued *Dominica Report, 1916-17*, pp. 48-9. The trees were planted in July 1913 on land which had been used for provision gardens for many years, and had then been for some time abandoned. They are spaced 20 x 20 feet. For the first two years the trees made excellent growth, without manure. The plots were weeded when necessary, and the trees were sprayed regularly to keep down scale insects. At the beginning of 1915 spraying was discontinued, in order to see how far the means of natural control would be effective. During the year scale insects of several species became very abundant on the trees, and their development was seriously checked. Many of the trees died back to near the base, and some were killed outright. The Curator in reporting the existence of this condition, described it as familiar in his experience of the course of establishment of lime fields in the coastal districts of Dominica. The remedial treatment given to the plots, towards the end of 1915, consisted in a thorough draining, forking, and the application of a small quantity of lime, and then of organic manure at the rate of 2lb. per tree. Spraying was not resumed. I inspected the plots in March 1916, before this treatment had taken effect, and made their condition the subject of a memorandum then submitted. The condition of the plots at the present time is astonishingly good. There are traces remaining here and there of the scale infestation and its effects, but, on the whole, the trees are in vigorous health, and have grown so rapidly that they are now well ahead of what one expects to see in 4-year limes which have had no check at all.

‘The result attained can only be attributed to the draining, cultivation, and manuring carried out towards the end of 1915. The shelter-belts then planted are not sufficiently developed to have contributed to the result, and the rainfall was abundant during the periods both of failure and of recovery.

‘In the memorandum referred to above it was pointed out that the reason commonly given for the relative freedom of citrus trees in Dominica from scale-insect infestation, namely, that it is due to the control exercised by fungi parasitic on the insects, does not adequately account for the observed facts.

‘During the period of severe infestation of the plots just described, the trees on the manurial plots closely adjacent remained comparatively free from scale, and suffered no injury, even in the case of the no-manure plot, which received cultural attention only. In the period of the recovery of the infested plots there is no reason to believe that the conditions were any more favourable to fungus control than during their decline. Even in a forest district with a high rainfall, where the fungi are particularly favoured, the same difficulty has been experienced in establishing limes on ground from which the original fertility had been removed by exposure and the cultivation of provisions. It seems clear in these cases that the determining factor is nutrition: that ill-nourished trees, especially during the period of their vegetative development, are in a condition which favours infestation with scale insects, while on well-nourished trees, the insects when they are present remain few in number and do no appreciable harm. The term natural resistance may conveniently be used in this connexion, though whether the character on which it depends is a positive or a negative one I do not know. The effect may be seen illustrated over a wide range of plants in their relation to scale insects, and has been described in connexion with cacao trees and thrips by successive entomologists of this Department.

‘It is well known, and forms the basis of an accepted practice, that young limes can be nursed up to bearing age, without suffering such a check as has been described by enclosing them in a shelter crop. Sugar-cane and various other plants, including the weeds and bush natural to the situation, have been used for this purpose. The effects of such treatment are exemplified in the experiments under notice by the plots grown in *Tephrosia candida*. To quote from the Curator's report: “The difference in growth of the plot in *Tephrosia* when compared with the grass plot is most remarkable. The trees in the former plot are now 8 to 10 feet high, and are comparatively free from scale insects. The trees of the plot in grass are very liable to attacks by scale insects, which require repeated spraying to keep them down. Their average height is from 4 to 5 feet.”

‘If the effect of shelter were attained simply by the encouragement of the fungus enemies of scale insects, we should not expect to see any considerable difference in the growth made in the sheltered and the open plots, since scale has been kept down in the latter by spraying. It is clear from this experiment, the results of which coincide with general experience, that close shelter greatly accelerates growth. My opinion is that the increased vigour of the trees so attained is in itself a sufficient protection against scale-insect infestation.

‘The Dominica experiments have confirmed and clarified certain conclusions, hitherto based on scattered and somewhat indefinite observations, concerning the growth of young lime trees. The matter may now be stated, with considerable certainty, as follows:—

‘A. Young lime trees, from the time they are set out to the time of bearing, or as it would perhaps be preferable to state it, to the time when they are closing in and affording each other shelter, are liable to be held back, or to suffer severe checks, from infestation with scale insects. This liability is the greater as the situation is more open, and the soil is more depleted: in particularly well-sheltered situations, and in ordinary situations where the soil is rich in humus, the condition does not appear. An abundant supply of rain does not in itself prevent its appearance.

‘B. The condition can be successfully met, and can by timely action be prevented, in the following ways:—

‘(a) By the artificial control of scale insects by regular spraying. This measure simply prevents injury to the plants.

‘(b) By the provision of close lateral shelter. This measure greatly forwards the growth of the plants, which at the same time remain free from serious infestations of scale.

‘(c) By the manuring and careful cultivation of the plants in the open field, provided that the situation is not badly exposed.

‘In these experiments the development secured by methods (b) and (c) is so greatly superior to that obtained by method (a) as quite to eliminate the latter from recommended practices. The shelter method is the simplest, but for good results care must be taken to keep clear around each tree a space just sufficient for its full development. Removal of the shelter will thus be gradual. Anything approaching overhead shade should be avoided. In applying the third method, the more that shelter in the way of wind breaks and hedges is provided, the less will be the attention required to maintain the vigour of the trees.

'The conclusions drawn from these experiments with regard to natural resistance to scale-insect infestations are applicable to mature trees, but under Dominica conditions these are rarely severely attacked.'

#### DAMAGE TO PUNCHEONS, ETC., BY BORERS.

There is a considerable annual loss in Dominica owing to borers attacking puncheon and other packages used for exporting lime juice, particularly raw juice. This matter received attention during the year. The report of Dr. J. C. Hutson, the Acting Entomologist of the Imperial Department of Agriculture, which is of great interest to planters, is reproduced below :—

'I have examined the insects sent from Dominica by the Curator under cover of letter No. 663, and find that they include two kinds of wood-boring beetles, the majority of them belonging to the genus *Xyleborus*, and the others to a closely related genus. They are commonly called "Ambrosia" beetles.

'These small insects breed mostly in the sap-wood of recently felled or dying trees, but sometimes penetrate the heart-wood, riddling it with holes. They do not feed on the wood, but on a substance which has been called "Ambrosia." This is really a fungus, which is cultivated within the galleries by the beetles to feed themselves and their young. This fungus often stains the wood around the holes, giving them the appearance of having been drilled out with a red-hot wire. It is doubtful if these borers breed in seasoned wood, such as puncheon staves, but it is generally considered that they merely bore into seasoned wood for the purpose of raising their crop of fungus, coming into the lumber yard or storehouse from outside.

'In a case like this it is suggested that the methods of control be carried along two main lines :—

- (a) To destroy all borers that are already infesting the puncheon staves ;
- (b) To prevent, as far as possible, the subsequent infestation of the sound material in the storehouse or yard.

'The following suggestions are made for the destruction of the borers :—

'(1) A careful inspection of all puncheon staves and puncheons, and the immediate destruction of all badly infected and useless material, followed by a general clean up. Instead however of destroying all the badly infested material, some of it might be used in an experiment to find out the effect that a thorough application of steam heat would have both on the wood itself and on the insects contained in it. This infested material could be loosely packed in a small air-tight chamber, and the steam forced into the chamber until a temperature of at least 118° to 125° F is obtained. This temperature should be maintained for several minutes. If used in a large room or building, the steam heat must be maintained for a much longer time, probably several hours, so that the heat can penetrate everywhere. A temperature of at least 118° F. should be kept up. If this method is found to be effective in killing the infesting beetles, and does not injure the wood, it could be tried with the other less heavily infested material later on.

'(2) An alternative method is a thorough fumigation with carbon bisulphide. This fumigation should be tried on a small scale at first by putting a few of the infested staves in an air-tight chest or bin, and noting the effect on the borers.

'*Amount of liquid to be used.* This depends on the size of the building, on its tightness, and on its temperature. With a reasonably air-tight building or room, and at a temperature of between 80° and 90° F, 1 lb. of carbon bisulphide is required for every 400 cubic feet of space. If the building cannot be made tight enough to permit thorough fumigation, the amount of liquid should be doubled.

'*Preparation.* To render the building as air-tight as possible, all holes and cracks in the floor, walls, and roof should be plugged up. The puncheon staves can be stacked up inside in such a way as to allow of the penetration of the gas to all parts. All doors and windows should be tightly shut and wedged, and all cracks plugged up. At least two openings (i.e a door and a window) should be so arranged that they can be opened from *outside* after the fumigation is completed, so as to ensure a thorough ventilation before entering. Have everything ready, so that after placing the liquid, the last opening can be closed quickly.

'*Placing the liquid.* The vapour given off by the bisulphide is heavier than air, and sinks downwards, so that the liquid must be placed as high up in the building as possible.

## REMEDIAL MEASURES.

'*Duration of fumigation.* The fumigation should last for thirty-six hours, and it can be started on Saturday afternoon and carried on till Monday morning. In this way very little time is lost.

'*Caution.* The vapour given off by carbon bisulphide is *highly inflammable* and no fire of any sort should be allowed in or near the building during the fumigation, or until after the building has been thoroughly ventilated. Fire would include lighted cigarettes cigars, lamps or lanterns. No electric light should be turned on in the building during fumigation, as there is always the danger of a spark.

'It would be advisable to put up danger signs, and to have a watchman on guard both night and day during the fumigation. The carbon bisulphide will soon evaporate, and leave no taint. Enquiry should be made whether this form of fumigation affects any Fire Insurance that may exist.

'After the puncheon staves have been thoroughly fumigated, and presumably freed of borers, it is advisable to try and keep this material from a re-infestation. It is suggested, therefore, that quantities of naphthalene be scattered over and around the stacks of material. This will help to keep the insects away, and can be renewed as required. A thorough inspection of the yards and storehouses should be made at least twice a year, and all material that may have become infested should be removed for treatment.

'All new consignments of material should be inspected on arrival, and all infested material destroyed, and the remainder fumigated if necessary.

'It is advisable not to allow the stave material to accumulate more than is necessary, but it should be converted into puncheons and shipped. The use of carbolineum on puncheons is not to be recommended, as it is liable to taint the lime juice. It can however be used in treating the more permanent timber in and around the yards and storehouses, and will serve to prevent infestation.

'Finally, keep the whole plant as free as possible of all accumulations of useless material and rubbish which might serve to attract the borers.

'The above suggestions are somewhat tentative, and may have to be modified to meet the local conditions.'

## FRUIT FLIES.

The mango crop during 1917 was a very large one. Unfortunately a high proportion of the fruit became infested with fruit flies to an extent not hitherto experienced in Dominica. This abnormal outbreak may be due to special conditions favouring the insect, which in time may pass. Should, however, the pest remain in great strength, it will be difficult to obtain a sound mango fruit in the island, unless remedial measures are adopted, such as the use of a poisoned spray bait.

The insect which caused the damage has not been identified, as efforts to breed out the flies failed. The Entomologist reported on this matter as follows:—

'These are the larvæ or maggots of a species of fruit fly. The adult fly inserts its eggs into the fruit, where they hatch, and the maggots burrow and feed in the interior of the fruit, often causing it to drop prematurely, and in any case spoiling it for commercial use. When full-grown, the maggots usually leave the fallen fruit, and pupate in the ground, forming a somewhat oval, hard-skinned, brown puparium or pupa case. These can often be found in the soil an inch or more beneath fruit which has been lying on the ground for some days.

'We have in the collection of this Office specimens of a fruit fly bred from guavas sent up from Dominica in October 1909. Mangoes and oranges were also sent, as being suspected of fruit-fly infestation, but no flies were obtained from either of these fruit. This fruit fly is named *Anastrepha acidusa*, and is the only species of fruit fly from Dominica of which we have any record. The fruit fly is brownish, with a rather slender abdomen, and dark bands and spots on the wings. I cannot say with certainty whether the maggots sent by the Curator belong to this species until I have seen the adult flies.

'These could be bred in the laboratory at Dominica by placing an infested fruit on a saucer or plate of fine sand or finely sifted soil, and covering this with

## REPORT ON EXPERIMENT STATION.

a bell-jar, or gauze-wire cover. The soil should be kept very slightly moistened. The mature maggots will mostly leave the fruit, and pupate in the soil, whence they will later emerge as adult flies. These can be killed by means of cyanide or chloroform, and sent up for determination.

There are various methods of controlling fruit flies, and one of the simplest is the destruction of all fallen fruit as soon as possible after it has dropped. By this means many maggots are killed. It seems probable that this fly also breeds in guavas, so that this fruit should also be destroyed wherever practicable.

It is possible that parasites may control this fruit fly under normal conditions, and that these are temporarily reduced in numbers, thus allowing the fly to become a pest under favourable conditions, as suggested by Mr. Jones. Perhaps some of these parasites may be obtained in the course of the breeding of adults as suggested above. Any small flies or other insects emerging in the breeding jars referred to above should be collected, and sent with the other specimens.

A poisoned bait spray has been used with considerable success against fruit flies in other countries. The spray consists of a mixture of  $2\frac{1}{2}$  lb. of sugar, 3 to 5 oz. of arsenate of lead, and 4 gallons of water, which is sprayed on to the trees. The flies feed on this mixture. This spray would only be practicable on small grafted mango trees, or on guava trees at a time when the flies are abundant, and if tried, experiments could first be made on a small scale to see the effect.

## EXPERIMENT STATION.

This Station was started in April 1913 on Government land beyond Morne Bruce, and within easy distance of the Botanic Gardens. March 31, 1918, saw the completion of five years' work. A statement showing the expenditure and receipts during that period is given below:—

		Expenditure.			Receipts.		
		£	s.	d.	£	s.	d.
1913-14	...	50	0	0	17	9	7
1914-15	...	70	0	0	61	1	5
1915-16	...	120	0	0	86	9	10
1916-17	...	175	0	0	121	2	11
1917-18	...	175	0	0	180	12	2
Head labourer's house	...	60	0	0			
		<b>£650</b>	<b>0</b>	<b>0</b>	<b>£466</b>	<b>15</b>	<b>11</b>

The results are not unsatisfactory, and from now on there should be a considerable increase in the receipts, and only a small increase of expenditure. The excess of receipts over expenditure during the next five years should be sufficient to provide a small up-to-date factory, after which the Experiment Station should be a source of profit. It would contribute towards the maintenance of the Agricultural Department in the same way as the cacao experiment plots in the Botanic Gardens, but on a larger scale.

On taking over the land, there were found to be about 4 acres of lime trees twenty years old, which had been abandoned for many years. About 2 acres of these were growing on steep lands, and the remainder on slopes of a moderate fall. On the latter it was possible to start eight manurial plots of  $\frac{1}{4}$ -acre each. The trees were originally planted 12 feet by 12 feet, but on the plots these were thinned to 24 feet by 24 feet. This removal of three trees out of every four appeared to be a drastic measure, but the results fully justified the work. The effect of drainage and manure on the health, growth, and yield of the trees was remarkable. Unfortunately the hurricane of 1915 did some damage to the trees, and that of 1916 practically destroyed three plots, and greatly damaged two others. A table showing the yields of the plots for a four-year period, which is of great interest as indicating what can be done with old cultivation, was published in the Annual Report for 1916-17.

Owing to the damage caused by the hurricanes, the plot experiments had to be recast, and now consist of three series of five plots each, one of the series being limes of twenty-five years old, and two series of young lime trees planted in

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1913-14. It is intended to add another series of five plots of budded limes for the purpose of comparison with seedling limes of the same age. The crop yields are being carefully recorded.

The area now under bearing limes, and young trees just commencing to bear is  $7\frac{1}{2}$  acres. To this must be added 5 acres in course of being established. Another 3 acres will be planted shortly, which will bring the total under lime cultivation to over 15 acres. There is also the possibility of further additions in the future. The crop during the twelve months ended March 31, was 649 barrels of fruit.

Efforts should be made to establish the 15 acres in lime cultivation as speedily as possible. This area under good cultivation should yield 200 barrels of fruit per acre, or more, and justify the erection of a small factory at the Experiment Station to deal with this crop. At present the fruit has to be carted to the Bath estate, nearly a mile away. This would be impossible with our small carting facilities, except that up to the present, generous aid has been given in this matter by the manager of the Bath estate. It is important, however, that means should exist at the Experiment Station for dealing to the best advantage with the rapidly increasing lime crop, and also for the purpose of training the agricultural pupils, as well as other young men who may arrive in the island to invest in lime properties, in the work of preparing lime products for the market. Given a small factory, the Department would be in a position to offer a course of practical instruction to young men, commencing with the sowing of the seed and ending in the manufacture and shipping of the products of the lime. Further, factory work needs careful investigation in several directions, which the staff of the Department should be in a position to carry out.

In addition to the area under lime cultivation, there are 8 acres planted in coco-nuts, and small areas devoted to the best varieties of budded grape fruits, and orange, camphor, Shea butter trees, and Honduras mahogany trees. About 2 acres of poor and exposed lands have been planted in lemon grass and *Gliricidia maculata*, for the purpose of furnishing the mulching material required by the plots.

During the time the Experiment Station has been in existence it has been visited by a number of planters interested in the lines of work carried on, and it may be desirable to refer briefly to those experiments which form the chief points of discussion during such visits.

## PROTECTION FROM WIND.

The upper part of the Experiment Station, which is now nearly established in limes, is exposed to the prevailing winds. To protect the cultivation, wind belts of the well-known *Pois doux* (*Inga laurina*) are being formed. Up to the present the cultivation has been helped by subsidiary wind-belts of the Nicaragua shade tree (*Gliricidia maculata*), a quick-growing and useful plant for this purpose. A considerable amount of protection was also afforded to young limes by *Tephrosia candida*, a leguminous plant grown as a green dressing.

The lower part of the Station, a portion of which it is hoped to establish in limes as time goes on, is a straight and narrow valley, down which the wind rushes. The slopes in some instances are too steep and exposed, and the layer of soil too thin to plant, but the depressions will grow limes if surrounded by wind-belts. The poor and exposed lands can be used to grow certain plants for use as mulches, or native and exotic trees for use as firewood.

Happily this matter of wind breaks is well understood in Dominica. A very large part of the area under limes in the island is protected from the wind by the natural conformation of the land, of which every advantage is taken by planters. Where land is exposed, experienced men seek to mitigate the effect of the wind by growing shelter-belts of the *Pois doux*, Galba, and other trees. It is only the young and inexperienced who do not see the need of providing shelter in the first instance. By failing to do so they add greatly to the cost of establishing their plantations, and buy their experience at a ruinous price. Whenever new lands exposed to the wind are about to be planted, a carefully thought out scheme of wind-belts should be planned and carried into effect as early as possible.

Reference has been made to the use of the Nicaragua shade tree (*Gliricidia maculata*) as a secondary wind-belt. This plant has proved very helpful in the Experiment Station. Cuttings of about 3 feet long, of which a foot should be placed in the ground, are found to strike readily, and grow rapidly. If small

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holes are made for the cuttings, and these are placed in the ground with care, there are no failures. Unfortunately, on some estates the holes are made with an iron bar, and the cutting is then forced in the hole. This action strips off the bark, and the cuttings cannot emit roots. It requires the same care to place a cutting in the ground as it does to place out a plant.

For use as a secondary wind-belt, a row of *Gliricidia maculata* should be run between every third and fourth row of limes (across the direction of prevailing winds). It needs to be cut back twice a year. A few weeks after being topped it is again affording some protection, and on each cutting it yields a good supply of mulch for the lime trees. In order not utterly to deprive the young lime trees of shelter at the time of cutting back, it is best to top alternate rows every three months. This tree is deciduous, but by topping it is kept in an evergreen state practically all the year round, and is made by these means to afford protection even in the dry season of the year. Planted on either side of a permanent wind-belt like the *Pois doux*, it is helpful in bringing on those plants during the early years of their existence.

## DRAINING.

It may be stated that this cultural operation is generally neglected on the majority of lime estates, until it becomes urgently necessary. It is then usually carried out in such a manner as to give an additional check to the already severely tried trees, and to add to the immediate difficulties of the management.

When draining operations have at last to be carried out on established estates, owing to the low vitality of the trees, the work, in the majority of cases, is done in a very unsatisfactory way. Work which should be done gradually, and extended over at least three seasons, is attempted at a single operation. The drains are usually made too narrow and too deep for their width. The earth, which is chiefly subsoil, is thrown upon the adjoining surface soil. Thus, a living soil from which the trees derive their nourishment, is largely covered by a dead soil which needs a lengthy exposure to the sun, air, and rain, and to the effects of weed growth, and to applications of organic manures, before it becomes fertile and helpful to the lime trees. This covering of the living surface soil, often to a depth of several inches, gives a further check to the trees, and although draining, even when carried out on unsound lines, will ultimately result in some improvement, the immediate effect of faulty operations is further to delay the recovery of the plantation. In old cultivations, in which draining has been neglected, it would prove a sounder plan to drain gradually by instalments, rather than to attempt the whole of the work at one time.

In new plantations these operations should be carried out during the years between the time of planting and the coming into bearing of the trees, that is, a period of three or four years. On flat and moderately undulating lands, a drain should be run between each two rows, for under such conditions the trees would be spaced at 20 feet to 25 feet apart or more. This plan results in what is called the 'bank' or 'bed' system, that is, the soil from the drain is thrown up until the highest level is in a line with the row of tree stems, whence it gradually falls on either side to the drains. Thus on flats, and on moderately undulating lands the fields are formed of a succession of beds. This plan is formal in appearance, and effective in its operation.

When fields have been lined and planted with limes, which is usually done between June and November—the wet season—steps should be taken the following dry season—January to May—in the work of beginning a system of drainage which, if carried out on sound lines, will be destined to play a great part in maintaining the health of the trees, and in prolonging the life of the plantation.

During the first dry season after the trees are planted, surface drains about 2 feet wide, and 10 to 12 inches deep, should be dug. The soil from the drains should be spread over the land to which it will afford a light top dressing. The next season the sides of the drains should be broken in, and the top dressing repeated. The third year the drains should be deepened a few inches in order to afford the annual dressing. By this time the 'bed' system will be attained, but as drains always tend to silt up, especially so in a wet country like Dominica, they should be annually cleaned, and kept at a proper depth. This secures a valuable top dressing for the trees each year. Procedure on the above lines is very helpful to the young limes. Under such conditions they show great vigour. By the time the draining system is complete, the trees are commencing to bear.

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It is practically certain that draining, as outlined above, when applied to lime trees in course of being established, will mitigate the critical period in the life of young lime trees, and it may in conjunction with shelter, such as is given by *Tephrosias* and *Indigoferas*, overcome it.

In many instances in Dominica limes are planted on steep slopes. The usual custom in these cases is to plant closely, 10 feet by 10 feet, or 12 feet by 12 feet; nothing or very little in the way of drainage being attempted. The trees under these conditions do fairly well whilst young, but once having passed the vigorous stage characteristic of the first years of maturity, their appearance and yield of fruit are decidedly poor. This is largely due to surface washing by which the best soil is carried away each season on the occasion of torrential rains. It would appear that a good deal more could be got out of such cultivations by planting at wider distances, and by following the plan of surface drains recommended on flats or moderately undulating lands. Experiments with a view of obtaining information on this point have been started at the Experiment Station.

It is almost needless to point out that surface drains on slopes should always run across the fall of the land, and be able to deliver the water to the main drains slowly and with a minimum of rush. In a hilly country like Dominica, the main outlets are usually rivers or streams, ravines, or natural depressions in the land.

It must not be overlooked that considerable areas of limes are grown and do well in Dominica on what may be termed boulder lands, that is, land strewn with rocks to such an extent that very little soil is to be seen. Such areas are usually naturally well drained, which is fortunate, as the ordinary methods could not be applied in these instances.

## MANURING LIMES.

Very little had been done in the work of systematically manuring lime fields and in recording the yields, until the experiment plots were started. Here again interruption occurred, as, owing to the hurricanes of two successive seasons, the experiments had to be recast and restarted. But in the four years' record the results obtained were highly instructive to planters, because what was accomplished by cultivation and manuring in the case of old and neglected trees at the Experiment Station is also possible on estates.

There can be no doubt that the leading factors in successful plantation work are: shelter from wind, draining, and manuring; the last named is placed third for the reason that the best results cannot be obtained if the trees are exposed to the wind, and the fields remain undrained. Trees requiring shelter cannot make the best use of manures, whilst in the case of undrained fields the soil is not in a properly aerated condition so as to give the best results, and a loss of concentrated nitrogenous manure is possible owing to surface wash. Therefore each factor should receive careful attention in order to secure maximum results.

The main manurial experiments now carried on consist of five plots, three times repeated, one series with old, and two series with young limes. They are as follows:—

- A. Complete manure of nitrogen, phosphates, and potash.
- B. Control. No manure.
- C. Mulch of grass—5 tons per acre.
- D. Nitrogen and phosphates.
- E. Nitrogen and potash.

There is also a single plot which receives nitrogen alone, but it is not possible at present to add check plots to this.

It is hoped to add to the experiments as the area of cultivation extends.

Another matter of great importance on which information is wanted is in regard to the right time of the year to apply concentrated nitrogenous manures to lime fields. A practice has sprung up amongst planters of applying these quick-acting manures at the close of the season, that is about November to December. In the Agricultural Department these particular manures are always applied to the plots with the early rains in April to May. Justification for this action is sought in the facts that it is the spring time of the year, that the trees are waking up after the irresting period—the dry season,—that from April onwards the days are

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lengthening, that the daily average of sunshine is increasing, and that the temperature of both air and soil is rising. From May to September is the period of maximum vitality of plant life in which lime trees are able to take up and make the best use of available plant food.

To apply quick-acting manures in November to December, when the reverse conditions to those mentioned are being felt, does not appear altogether sound. The time of application may be a cause amongst several possible causes, which leads some planters to assert that very poor results or none have followed the application of these manures at that period of the year. In the Experiment Station the effects of every application of quick-acting nitrogenous manure are apparent, but further experiments are needed to settle this important point beyond doubt. Possibly considerable losses are being sustained yearly owing to want of information on this matter. If a hundred acres of bearing lime trees were available at the Experiment Station, every acre could be included in some useful experiment for the purpose of increasing our knowledge of lime cultivation.

It is probable that the time of application of phosphatic and potassic manures is not so important as in the case of nitrogenous manures, but preferably these should be applied between January and May. In the matter of the application of pen manure, this is largely a question of estate convenience. Regarding mulches, these should, whenever possible be applied early in the year, so as to afford a covering to the soil during the dry season, together with availability as plant food during the following wet and growing season.

## MULCHING.

The mulching of both lime and cacao plots has been recommended for a long time as a means of maintaining the humus content of the soil, without which the trees soon fall into a poor condition. In Dominica this can be done by the application of pen manures; by cutting off the tops of native bush and carrying the material on to the plantation; by the use of dead leaves of deciduous trees; by collecting accumulations of organic matter in drains and their outlets, and by growing special plants in odd corners of the estate for the purpose of supplying mulches.

In estate practice in Dominica it is held by planters that the cutting and carrying of green mulches of native bush, and the collection of dry material under deciduous trees is much too expensive a method of soil improvement. It is however somewhat difficult to accept this, unless the material is carried over long distances, a proceeding which is not recommended. It cannot and should not be as expensive as the cost of producing pen manure. Probably the real difficulty lies in the fact that the average planter has rightly a great belief in the efficacy of pen manure, therefore the expenditure in this case is considered justifiable. In the matter of mulches, either green or dry, of native plants, there is a doubt as to the utility of the work in the minds of some owners and managers, which makes all efforts and expenditure in applying them appear unnecessary and large, in view of the already held opinions that all work in this direction is of questionable value.

In the Experiment Station, which is limited in area in comparison with estates, and in which there is little in the way of native bush to draw upon, it has been necessary, in order to secure material for the mulched plots, to plant up odd corners with lemon grass and *Gliricidia maculata* for this purpose. These areas lie close to the plots; therefore the cost of carrying on the mulch is reduced to a minimum. Later on it is hoped to measure the areas which produce mulch, and to calculate the annual yield of this material. It will then be possible to state the amount of land required to be set aside for each acre of lime cultivation on a 5-ton requirement of mulch per acre per year. The supply of mulching material may be solved on some estates along these lines.

In Dominica, owing to the broken nature of the country, there are no large stretches of cultivation. The estimated acreage under limes (6,000 acres) is made up of numerous small areas. The majority of these are surrounded by native vegetation which, if utilized, should maintain the fertility of cultivated lands at a high standard. On a few large estates, on which the difficulty of obtaining material is obvious, a good deal might be done to improve the situation by planting the banks of rivers and streams, edges of ravines, and lands too steep for lime cultivation, with plants suitable as mulch producers.

It is a fortunate thing for the lime industry that a considerable portion of the cultivation which lies on slopes at the foot of cliffs, receives from the vegetation which clothes the rocks above, a large amount of valuable material yearly. This,

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however, is seldom enough, and even in such favoured localities applications of mulch would prove helpful. In open fields, which have no such natural sources of supplies, this form of manuring is necessary if the trees are to be maintained in good health. This work of mulching should be additional to the use of all the pen manure that can be produced and applied on the estate.

## GREEN DRESSING.

The uses of such plants as the Horse bean (*Canavalia ensiformis*) as a ground cover, and of *Tephrosia candida*, both as a ground cover and for affording lateral shelter to young limes for a period of two years or more, have been demonstrated at the Experiment Station, in which place they have proved of high value. The functions of the plants as soil enrichers have also been explained to planters.

As a result of the experiments there is now a considerable demand for seeds of the Horse bean and of *Tephrosia* for growing in young cultivations. It is hoped that the use of these nurse and cover plants will continue to increase.

## BUDDING OF LIMES.

In recent annual reports reference was made on two occasions to the experiments now being carried on with limes budded on the sour orange, citron, and M'gergeb stocks, the last named being a variety of citrou received from Algeria, where it is used as a stock for oranges.

Experience has shown that, while lime trees are blown over by thousands during the occurrence of hurricanes, the sour orange and sweet orange trees, if growing on fairly deep soils, are never uprooted under like circumstances. This led to these experiments being made in the budding of limes, the chief object of which is to put to test the root-holding power of the sour orange when carrying a lime top, which, in the case of a well-grown tree, is much larger and heavier than an orange top. Many years may elapse before the budded plants are put to test. In the meantime the planting of this class of plants will probably be continued on a small scale. It is important to remember that budded plants should always be placed out in soils of a good depth, in order that the taproot may be allowed to develop. The object aimed at would be nullified by planting on shallow soils overlying a hard subsoil.

It is also known that several thousands of sweet orange trees grown upon the sour orange stocks in a forest district have proved immune from the root diseases which cause a considerable loss of trees amongst lime cultivations in newly cleared areas. If this immunity continues, the loss of lime trees which now occurs under these conditions would be prevented by using the sour orange as a stock.

The trials now being made with limes worked upon sour orange stocks are sufficiently advanced, both on estates and at the Experiment Station, to show that under careful cultivation the plants will attain to a good size in four years. Like all budded citrus plants, progress is slow during the first year after planting in the field. Fair growth is made in course of the second year, and during the third and fourth years the rate of progress is excellent, especially so when green dressings are used, and shelter afforded.

Should the budded limes come successfully through the root-holding trials, whenever Nature may impose the test, it is probable that this class of plant will appeal to planters who like to do things well, and who possess the capital to carry out their ideas. That seedling limes will continue to be largely used is certain, owing to their cheapness and to the fact that though easily overturned during storms they can be renewed by suckers within two or three years, and that once renewed by suckers, they are not likely to be again disturbed as far as the roots are concerned.

Should the budded plants in due course prove to be able to resist the high winds, and accomplish all that is wished of them, it would have to be admitted that the grower of seedling limes, in spite of initial cheapness, has to pay in the end a much higher rate in order to secure immunity from uprooting than the purchaser of budded limes. But it may be argued that many planters are better able to meet this cost when in possession of an established though damaged property, than they were to pay for the high cost of budded stock at the commencement of planting operations.

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The experiment already made shows that limes will grow well upon sour orange stocks. With regard to citron and M'gergeb stocks the results are in doubt. Up to two years after planting very poor growth has been made by the first named. Growth on the M'gergeb stock has been better, but it gives no promise yet of being so suitable a stock for limes as the sour orange.

## PROPAGATION BY LAYERING.

Some years ago a few experiments were made on coast estates in the propagation of limes by layering. The method usually followed is to remove a ring of bark from the stem of a selected branch, and then to place a few handfuls of moss over and above the wound, the moss being held in position on the stem by sacking, or bound by wide bands of vegetable material such as the sheathing cases of leaves of *Musa textilis* and the dry leaves of the Pandanads; or by dividing a bamboo pot and then placing it in position and filling with either moss or earth. If the moss or soil is kept wetted, roots are emitted in due course. When strongly rooted, which usually results in two or three months, according to the season of the year and the amount of attention given, the branches may be severed and planted out. This method of propagation cannot be recommended for the drier coast districts of Dominica. It is troublesome, costly, and slow, and such plants after being planted in dry localities tend in their young state to produce flowers and fruits, a weakening process, instead of the free growth or strengthening process, which is needed. When in this stage they are apt to fall victims to attacks of scale insects. The efforts to overcome these attacks by pulling off the successive flushes of flowers, and the need of applications of nitrogenous manures to promote a free growth have resulted in this form of propagation being ruled out under the conditions mentioned. Dependence is rightly placed on healthy seedlings, which can be raised in quantities both easily and cheaply.

This matter, however, presents another aspect in the case of lime growing in wet districts. Under moist climatic conditions the lime branches emit roots readily; the daily attention which is required in a drier climate is not necessary, hence propagation proceeds more quickly and at less expense. As it is probable, but not yet fully proved, that the lime tree will not be so long-lived under the wet climatic conditions of the interior lands, as it is under the drier climate of the coast zone, a method of propagation which is likely to result in the early production of fruit is worth a careful trial. In such experiments care should be taken only to propagate from young, healthy, bearing trees.

An experiment with plants raised by layering is now being tried on Neba estate, which is located in a district having a considerable rainfall. The rooted cuttings are said to grow vigorously in their early stages, and to yield early. A few plants have also been placed out at the Experiment Station, in order that their behaviour under coast conditions may be closely observed.

## YIELD OF LIME TREES.

Although lime cultivation was taken up in Dominica over sixty years ago, and developed with considerable energy during the past twenty-five years, the possible annual yield of fruit per tree over a series of years, in the best positions, and under good handling, does not appear to be known, nor does this point excite much interest. Compared with the returns of orange and grape fruit trees, the best yield of lime trees recorded per acre in Dominica appears low. The average crop of orange trees under good cultivation is from 800 lb. to 1,000 lb. per tree, while the best recorded crop of limes is 200 barrels per acre, which, allowing the trees are spaced at 20 feet, gives a yield of only 320 lb. of fruit per tree. In this connexion it has to be remembered that the proportion of juice from a given weight of fruit is higher in the case of the lime than the orange. Still it is evident that lime trees in good positions, properly spaced, and given a complete manure annually, are capable of giving a higher return than 200 barrels of fruit per acre.

On estates which are regarded as doing well, a crop of 150 barrels of fruit per acre is considered good. There is, however, a good deal of cultivation on which the return is below 100 barrels of limes per acre.

Under the best cultural conditions there would always be some variations in yield according to position of the estate. It is obvious that a lime estate in the mountains, at an elevation of 1,800 to 2,000 feet can hardly be expected to produce on the same lines as well sheltered estates located in the hot moist valleys near to

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the coast, but by a general improvement of cultural conditions the average yield of plantations could be raised considerably above what it is at present.

While the crop is in the main limited because of the lack of good husbandry, an additional cause of low returns is the overcrowding of fields. If trees were properly spaced according to location, these should when fully developed stand clear of their neighbours. The bearing area of the trees is, under such conditions, greatly increased. Overcrowding limits bearing the area. Close planting, how ever, is not without its advocates, one of the arguments put forward being that during hurricanes close planted trees support one another, and prevent overturning. Fortunately, hurricanes are of rare occurrence, and a policy which permanently reduces the bearing area of trees by over 50 per cent. for this reason appears to be an over cautious one.

In connexion with this question of yield, it is somewhat surprising to find at the present stage of the industry that no area of cultivation exists in the island which has received a complete manure of nitrogen, phosphates, and potash annually for a period of five successive years, or a suitable application of pen manure or mulches over a similar period. Only by the annual application of complete manures, backed by good cultivation, can it be found out what the lime tree is capable of yielding in fruit. The results under indifferent cultivation are well known. Let it be hoped that the time has now arrived for greater effort in the improvement of plantation work. In the trying times that are ahead, the interests of Dominica would be best served by methods which would quickly increase the returns per acre on established estates, rather than by new plantings which would take a number of years to mature. Important as is development work on all estates, this line of activity might very well be put aside on old estates in Dominica for a few years in favour of intensive methods of cultivation.

While this lack of systematic manuring of lime trees after so many years is remarkable, the candid critic would also point out that the starting of an Experiment Station only five years ago, and then only in a small way, is equally remarkable in the history of the lime industry of Dominica, when so many problems affecting this cultivation have so long required investigation. These matters show the general lack of interest in all measures appertaining to an intensive system of agriculture.

The distances of planting at the Experiment Station range from 15 feet on steep slopes to 20 feet, 25 feet, and 30 feet in more favourable situations. In due time records of the results in yields of fruit in these spacing experiments should be forthcoming.

## NEED OF CARE IN PRUNING.

In the early years of a healthy lime plantation very little is needed in the way of pruning, the chief requirements being the keeping down of suckers, and the pruning away of the lower branches in order to keep an open space between the branches and the ground. As time goes on more pruning is required, owing to injury to the branches by wind, to attacks of scale insects, and to the effects of plant diseases.

Young lime trees when badly pruned, which is, unfortunately, usually the case, possess great powers of recovery, and what are very bad wounds are sometimes callused over at this stage. As the trees become older, this power of recovery diminishes, and unless pruning is properly done, the tree cannot cover the wounds with new bark. The wood in the majority of instances then decays, and if the injury is near the base of the trunk, the tree is doomed, although several years may elapse before death supervenes.

There is urgent need of greater attention being paid to pruning in plantations, in order both to lengthen the life of the trees and to put an end to the unworkmanlike proceedings which at present are the cause of great losses to planters.

This matter is dealt with fully in the Mycologist's memorandum at pages 12 and 13. The issue of a pamphlet dealing with the main principles of tree surgery should be welcomed by all lime planters.

## PROPPING OF LIME BRANCHES DURING CROP.

This work is carried on to a considerable degree on some properties. Whether it is really needed to the extent that it is carried on, and whether the expenditure which it involves is altogether sound, are sometimes subjects of discussion amongst planters.

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There can be no doubt that the propping of branches on some old plantations is necessary. This is due in many cases to too close planting which results, in the struggle for light, in the production of elongated branches which cannot possibly carry the weight of fruit without being bent to the ground or broken. As long as the trees are young, support is not required to any extent, but as the inevitable vacancies occur in the fields, whether caused by hurricanes or disease, the need of propping increases as time goes on.

On old plantations in which the proportion of diseased trees is high, and especially in cases in which the wood of the base of the trunk and of the main branches is affected by decay, the need of supporting the branches during crop is apparent to all. Trees so affected are doomed, although several years may elapse before death takes place. During this period good crops are borne, and even heavy crops in the case of fields which are manured. In these instances support of the branches is needed, and is usually given.

Propping is also largely practised in the case of trees growing along the public roads, and estate roads and paths. The object is in most cases twofold: one, to press the branches away from the roadsides, and two, to afford support, as the trees grown under these conditions usually bear well. In the case of public roads inconvenience is often caused to travellers by the reluctance of some planters to cut back or to prop back the branches of what are considered by many owners to be their best trees, for in unmanured fields the best specimens are usually found on the edges of the cultivation. This is due to the fact that the trees get room and light for development, and they also receive from time to time a top dressing in the shape of scrapings from the road drains. If therefore the additional room and light and the occasional top dressing result in the production of good trees, surely it at the same time affords a lesson in cultural matters which should be learned and followed.

The need of supporting and pressing back branches along roadsides could be overcome in future by taking care to plant sufficiently far back to allow of the full development of the trees without interfering with the rights of the public, and on estate roads and paths it is apparent that planters reap no advantage whatever, but it is probable that they are the losers in the long run by the practice of planting on the boundaries of public highways and on the edges of estate roads.

Generally speaking, this work of propping is largely due to preventable causes. Sound, healthy trees, properly spaced, can carry their crops without assistance, just in the same way as orange and grape fruit trees do. To space the trees properly, and to prune soundly will greatly reduce the need of supporting the branches. Owing to lack of forethought this work has become a considerable item of annual expense on a number of estates. While propping must be kept up in old fields, new areas of limes should be treated with the object of reducing to a minimum this item of annual expenditure.

And there is another aspect of this situation; a lime tree propped is nearly always a lime tree injured. The work is usually badly done, and by the time the prop has decayed or been removed, the bark has been rubbed off the branches owing to swaying caused by the wind. As old trees cannot callus over the wounds, decay of the wood follows, and the branch will at a later time break off at the point of injury. That some crop is saved by supporting the branches is undoubted, but this is only accomplished at the cost of permanent injury to many of the trees.

## USE OF DYNAMITE IN LIME CULTIVATION.

In the annual reports for several years past references were made to the experiments with dynamite carried on amongst lime cultivation at the Experiment Station during 1914. These consisted of a large number of explosions being effected amongst old trees on poor soil, and also the use of dynamite in blowing out eighty holes for planting both budded and seedling limes.

Careful observation of the plots during succeeding years showed that no results followed this work, the area of old trees treated being in no wise better condition than the control cultivation adjoining. In the case of holing, the plants growing in those blown out by dynamite have done no better than those growing in places prepared in the ordinary way by pick and spade. Reports from an estate which carried on similar experiments confirm the above observations. It appears to be clear that planters would obtain a better return for their money by spending it upon draining and manuring.

It is probable that dynamite might be used with advantage in Dominica on estates on which there is cultivation on shallow soils overlying a hard-pan, the breaking up of which might be expected to improve field conditions.

## GENERAL INFORMATION.

A possible explanation of the failure to obtain results by explosives is that in a wet country like Dominica the subsoil is never in a sufficiently dry condition to allow of a shattering effect by the dynamite. Consequently the explosions only serve to bring about further compaction of an already compact subsoil.

## NEEDS OF THE DEPARTMENT.

The Agricultural Department of Dominica is the one Agricultural Department in the smaller islands of the West Indies in which the staff has been weakened by the absence of an officer during a considerable part of the war period. This has led to curtailment of the work at a time when there should have been an increase of effort. In contrast to this state of affairs in Dominica we hear that in neighbouring islands additions have been made to the staffs, this action being the outcome of a keen desire on the part of the Governments and planters concerned to strengthen the Agricultural Departments, with a view of increasing their activities during and after the war period.

Accepting the position that a pause in the work of the Agricultural Department may not prove detrimental during the present time, the question of the future arises.—Is the Agricultural Department of Dominica to remain at a standstill when so much is being attempted in the way of agricultural effort and organization in certain other islands?

In the Windward Islands Colony, the units of which are like Dominica in conformation, climate, and productions, a glance at the lists of the respective agricultural staffs in the several islands will at once show that effort is on a much larger scale in those places than it is in Dominica, while it is certain that the need of instruction in this island is as great, probably greater, than in any other place in the West Indies.

The past record of the Agricultural Department of Dominica has been a successful one. Receiving a good measure of support from planters, matters have, on the whole, run smoothly and well. There have been none of the bickerings and recriminations with planters which have been such blots in the working of these Departments in some islands. In fact the complacent attitude of planters towards the Department has almost become a danger in these times when so much is needed in the way of organization and effort, if the agricultural interests of Dominica are to be kept up to the level of development of those of other islands. Not contentment with things as they are, but stimulation of public opinion in the direction of further agricultural effort, and a realization that matters are not on sufficiently progressive lines are needed before this Department is likely to be strengthened and placed on an equal footing with those of other and more go-ahead islands.

In view of the intention of the Home Government to increase the staff and strengthen the position of the Imperial Department of Agriculture for the West Indies after the war, it will be also necessary, where it is needed, as in Dominica, for the local Government to strengthen the local Department of Agriculture. It is difficult to see how an effort on the part of the Home Government to increase the grant-in-aid of agricultural investigation and research can be successful, unless such grant is conditional upon all Governments concerned in the West Indies undertaking to maintain the local Departments on a basis which will enable them to co-operate with and carry out such experiments as may be directed by the central organization. Extreme care should be taken that the acceptance of greater responsibilities by the Home Government in connexion with agricultural research and development in the West Indies should not be interpreted to mean that less may be done by each local Government. An extension of the activities of the Imperial Department of Agriculture, and the appointment to the Head Office staff of additional scientific officers, will not mean what it is intended to mean, and such action will not accomplish what it is hoped to accomplish, if the local Departments in the several islands are allowed to remain in their present understaffed condition, and with their limited range of action.

The staff of the Agricultural Department of Dominica consists of a Curator, and a second officer whose official title is that of Assistant Curator and Chemist. The latter having been absent from the colony since May 1917, the work of the Department has fallen upon a single individual, a state of affairs which prevents the starting of any new lines of work.

On the return of the Assistant Curator and Chemist the work requiring chemical investigation will be resumed as formerly, and it will also be necessary

## GENERAL INFORMATION.

to fill the position of Junior Assistant Curator, for which a vote of £150 has been on the Estimates for several years. The latter would assist in the management of the Gardens and Experiment Station, and be available for visiting estates in order to make preliminary investigations of plant diseases, and to assist in other important matters which require attention from time to time.

Assuming that the above posts are filled after the war, there still is need of a good local Instructor, who would be in a position to visit the peasants, and advise them in respect to their lime and cacao cultivations, and also attempt to get them interested in small cultivations, such as ground nuts, the growing of papaws for papain production, the cultivation of onions, the possibility of vanilla growing (now that a market exists for the green fruits), and to interest them to a greater extent in the growing of good fruit trees, and in the greater production of vegetables. As it is known from experience that an Instructor who advises and rides away does not accomplish much good in Dominica, it would be necessary for two or three of the more populous districts to be selected, and the Instructor would be expected to spend most of his time within those districts, in order to get to know the people and their agricultural wants thoroughly.

Such matters as bee-keeping amongst the peasantry should also receive the attention of a local Instructor. Measures for the improvement of small stock such as poultry, pigs, sheep, and goats, which are kept in and around villages, should also be put into operation. There is a wide and useful field of work in these directions. The distribution of seeds and plants, the teaching of bee keeping, assistance in furnishing bee keepers' supplies, and help in the way of providing small stock would soon bring about a sympathetic interest between the Instructor and the peasants.

Desirable as is some move in the direction of teaching the peasantry, it is certain that a system of instruction which is linked with co-operative factories for purchasing peasants' limes would give the best results. Given such a factory in populous districts like Grandbay and Laplaine, the manager would be able to give advice at any time, and be at liberty for three or four months in the year for travelling about the district for this purpose. A system of instruction worked in conjunction with a co-operative factory would certainly yield the best results.

In the early years of the century, when for a space of ten years the Imperial Government maintained the Agriculture Department of Dominica, one of the lines of work was the importation of pedigree stock for the improvement of local breeds of animals. Two stallions and a donkey stallion were stationed at Morne Bruce, and at times travelled about the island; Poland, China, and Tamworth pigs, African woolless sheep, Toggenburg goats, Belgian hares, and good breeds of poultry were bred at the Agricultural School, and the progeny sold to planters and peasants.

Since those days very little has been done by private enterprise to improve breeding in the island. There is certainly the need of Government assistance in this direction. Under present conditions it is hardly likely that anything will be done in the direction of keeping stock by the Agricultural Department, but it is highly desirable that a sum of money should be voted on the Estimates each year, to be paid out in subsidies to private owners who see the need of, and are wishful to take steps to import stud animals for improving the breeds of cattle and small stock. This form of assistance might be given on the animals being imported, and on condition that they remained in the island for a certain period, and are available for the improvement of stock.

Another matter closely connected with the advancement of agriculture is the system of agricultural education at the Grammar School. Started in 1911, good progress was made until December 1914, when the Science Master was promoted to another island. The annual reports issued show that 50 per cent. of the pupils availed themselves of science teaching. No steps have been taken to fill the post of Agricultural and Science Master, and it is understood that nothing will be done until peace comes. For such an important and necessary position to remain vacant for over three years is a most unfortunate set-back to the cause of agricultural education in this island.

The same state of things exists in respect to training agricultural pupils, six of whom are usually under instruction in the Department. This work has practically come to an end, owing to the want of assistance. It is hoped that this state of things both at the Grammar School and in the Agricultural Department is only temporary, and that work will be resumed with vigour as soon as circumstances permit.

**GOVERNMENT CO-OPERATIVE FACTORIES.**

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As shown in another part of this report, the gross cost of the Agricultural Department during the year ended March 31, 1918, including the training of agricultural pupils, was £1,443 15s. 4d. The receipts which amounted to £602 7s. 0d. brought down the expenditure to £841 8s. 4d., a trifling sum to be paid for the maintenance of an Agricultural Department, which includes the upkeep of a large Botanic Garden and Experiment Station, and nurseries of considerable size for the supply of plants and seeds below cost of production.

It is clear that a Department suited to the agricultural needs of the island would require annually a vote of from £2,500 to £2,600 for its maintenance. Of this sum, it is certain, if the present lines of development are followed, that the annual receipts from the cacao and lime cultivations, and the nursery work will amount to £1,000 yearly, possibly more in good years. This leaves a sum of £1,500 to be provided, which represents a charge on the present value of agricultural exports of slightly more than  $\frac{1}{2}$  of 1 per cent. It is for the authorities and planters to decide if such a sum can be provided, in order to maintain the Agricultural Department on sound progressive lines.

**GOVERNMENT CO-OPERATIVE FACTORIES.**

A matter which has been fully discussed officially during the past two years is the organization of the peasants' lime industry. That a co-operative factory on the lines which have been found so successful in St. Lucia and Demerara would do much to give stability to the industry, and encourage the further planting of limes by the peasants is undoubted; but it has to be remembered that in an island in which a lime industry is established there are difficulties to face which are non-existent in those places in which the production of lime products is in its early stages. In the working of co-operative factories it is usual for the peasant to receive a first payment of from 3s. to 4s. per barrel of fruit on delivery, and, at the end of the year after the produce has been sold and the accounts made up, a bonus is declared. There are times in Dominica when, owing to the great demand for raw juice and consequent high prices, more could be offered by private firms for peasants' limes than a carefully managed factory making concentrated juice could earn. And the peasants themselves have made it clear that, although a co-operative factory might be brought into existence for their sole permanent benefit, they would, in face of full knowledge of this fact, unhesitatingly sell their fruit to the highest bidder. This difficulty might be overcome if arrangements were made whereby, when any local demand for raw lime juice arose at prices more remunerative than those obtainable for concentrated juice, the co-operative factory should sell raw juice to the local buyers, and give the co-operating peasants the benefit of the higher prices so obtained. The factory would be in a better position than the individual peasants to provide the required raw lime juice for the local buyers.

Co-operative factories in the several districts in which the production of limes warrants them would greatly help the small grower, and stimulate the planting of limes, if this question of private competition with the co-operative factories could be satisfactorily overcome. In a country like Dominica, in which there are few estates in comparison with the total area, a Government policy which will strengthen the position of the small grower, and enable him to develop his cultivation, and market his products advantageously, is undoubtedly a wise course to follow.

This view is expressed with knowledge of the fact that the Dominica peasant is backward and suspicious, and a difficult person to deal with. But this is largely due to his isolated life. He has had few chances in the past. He is poor in everything that leads to enlightenment. A form of agricultural organization designed for his benefit, which would tend to increase his activities, and awaken new interests is certainly desirable, and particularly so at a time when the peasant is losing interest in lime cultivation on account of low prices, together with the possibility at any moment of being without a market for his fruit.

The past history of Dominica has shown that the island never has possessed, and probably never will possess a large resident planter population, that is, a large body of planters who regard Dominica as their home, in which generation succeeds generation on the family estates, as is the case in some islands in the West Indies. That this has not come about is due to the fact that Dominica is suitable for the development of that class of interests in only a limited degree; that in the main it is essentially a country which can only be well developed by utilizing in the fullest possible measure the aid of the small grower.

The few well-to-do planters will always be on estates along the Leeward Coast in the southern district, and in a comparatively flat district lying to the north, and known as Lasoye. In other parts of the island the resident planter is practically unknown. The Imperial Road, which had fourteen resident planters and their families some years ago, has now only one. On the Windward Coast, from Peguoa in the north to Petit Savanne in the south, a stretch of country nearly 20 miles in length, and of considerable possibilities, there is not a single resident estate proprietor, and not more than half a dozen estates; but in the last named district there are settlements of peasants who, with organization, could be got to develop the country, and give it what it requires—a large permanent population.

The past history of Dominica shows that on the failure of certain products the well-to-do planters realized their effects, and sought fresh fields for their energies, leaving an impoverished native population, and an almost bankrupt Government to carry on as best they could.

If the lessons of the past are read aright, steps would be taken to encourage the small growers, and to form from that material a contented and industrious population.

#### CACAO AND LIME EXPERIMENT PLOTS.

The results of the cacao manurial experiment plots as carried on for a period of seventeen years, for fifteen of which the records have been carefully kept, were published in the Annual Report for 1916-17, and later in the *West Indian Bulletin*, Vol. XVI, No. 4. It is therefore not proposed to publish a report on the plots in the present report.

A report on the manurial experiments with lime trees which, after being carried on for four years, were disorganized by the hurricane of 1916, appeared in the last annual report. The results of the new series having only been run for one year are of no special interest to planters, and these will not be published until another season has passed, and the figures for two years are available.

#### CROP YIELDS AT THE GARDENS.

The cacao crop for the year ended June 30, 1918, was 65½ cwt, this being the smallest crop reaped for a number of years. The average annual crop for a period of five years, 1914-18, was 82½ cwt. from an area estimated at 7½ acres.

The rainfall for the year ended June 30, 1918, was 78.08 inches.

Three bags of cola nuts, of a total weight of 651lb., and 1 bag of nutmegs of a weight of 244lb. were shipped to London.

There were also sold locally 649 barrels of ripe limes, and a large quantity of mangoes and citrus fruit.

#### PERMANENT EXHIBITION COMMITTEE.

On the outbreak of war, the Committee unanimously decided not to take any part in Exhibitions during its continuance. The vote for the Committee, which the Government continued to provide, has been used, with the consent of His Honor the Administrator, for purchasing and shipping fruit to the Red Cross Hospitals in London. During 1916 six shipments were made, which consisted of 269 boxes of limes, 22 boxes of oranges, and 10 boxes of grape fruit, a total of 301. During 1917, owing to the voyage of the steamers having been considerably lengthened for reasons of safety, it was only possible to make four shipments. These were contributed as follows:—

Permanent Exhibition Committee, limes,	157	boxes
Botanic Gardens, oranges,	16	"
" " grape fruit	8	"
	<hr/>	
	181	boxes

## PLANT LEGISLATION.

Mr. A. E. Aspinall, honorary representative of the Dominica Permanent Exhibition Committee in London, kindly undertook to receive and distribute the fruit. The Committee is under a deep obligation to Mr. Aspinall for his assistance, and also to Messrs. Scrutton, Sons, & Co., for allowing the fruit to be carried freight free on their steamers. Mr. R. E. A. Nicholls has rendered valuable assistance locally, by purchasing the limes and superintending their packing and despatch.

## PLANT LEGISLATION IN DOMINICA.

The first step in the direction of plant protection was taken in 1898, when Act No. 3 was passed to provide against the importation of articles likely to introduce diseases among plants. Under the authority of this Act a Proclamation, dated August 27, 1898, prohibited the importation from Ceylon of plants, seeds, berries, earth, and soil. This Act was suspended by Law No. 9 of 1904, in which provision is made for the fumigation and disinfection of imported plants, cuttings, buds, grafts, bulbs, roots, and seeds, and their packages; also fruit and vegetables intended for propagation, and not for consumption as food.

Under Law No. 6 of 1907 power is conferred to prohibit by proclamation the importation of plants, cuttings, bulbs, roots, seeds, or berries, or any earth or soil, or any article packed therein, or any packages, or other articles or things likely to be the means of introducing any plant disease.

A Proclamation dated February 5, 1909, under No. 6 of 1907, prohibits the importation into Dominica of all plants from Dutch Guiana which are likely to be a means of introducing disease from that country.

A Proclamation dated October 26, 1910, prohibits the importation of banana plants and suckers from all countries of Central or South America, and from the island of Trinidad, also of coco-nuts in husk and all growing plants or parts of plants of coco-nuts, from Cuba, Jamaica, Trinidad, and all countries of Central or South America.

A Proclamation dated August 7, 1915, prohibits the importation of citrus plants and citrus budwood from the United States of America. This is superseded by a Proclamation dated October 9, 1916, which applies to citrus plants, citrus budwood, or citrus fruit, or any parts of such plants from the United States of America, Cuba, Jamaica, Haiti, San Domingo, and Porto Rico.

A second Proclamation of the same date restricts under certain conditions the entry of rooted plants from the countries named in the above Proclamation.

A Proclamation dated October 29, 1917, prohibits the importation of seed-cotton or cotton seed from all countries or places outside the Colony of the Leeward Islands, save and except from some other Presidency of the Colony or from the Colony of Trinidad and Tobago and its dependencies, or from the Colonies of Grenada, St. Vincent, and St. Lucia, provided, however, that small quantities of cotton seed for experimental purposes may be imported into the Presidency of Dominica, on the written permission of the Superintendent of Agriculture, on such terms and conditions as he may prescribe.

With regard to the export of plants, it is only necessary to state that such cannot be admitted into the United States unless accompanied by a certificate showing that they have been inspected by a duly authorized official, and found free from injurious plant diseases or insect pests.

Persons wishing to export plants to the United States from Dominica should notify the Curator of the Botanical Gardens, who will arrange for the inspection, and the issue of the necessary certificates.

The importation of nursery stock into the United States by mail is prohibited

## Details of Administration.

### EXPENDITURE, RECEIPTS, ETC.

The votes for the Agricultural Department for the year were as follows :—

	£	s.	d.
Salaries Curator, Assistant Curator and Chemist, and Foreman ...	602	0	0
Travelling expenses .....	50	0	0
Maintenance Botanic Gardens .....	280	0	0
Cultivation of saleable products .....	260	0	0
Fumigation of imported plants .....	5	0	0
Maintenance Public Gardens .....	15	0	0
Purchase of special manures .....	50	0	0
Printing Reports, etc. ....	40	0	0
Cacac Prize Holdings Competition .....	25	0	0
Experimental Lime and Coco-nut Plantations .....	175	0	0
Purchase of vegetable seeds .....	15	0	0
Trial shipments of fruit .....	20	0	0
Field experiments .....	20	0	0
Chemicals and apparatus .....	55	0	0
Lime Mill for Experiment Station .....	50	0	0
Telephone rental .....	8	0	0
Shed for Meteorological Instruments .....	15	0	0
Repair to Ladies' Cloak Room .....	5	0	0
Contingencies .....	10	0	0
Total .....	£1,700	0	0

The actual expenditure during the year under the above heads was £1,327 7s. 2d. The grant to meet the cost of training agricultural pupils was £195, of which £116 8s. 2d. was expended. The total gross expenditure was therefore £1,443 15s. 4d.

The receipts under the various heads were as follows :—

Cacao, £280 1s. 11d.; Limes, £180 12s. 2d.; Plants, £79 9s. 4d.; Fruit, £27 12s. 8d.; Vegetable seeds, £18 14s. 8d.; Cola nuts, £13 5s. 5d.; Miscellaneous, £2 10s. 10d. Total, £602 7s. 0d.

The total cost of the Agricultural Department during 1917-18 was therefore £841 8s. 4d.

### STAFF CHANGES.

The Assistant Curator and Chemist left the island on leave on May 31, in order to undertake war work in England. He is likely to remain away during the continuance of the war.

E. J. Pierre, Overseer in connexion with Agricultural Instruction, resigned, and B. J. Paul, late Agricultural Pupil, was selected to fill the vacancy.

### ADDITIONS AND REPAIRS TO BUILDINGS, NURSERIES, ETC.

A small structure for housing meteorological instruments was built, and a few minor repairs to buildings were effected.

The boundary of one of the small plots on the western side of the Gardens, which had long been in dispute, was settled, and twenty-four reinforced concrete posts for carrying a wire fence were placed in position on the line.

### CORRESPONDENCE AND DISTRIBUTION OF INFORMATION ON AGRICULTURAL MATTERS.

During the year 882 communications were despatched from the office of the Department, and ninety minute papers were dealt with. Forty-six copies of the various issues of the *West Indian Bulletin*, and 164 copies of the Annual Report on the Agricultural Department for 1916-17 were distributed free of charge to leading planters, officials, and others in the island.

A considerable number of planters and others desiring information on agricultural matters called at the Gardens during the year.

A number of new books were added to the Library during the year, and the publications of a number of Tropical Agricultural Departments were duly received, and bound. The opportunity is again taken of thanking those Departments who kindly forward their publications.

### PLANT AND SEED EXCHANGES, FOREIGN AND LOCAL.

Contributions of seeds and plants were received from the following: the Imperial Commissioner of Agriculture; Royal Gardens, Kew; United States Department of Agriculture; Botanic Gardens, Buitenzorg, Java; the Agricultural Departments of Trinidad, Jamaica, British Guiana, Northern Nigeria, Antigua, St. Kitts, and Montserrat; also from the Hon. Dr. Nicholls, C.M.G.; Hon. W. H. Porter, I.S.O.; and Messrs Rowntree and Co., Picard.

Seeds and plants were sent to the Imperial Commissioner of Agriculture; Royal Gardens, Kew; United States Department of Agriculture; Botanic Gardens, Buitenzorg, Java; Ministry of Agriculture, Cairo, Egypt; Forest Department, Nairobi, British East Africa; the Agricultural Departments of Barbados, British Guiana, Trinidad, St. Vincent, Grenada, St. Lucia, St. Kitts, and Montserrat.

### VISITS BY OFFICIALS OF THE DEPARTMENT.

Sir Francis Watts, K.C.M.G., Imperial Commissioner of Agriculture for the West Indies, paid a visit to the Gardens on July 24, while on his way from the Northern Islands to Barbados.

Mr. W. Nowell, D.I.C., Mycologist on the staff of the Imperial Department of Agriculture, arrived in the island on June 28, for the purpose of continuing his investigations of the fungus diseases which attack lime trees. He left for Barbados on July 8.

Other visitors during the year were—Mr. W. R. Dunlop, Scientific Assistant on the staff of the Imperial Department of Agriculture, and Mr. F. R. Shepherd, Agricultural Superintendent, St. Kitts.

### METEOROLOGICAL RETURNS.

#### RAINFALL.

The rainfall at the Botanic Gardens for 1917 amounted to 80.80 inches, or 3.64 less than the previous year, and 2.50 inches more than the average annual precipitation of the last twenty-five years, which is 78.30 inches.

The following table shows the mean monthly and annual rainfall at the Botanic Gardens from 1893 to 1917, a period of twenty five years, and the accompanying chart shows at a glance the fluctuations from year to year.

**RAINFALL AT THE BOTANIC STATION, DOMINICA, 1898-1917.**

Month.	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	Mean monthly rainfall	
January ...	3.62	10.20	4.08	5.52	2.60	3.00	6.78	2.25	4.32	2.01	3.10	7.92	3.88	3.74	4.48	1.56	2.30	5.20	11.46	8.21	7.48	3.22	1.76	10.70	5.00	4.98	
February	7.65	4.99	1.09	1.23	3.21	2.11	3.00	1.15	0.88	0.43	5.01	5.58	2.56	2.04	3.82	1.16	5.02	11.42	4.00	1.32	2.32	5.56	1.04	1.90	4.10	3.80	
March ...	2.97	4.39	5.35	2.73	3.36	1.53	1.32	3.56	3.27	2.69	2.44	2.16	4.38	0.90	1.96	3.68	2.08	1.16	3.11	4.66	7.29	2.23	.84	4.52	6.74	3.17	
April ...	4.71	2.33	2.92	1.27	1.39	0.75	0.60	1.29	0.25	2.80	0.57	1.61	1.90	3.18	2.68	3.08	8.12	2.86	5.00	3.38	1.57	6.45	15.75	1.22	.47	3.04	
May ...	5.45	3.09	10.08	6.12	12.75	1.19	1.76	7.62	2.05	6.86	2.44	1.58	4.32	3.78	1.64	2.24	1.32	7.30	11.16	1.56	3.46	2.58	3.65	2.05	2.94	4.38	
June ...	16.12	8.22	3.19	8.23	6.50	11.78	7.23	5.59	12.18	12.89	9.02	6.00	5.54	9.46	5.54	6.16	9.00	14.26	6.54	5.44	3.49	7.27	9.17	4.82	15.34	8.35	
July ..	13.67	8.62	7.13	14.88	8.80	14.75	10.08	10.50	22.96	9.74	8.91	10.38	6.10	10.10	8.00	9.22	9.86	12.60	8.08	5.83	7.57	11.83	14.84	8.23	13.70	10.65	
August ...	11.86	5.84	9.67	7.07	8.67	16.35	6.32	7.34	13.53	7.41	18.41	7.69	14.18	7.30	7.40	9.41	13.12	10.22	11.43	4.88	10.93	3.98	14.74	16.58	8.53	10.08	
September	11.15	8.22	17.42	6.47	4.51	7.89	7.04	5.28	5.86	8.62	9.69	11.32	8.32	10.88	11.60	7.52	6.44	8.90	15.34	3.32	8.39	7.71	11.36	6.20	15.02	9.39	
October ...	8.94	14.41	11.32	3.93	8.42	7.97	1.81	6.60	4.84	5.75	12.73	10.21	9.10	8.12	7.80	5.12	13.10	3.82	7.06	7.26	10.40	5.13	8.41	10.06	2.46	7.77	
November	3.18	6.14	11.21	16.81	7.81	6.55	5.02	3.49	6.43	11.20	4.17	3.13	5.48	9.58	5.98	1.96	4.33	5.40	6.94	11.20	4.28	9.44	10.05	14.28	1.32	7.03	
December	10.61	4.99	5.66	6.60	10.55	5.86	2.19	3.68	4.32	7.16	14.23	4.84	5.72	2.94	8.42	7.80	5.82	7.50	7.14	6.66	2.72	9.70	8.40	3.77	4.58	6.51	
Total ...	98.93	81.44	89.07	80.86	78.77	79.73	53.15	57.75	81.09	77.46	90.72	72.45	72.06	72.02	69.30	59.91	81.14	90.64	97.26	63.75	69.80	75.10	100.01	84.42	80.80		

## METEOROLOGICAL.

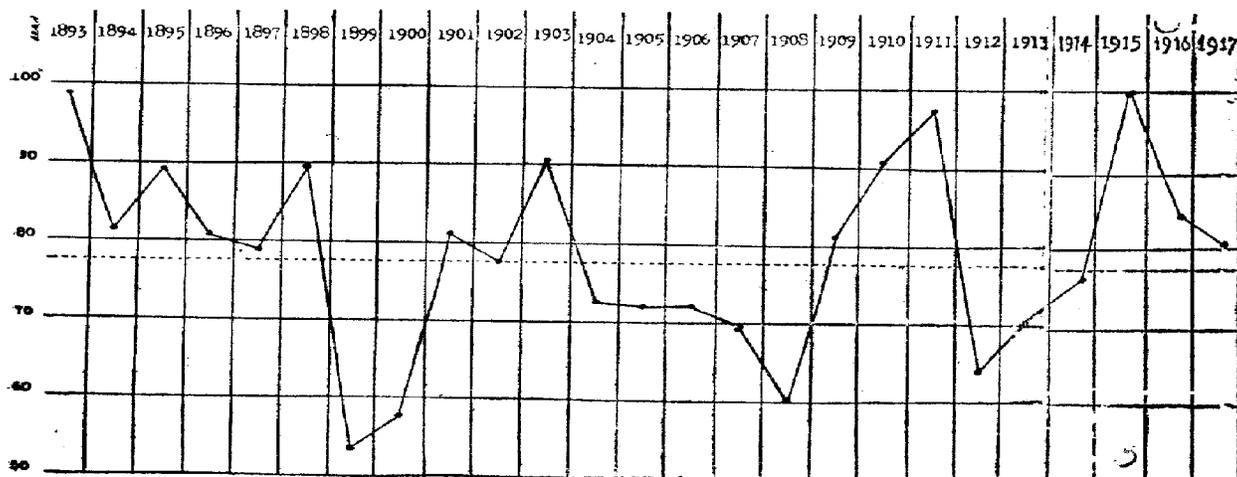


Diagram showing annual rainfall in the Botanic Gardens, Dominica, 1892-1917. The average for this period—73.30 inches—is shown by the dotted line.

Another chart shows the mean monthly rainfall over the same period. From this it will be observed that the months of February, March and April are the dry months, with a mean rainfall of about 3 inches, and that July and August are the wettest months, with a precipitation of over 10 inches.

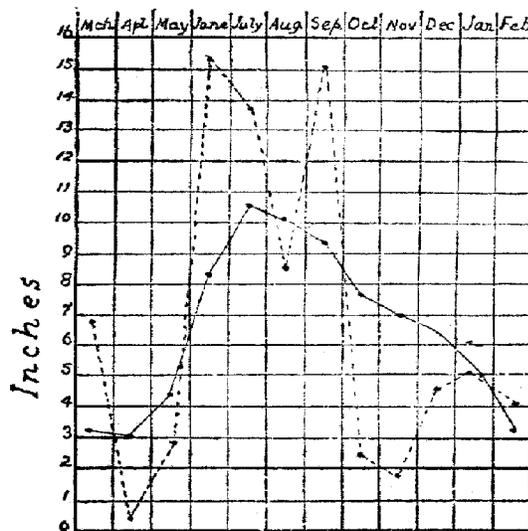


Diagram showing mean monthly rainfall Botanic Gardens, Dominica, for twenty-five years 1893-1917. The monthly rainfall for the year under report is shown by the dotted line.

Following the above will be seen the monthly rainfall at the thirty recording stations located in different parts of the islands, and the thanks of the Department are due to those planters who furnish the information from year to year.

From this table it will be observed that the mean rainfall for the thirty stations is 110.53 inches. By taking the island in districts, we obtain the following returns: the thirteen Leeward Coast stations registered a mean of 88.67 inches; the three Windward Coast stations averaged 125.90 inches; eight Inland stations 149.30 inches, and six Laseye stations 90.49 inches.

