

TRINIDAD AND TOBAGO.

Council Paper No. 85 of 1932.

DEPARTMENT OF AGRICULTURE.

**Administration Report of the Director of Agriculture
for the year 1931.**

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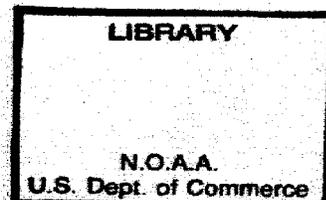
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REPORT ON THE DEPARTMENT OF AGRICULTURE, 1931.

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DEPARTMENT OF AGRICULTURE.

Administration Report of the Director of Agriculture
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M. P. No. 11175.

I.—AGRICULTURAL EXPORT INDUSTRIES.

In common with primary producers all the world over those engaged in agriculture in Trinidad and Tobago have, during the year under review, had to grapple with the difficult task of adjusting production costs to unprofitable prices. This difficulty has been greatly enhanced by the fact that the year 1931 has been the third in succession during which world prices have been abnormally low for the major export crops of the colony.

2. Statistics for one or two years often prove misleading, and, in the following table, the values of the agricultural exports for 1931, according to the Customs returns, are compared with the values for the three-year periods 1926-1928 and 1929-1931. These figures will be best understood if they are studied in relation to the export figures given later under individual crops.

Agricultural Exports.

Article.	1926-1928 average yearly value.	1929-1931 average yearly value.	1931 value.
Cacao	£ 1,531,148	£ 1,136,174	£ 826,333
Sugar and By-Products	1,014,677	939,360	934,633
Coconuts and Coconut Products	223,768	201,567	115,515
Coffee	12,833	20,370	16,276
Limes and Lime Products	6,056	27,886	34,921
Grapefruit and Oranges	2,028	3,547	4,587
Tonca Beans	1,824	7,665	3,583
Pulse, Beans, and Peas	4,816	10,012	2,783
Livestock and Hides	8,441	7,076	6,221
Bitters	76,862	50,974	27,288
Miscellaneous	20,192	4,245	3,485
	£2,902,645	£2,408,876	£1,975,625

3. Cocoa has been described by the commercial community as the most sensitive economic barometer of the colony, and unfortunately this crop has been most affected by the depression: during the years 1926-1928 the average yearly value of the cocoa exports amounted to £1,531,148; for the next three-year period 1929-1931 the yearly value fell to £1,136,174; and in 1931—the last year of the period—the value was only £826,333.

4. With regard to sugar, the fall in price is obscured by the larger exports in 1929 and 1931.

5. Exports of coconuts and coconut products in 1931 were worth approximately half of the average yearly value for 1926-1928, but some allowance must be made for the copra retained in the Colony in 1931 for the manufacture of edible oils and lard substitutes. Among the minor products exported, coffee, grapefruit and oranges, lime products, and tonca beans show definite increases in value.

6. During the year the total acreage under crops has been broadly the same as in the previous year. In certain areas there has been a tendency to substitute canes for cocoa, while plantings of crops other than canes, cocoa, and coconuts have been common, but on a small scale. Owing largely to the depressed conditions many properties have not received adequate attention, but, far from there having been a serious dislocation in the agriculture of the colony, the total tonnage of exports in 1931 was, in fact, appreciably greater than in 1930.

COCOA.

Exports and Values.

7. Quantities and values of the cocoa exports during the six years 1926-1931 are given below, together with the average prices for plantation cocoa according to figures supplied by the Cocoa Planters' Association.

			<i>Exports</i>	<i>Value.</i>	<i>Price per</i>
			<i>lb.</i>	<i>£</i>	<i>fanega (lb.).</i>
					<i>\$ c.</i>
1926	..	..	50,067,881	1,270,335	12.99
1927	..	..	51,934,857	1,671,883	15.82
1928	..	..	58,008,156	1,651,179	13.21
1929	..	..	61,888,740	1,446,127	10.99
1930	..	..	53,825,120	1,136,056	9.34
1931	..	..	57,186,512	826,333	6.88

8. The crop distribution during the year was unusual; in May and June there were abnormally large pickings, but from October to December the crop was almost negligible owing to unfavourable climatic conditions.

Witchbroom Development.

9. Witchbroom has steadily increased both in extent and in intensity. At the beginning of the year under review, 1,852 properties were affected; at the end of the year the number had reached 2,454. The disease is now widespread throughout the island, with the exception of the greater part of the Northern Range which so far remains untouched.

10. Detailed information regarding various aspects of this disease will be found in the Mycologist's report and in the account by the Agronomist of the work at Marper Estate.

Witchbroom an Economic Problem.

11. The witchbroom problem is primarily an economic one, and at no time in the history of the cocoa industry has it been as important as at present that owners should critically examine their organization and their cultural methods with a view to ensuring that essential work is not neglected and that maximum net returns are obtained. Only by this means can additional revenue be secured to compensate for the extra expenditure that is now compulsory, if witchbroom is to be kept within manageable bounds.

12. Turning for the moment to the smaller proprietors, there is one line of endeavour that should commend itself to them. I refer to the need for improvement in the preparation of their cocoa and in their methods of marketing it. To-day the small man receives on the average from \$1.00 to \$2.00 less per fanega for his cocoa than the larger proprietor. That acceptance of this handicap is quite unnecessary has been proved by two groups of small cocoa growers in Tobago who have established communal fermentaries; the quality of their cocoa has appreciably improved, and their profits have likewise increased.

Urgency of Control Measures.

13. The ultimate effect of the disease on the cocoa industry of the island is clearly dependent on future market prices. These cannot be foreseen and unceasing vigilance in searching for and destroying diseased material, whether brooms, pods, or cushions, is an obligation that rests on all cocoa proprietors, in their own interest as well as in the interest of their neighbours.

SUGAR.

Sugar Production.

14. In spite of fears at different times during the growing season that the rainfall would prove inadequate, weather conditions were on the whole favourable and the sugar output for the year was a record for the island. According to returns by the Sugar Manufacturers' Association, the sugar production during the past six years has been :—

							Tons.
1926	..	..	..	..	..	..	73,561
1927	..	..	..	..	..	..	51,982
1928	..	..	..	..	..	..	81,551
1929	..	..	..	..	..	..	89,926
1930	..	..	..	..	..	..	79,848
1931	..	..	..	..	..	..	98,573

Exports and Values.

15. The Customs returns give the following figures for the exports of sugar, molasses, and rum during the years 1926-1931 :—

	SUGAR.		MOLASSES.		RUM.		Prices Grey Crystals f.o.b. per ton.
	Exports.	Value.	Exports.	Value.	Exports.	Value.	
	Tons.	£	Gals.	£	Gals.	£	£ s. d.
1926	65,680	1,003,230	1,427,274	14,330	71,213	10,933	14 15 0
1927	41,805	762,366	1,188,840	14,471	35,699	8,155	16 10 0
1928	74,112	1,201,477	1,622,018	16,913	55,088	12,157	14 10 0
1929	81,503	1,049,863	1,373,420	18,227	73,841	13,639	11 10 0
1930	69,138	776,167	899,051	11,238	72,063	14,313	10 5 0
1931	86,054	902,990	1,599,414	15,924	86,260	15,719	9 0 0

Maintenance of Industry.

16. The loans authorized under the Sugar Industry Relief Ordinance of 1930 proved of material benefit to the sugar industry, as the assistance given by Government created a sense of security at a critical stage. With the exception of a small estate that closed down at the end of June, all the sugar estates have continued in operation in spite of adverse market conditions.

Cane Farmers.

17. Approximately 18,000 farmers—about the same number as in 1930—were engaged in the growth of canes for sale to the Factories and their output amounted to 384,948 tons as compared with 300,000 tons in 1930. Estate grown canes in 1931 amounted to 559,421 tons. Partly owing to the provisions of the Sugar Industry Relief Ordinance and partly owing to the voluntary action of the Sugar Manufacturers, cane farmers have enjoyed the unique advantage of not having been penalized by the decline in sugar prices in recent years. On the basis of 12s. per ton, cane farmers received £230,990 for their crops; this sum was more than £100,000 in excess of the amount to which they were entitled under the sliding scale previously in force.

Froghopper Blight.

18. Froghopper damage was comparatively severe in 1931 in the Northern and Central plains but light in the Naparimas.

19. First brood nymphs made their appearance at the beginning of June, but blight was nowhere widespread or severe. The emergence of second brood nymphs commenced in most districts about the middle of July. Under the influence of the copious rains which prevailed during August, this brood made rapid headway and the nymphal population was intense over a large area. Emergence of second brood adults in large numbers commenced during the second week in August and by the beginning of September a considerable acreage of cane was involved in severe second brood blight. Recovery was somewhat retarded by the dry weather prevailing at the time. A rapid increase in the abundance of "Green Muscardine" fungus, which rapidly parasitized the pest, brought the

brood to an end about the middle of September. The third brood appeared later but was not responsible for anything like the damage caused by the second brood. At the end of December the froghopper season came to a close with the emergence of a straggling fourth brood, which was of small dimensions and did very little damage.

COCONUTS.

Exports and Values.

20. Compared with the previous year there was a reduction in the quantities of nuts, copra, and coconut oil exported. Although the quantity of copra exported was not far below that of the exports in 1930, the reduction in value amounted to nearly £75,000. The quantities and values of the exports for the past six years, and the prices of copra for the same period, are given below :—

	COCONUTS.		COPRA.		COCONUT OIL.		Price of Copra.
	Exports.	Value.	Exports.	Value.	Exports.	Value.	
	Nuts.	£	lb.	£	Gals.	£	100 lb.
1926	5,041,036	25,135	13,858,996	166,263	82,791	15,373	23s.
1927	6,463,765	32,298	12,498,983	146,895	58,061	11,102	22s.
1928	6,799,655	34,824	21,351,860	227,555	65,285	11,860	20s.
1929	13,608,118	66,320	23,979,882	209,732	34,707	5,493	17s.
1930	5,886,127	25,830	21,891,259	175,965	41,154	5,938	14s.
1931	4,487,875	12,549	19,484,808	101,148	20,702	1,818	8s. 9d.

Coconut Oil Factories.

21. The reduction in quantities of copra and coconut oil exported is in part explained by the requirements of the local coconut oil factories which have supplied in a large measure the domestic demand for lard substitutes and edible oils. The tariff protection given to this local industry has reacted favourably on the producers of copra, who received a small bonus each quarter of the year over and above the market value of copra. In 1931 the factories purchased 6,148,965 lb. of copra and 46,304 gallons of coconut oil.

Coconut Wilt.

22. This disease has during the year exacted a heavy toll on coconut estates throughout the island with the exception, fortunately, of those situated in the ideal coconut areas along the sea coast. Further reference is made to this disease later in my report.

Red Ring.

23. Losses from red ring continue to be serious in the aggregate in certain areas.

LIME AND LIME PRODUCTS.

Acreage.

24. The market price of lime oil has continued to be an inducement to extend the cultivation of this crop, and the plants distributed from the Government nurseries during the year are calculated to occupy 185 acres. To this area must be added that planted with supplies from privately owned nurseries and plants layered from old trees on certain estates. An approximate estimate of the land now under limes in the colony is 1,500 acres.

Exports of Lime Products.

25. *Essential Oil*:—Production of lime oil has increased by approximately 50 per cent. in the last year. It is obtained principally by distillation, and, of the 1931 exports, only 109 gallons were hand-pressed. The following are the export figures for the past six years :—

	Exports.	Value.
	Gals.	£
1926	431	5,312
1927	104	1,454
1928	495	5,894
1929	797	9,516
1930	1,647	19,457
1931	2,413	32,071

Lime Juice.

26. The low price of raw and concentrated juices caused a serious reduction in exports of that commodity to the United Kingdom, and the 1930 United States tariff appears to have definitely closed that market. The following are the exports for the past six years :

	CONCENTRATED JUICE.		RAW JUICE.	
	Exports.	Value.	Exports.	Value.
	Gals.	£	Gals.	£
1926	7,886	1,926	Nil	Nil
1927	4,488	1,154	Nil	Nil
1928	5,653	1,487	Nil	Nil
1929	55,455	11,562	Nil	Nil
1930	21,762	3,759	47,554	4,096
1931	4,012	458	22,931	2,007

Citrate of Lime.

27. Two factories were equipped for the manufacture of citrate of lime, and 21,589 lb. were shipped in 1931 valued at £257.

Green Limes.

28. The value of green limes exported in 1931 amounted to £128. The principal market for green limes is the United States, where a general tariff of \$2.00 per 100 lb. is in force ; the months of best prices in that country are stated to be April to July, which is rather too early for the Trinidad crop.

29. Canada is a possible market, and, in co-operation with the Canadian British West Indian Produce Co., Ltd., a firm of fruit and vegetable importers and distributors, an arrangement was made to advertise this product in Canada. Sixteen barrels of limes were presented by various Trinidad growers, and the Permanent Exhibition Committee bore the expenses of packing and transport.

GRAPEFRUIT.*Exports.*

30. A further increase is to be recorded in grapefruit exports. Comparison of the shipments for the last six years in terms of boxes is as follows :—

	Exports.
	Boxes.
1926	54
1927	1,649
1928	23
1929	807
1930	2,184
1931	4,377

Acreage.

31. The distribution of 6,022 budded plants during 1931 from the Government nurseries makes an addition to the Colony's acreage, after deduction of plants used for supplies, of about 75 acres. The total colony acreage is now estimated at approximately 535 acres.

Central Packing House.

32. The outstanding event of the year, as far as the grapefruit industry is concerned, was the erection by the Co-operative Citrus Growers' Association of a Central Packing House equipped with modern machinery. The Packing House is a fine building measuring 140 feet by 60 feet and is provided with a railway siding. It was constructed under the supervision of Mr. A. V. Stollmeyer. The building was opened in time for the commencement of the 1931-1932 shipping season.

Legislation.

33. An Ordinance to control the export of grapefruit and budded oranges was brought into force on 1st October, 1931. It is designed to compel all grapefruit and budded oranges intended for marketing abroad to be passed through the Packing House of the Co-operative Citrus Growers' Association and to be sorted according to prescribed grades and sizes and packed in standard containers. Such fruit is subject to Government inspection and certification, and Mr. R. O. Williams was appointed Chief Fruit Inspector and Mr. Collier Jones an Inspector under the Ordinance.

COFFEE.

34. Exports of this crop showed an appreciable increase over the previous year, rising from approximately 500,000 lb. to over 850,000 lb. Robusta coffee bears well at the lower elevations and is finding favour with some planters as an alternative to cocoa. Success with Robusta coffee is dependent on the larger yielding habit of the plant, as compared with Arabica, which is of course a higher priced coffee.

35. Quantities and values of the exports during the years 1926-1931 are given below :—

	Exports.	Value.
	lb.	£
1926	497,688	20,371
1927	164,072	7,246
1928	265,410	10,883
1929	817,983	32,309
1930	491,988	12,525
1931	857,920	16,276

TONCA BEANS.

36. The good prices paid for Tonca Beans in recent years have led to a greatly increased interest in this crop. Exports for the past six years follow :—

	Exports.	Value.
	lb.	£
1926	83	8
1927	10,015	1,669
1928	884	147
1929	15,266	2,544
1930	9,219	1,538
1931	22,950	3,583

FOODS—IMPORTED AND LOCAL GROWN.

37. For convenience this subject is dealt with in this section. In my report for last year, I drew attention to the appalling bill that the colony pays each year for imported foods. In 1930 the duty-paid value of imported foods of all kinds (not including alcoholic beverages) amounted to over £1,600,000: in 1931 the value was approximately £300,000 less. The saving was appreciable and is all to the good, but the reduction quoted is not a true index of the extent to which locally grown food was substituted for imported, owing, in particular, to the fact that although flour shows a saving in value of over £100,000, the quantity imported in 1931 was somewhat in excess of the imports of this commodity in 1930.

38. The following articles show reductions both in value and in quantity :—

Imports in 1931 Compared with 1930.

	QUANTITY.		VALUE DUTY-PAID.	
	1931.	Decrease c.f. 1930	1931.	Decrease c.f. 1930.
Cattle for slaughter	6,560	755	£ 73,518	£ 7,808
Meats and Fish	11,781,661 lb.	790,294 lb.	220,615	33,663
Rice	35,307,749 lb.	1,141,423 lb.	175,925	62,298
Vegetables	10,247,105 lb.	1,301,810 lb.	67,735	15,964
Dholl	1,161,192 lb.	527,446 lb.	7,730	4,886
Sugar (Refined)	91,886 lb.	1,928,758 lb.	1,958	14,844
Edible Oils	74,798 gals.	265,387 gals.	18,972	57,699
Lard substitutes	402,639 lb.	1,891,246 lb.	11,090	39,948

39. The reductions recorded under the imports of refined sugar, edible oils, and lard substitutes reflect the benefits of tariff protection.

40. There was general evidence of an increased interest in food production in 1931, and local grown meat was more commonly seen on the market. Some measure of progress can, therefore, be recorded, but much remains to be accomplished. A bill of £802,328 for imported cattle, meats, fish, flour, and rice is excessive, and it cannot be regarded as satisfactory that the imports of milk, butter, eggs, fruits, and nuts showed an increase in 1931 over the previous year.

41. Reluctance to grow food crops may be traced to a number of causes:—

- (1) For more than 50 years—prior to 1920—cocoa averaged over \$20.00 per bag in value and it was sound business during this period to neglect food crops in favour of an export crop the returns from which allowed of an ample margin for the purchase abroad of relatively less valuable articles. To-day the position is altered for cocoa is worth half what it used to be.
- (2) The clay soils common in the country are not well suited for West Indian root crops.
- (3) The fear of praedial larceny acts as a deterrent to the planting of food crops.
- (4) Attempts to dispose of ground provisions and other local food crops on a commercial scale often prove extremely disappointing. In 1931, for example, the maize crop was larger than usual and growers experienced the greatest difficulty in effecting its sale, even at very low prices.
- (5) The limited amount of rice land now available prevents extension of the growth of this crop.

42. It is thus seen that traditions of the past and genuine difficulties of the present all conspire to restrict the growth of food crops for local consumption. But the position is unsound, and I cannot too strongly urge that cultivators should more generally adopt some form of mixed farming that combines, with the cultivation of export crops, the rearing of livestock and the growth of vegetables and ground provisions.

II.—DEPARTMENTAL INSTITUTIONS AND OTHER ACTIVITIES.

43. Detailed reports on the work at River Estate, Marper, the Government Stock Farm, the St. Augustine Nursery, and the Citrus Experimental Station have been prepared by the officers in charge and are attached to my report, together with reports by the Government Veterinary Surgeon, the Agronomist, and the Chief Inspector under the Plant Protection Ordinance. The comments and observations that follow relate, in part, to the work of the Departmental institutions, and, in part, to other activities during the year.

COCOA.

River Estate.

44. River Estate was maintained in good order during the year. In the report of the Manager will be found information regarding the crops and the general developmental work undertaken, while in the report of the Agronomist the results of the experimental work, with the exception of the selection of heavy bearers, are brought up-to-date.

Notes on Experimental Work.

45. Brief notes regarding certain of the experiments follow:

46. *Distance spacing.*—Over a period of 14 years the advantage has been in favour of a distance of 12 feet by 12 feet with 14 feet by 14 feet a close second. The yield, in the year 1931, was highest on the 14 feet by 14 feet plot, but there was little difference in this year between any of the distance plots which ranged from 12 feet by 12 feet to 18 feet by 18 feet.

47. *Shade Reduction.*—During the period 1911-1925 the average yields per acre per annum were :—

Full Shade	....	....	....	....	645 lb.
Partial Shade	....	....	....	....	805 lb.
No Shade	....	....	....	....	745 lb.

From 1926 to 1931 an equal portion of each field has been manured and the average yearly yields during this period are given below :—

Full Shade	....	....	....	....	517 lb.
Partial Shade	....	....	....	....	855 lb.
No Shade	....	....	....	....	731 lb.

48. *Budded Plants vs. Seedlings.*—In this experiment yields for the years 1918-1931 show but little difference between budded plants and seedlings ; in fact, there is a slight advantage in favour of the seedlings. The type of stock may be the explanation.

49. *Colour of Pods.*—The progeny of trees bearing dark red pods has on the whole given strikingly higher yields than the progeny of trees with yellow or light red pods. The average yields for 1924-1931 were :—

	SEEDLINGS.		BUDED.	
	Single trees.	Double trees.	Single trees.	Double trees.
	lb.	lb.	lb.	lb.
Yellow pods	200	36	139	77
Light red	165	—	190	—
Dark red	197	110	495	121

50. *Fertiliser and Manurial Experiments.*—The results of these experiments have on the whole been disappointing and the subject is one that needs far fuller investigation. Reference is made, in the next section but one of this report, to the satisfactory results on certain private estates where a phosphatic fertiliser has been used for several years past.

51. The present agricultural condition of River Estate reflects great credit on my predecessor, on the Cocoa Agronomist, on the present Manager, and on others who have been responsible for the working of the estate. Credit is also due to these workers for the mass of data that has been collected in the past relating to the yields of individual trees, for the selection of high yielding strains, and for certain experimental work. But, on the experimental side the work has been handicapped by three factors :—

- (1) The property was not originally laid out with experimental work in view, and, further, the cocoa fields were not uniform in condition when the estate was taken over by Government.
- (2) At no time has the departmental staff been sufficiently adequate to allow of the necessary amount of time being devoted to experimental work.
- (3) The existing series of experiments were laid down prior to the modern development in methods of technique for field experiments.

52. As a first step towards putting the statistical and experimental work on a sounder basis, a survey of the estate and of individual fields was commenced during the year, while a start has been made in the study of certain of the statistics made available by the work in the past.

Facilities afforded to the Cacao Research Staff.

53. The Department has placed such facilities as it possesses, both in plant material and in records, at the disposal of officers of the Imperial College of Tropical Agriculture engaged on special Cacao Research.

Witchbroom Disease of Cocoa.*Witchbroom Inspection Service.*

54. The Witchbroom Staff, which consists of a Chief Supervisor, an Assistant Supervisor, and 25 Assistant Inspectors, was active examining new properties for evidence of the disease and inspecting the control measures adopted by owners on properties known to be affected. During the year, 22,736 visits were made to estates for these purposes.

55. It has unfortunately been found impracticable, owing to the financial depression, to insist on a standard of effort and a scale of expenditure that is recognized by the Department to be urgently needed, and it was only in cases of serious neglect that the powers given under the Plant Protection Ordinance were exercised; 385 orders were issued, the majority of which were more or less satisfactorily complied with; compulsory action was taken in 27 cases; and 10 proprietors were prosecuted.

56. In addition to routine duties, special examination of cocoa properties in the Northern Range was undertaken when the disease was discovered in the Diego Martin Ward. Towards the end of the year an intensive examination was made for brooms and mushrooms on a small and neglected property. As a result 3,167 mushrooms were discovered during two months on the trees on a plot $2\frac{1}{2}$ acres in size and 175 mushrooms were found on material lying on the ground on one acre, demonstrating in an alarming fashion the dangers of neglect. The property in question borders on the Government property at Marper where the mushrooms for the same period, calculated on the basis of the same area, amounted to only 48, apart from those that appeared on brooms deliberately retained for observation purposes.

Witchbroom Investigations at Marper.

57. The practical work at Marper estate, which is situated in one of the areas most heavily affected with witchbroom, was under the supervision of the Agronomist in whose report will be found a detailed account of the field experiments.

58. Purchased in 1929 with the special object of enabling the Department to study the disease and to demonstrate on its own property, and on a commercial scale, the effect of routine cutting out of diseased material, the Marper cocoa estate has in the past two years been developed more and more on an experimental basis.

59. It is early to attempt to draw final conclusions, but on the negative side it is clear, up-to-date, that reliance cannot be placed on any special fertiliser as making a cocoa plant intolerant to witchbroom; and, while Bordeaux mixture has given evidence of exerting a certain measure of control, the results of spraying in general are far from encouraging. In one set of experiments a proprietary spray was used that was sufficiently strong to destroy temporarily most of the foliage on the trees, but the disease appeared in this plot in considerable quantities later.

60. Perhaps the two most encouraging features of the data collected at Marper are: (1) the fact that the undulating land within close proximity of the low lying and heavily infected vega has consistently shown a far lower percentage of infection, and (2) although the estate has been regularly invaded with spores from the surrounding area the disease cannot be said to be out of control.

Experimental Trial of Fertilisers on Cocoa.

61. In the search for some method of increasing cocoa yields at a profit, more consideration should be given by planters to the possibilities of commercial fertilisers and of phosphates in particular. The limited trials made in the past have admittedly been disappointing. For example, the fertiliser experiments at River Estate and elsewhere, which are described in the Agronomist's report clearly show that applications of fertilisers may easily prove unremunerative, and a commercial firm making investigations locally some years ago failed to, secure either alluring photographs or seductive data with which to advertise their fertilisers.

62. On the other hand, several planters in the colony are firm believers in the use of fertilisers, and the Department is indebted to Mr. M. Leotaud for some most interesting and striking figures that indicate a material benefit from the use of Buccaneer phosphate on several properties in which he is interested. No attempt was made to lay out experimental plots, but some of the fields were given phosphates and others were not. In every case the fertilised fields showed a definite increase in yield.

63. On one estate seven fields were selected; three were fertilised and four were not. For five years (1923-1927) previous to the application of the fertilizer the three fields had averaged 12 baskets (28-30 lb.) of dry cocoa per acre and the four control fields had averaged 11 baskets. For the five following years (1927-1931) the fertilised fields averaged 23 baskets and those that received no fertilisers gave an average yearly yield of 11½ baskets. The increase per acre was over 80 per cent. Other fields fertilised in succeeding years gave increases of 70 per cent., 40 per cent. and 25 per cent. respectively.

64. A note of warning is necessary: soil conditions vary from one estate to another, and any but elaborate experiments may be misleading, but the evidence kindly placed at the disposal of the Department by Mr. Leotaud certainly justifies the recommendation that planters should make experimental trial of this class of fertiliser.

65. In this connection I desire to acknowledge my indebtedness to Professor F. Hardy of the Imperial College of Tropical Agriculture for drawing my attention to the fact that, in the course of his investigations of cocoa soils in Trinidad and Tobago as well as in Grenada, he has been impressed, *inter alia*, with the correlation between yield and adequate supplies of available phosphates.

SUGAR.

66. It is to be regretted that there are no sugar specialists on the staff of the Department, but the Director of Agriculture, as Chairman of the Sugar Cane Investigation Committee and as a member of the Standing Cane Farming Committee, keeps in touch with the general requirements of the Sugar Industry, while the Assistant Director, as Chairman of the Scientific Committee, is in close contact with the investigational work of the technical officers engaged on soil, manurial, and entomological studies relating to sugar cane cultivation in the colony; the results of these investigations are reported regularly in the Proceedings of the Sugar Cane Investigation Committee.

Cane Farming.

67. Cane farming offers a wide field for detailed study, and a start has been made by the laying down of two sets of experiments to test the growth of food crops in rotation with canes.

68. The economics of cane farming in particular require investigation, as recommended by the Imperial Sugar Conference in London in 1931, and the present is a particularly opportune time for undertaking such studies as local sugar factories report a relative reduction in the past two years in the cost of estate grown canes, as compared with those purchased from cane farmers. This work must, however, await the provision of adequate funds.

Cane Variety Trials.

69. Co-operative cane variety trials between sugar estates and the Department were commenced in 1929 and have been carried out under the supervision of the Assistant Director. The experimental plots are given ordinary estate routine cultivation, and the expenses over and above the normal cost of growing canes, such as extra labour in planting and harvesting, are borne by the Department.

70. The objects of the experiments are two-fold:

- (a) To test the respective merits of both imported and locally bred canes as indicated by the yield of cane and of sugar per acre.
- (b) To learn the best time of harvesting for the varieties under test.

71. Plots of 1/20 of an acre in size were laid down following the method of randomized blocks as described by Fisher, each variety being repeated four times.

72. As little work had been done in this direction before 1929, the experiments laid down in that year, and harvested first in 1931, were in the nature of elimination tests. Several varieties then selected have since been discarded.

73. On the other hand varieties new to Trinidad, such as B. 726 and F.C. 916, were included in the 1930 planting for reaping in 1932.

74. Among the varieties selected for preliminary trials were :—

B.H. 10 (12), B. 417, Ba. 11569, Sc. 12/4, T. 1198, T. 2020, T. 2395, P.O.J. 36, P.O.J. 213, P.O.J. 2878, Uba, Co. 213 and the two newly released canes F.C. 916 and B. 726.

75. As a result of work to-date the following points emerge :

- (a) B.H. 10 (12) is still in the forefront of commercial varieties grown in Trinidad, especially on good types of soil. It does not rank as high on poorer and lighter lands.
- (b) Uba gives large tonnages under conditions that would not be tolerated by most other varieties.
- (c) Co. 213 shows great promises under bad froghopper incidence where other varieties have completely failed. The return of sugar per acre compares favourably with any other variety grown. Its growing period is, however, very long.
- (d) P.O.J. 2878 is fairly promising in the field but develops a lot of shoots near harvesting time. It might do better as a "spring plant".
- (e) B. 417 continues to give good returns on the lighter lands.
- (f) F.C. 916 and B. 726, which will be harvested in 1932 for the first time, have a most promising appearance in the fields.

76. Summaries of 1931 harvestings are given below :—

Plant Canes—Planted 1929.

YIELD IN TONS PER ACRE.

(a) Caroni—On heavy soil.

Co. 213.	B. 417.	Uba.	B.H. 10 (12).	Ba. 11569.	T. 2020	Mean.	Standard error.
32.18	30.77	30.68	27.13	24.93	22.46	28.03	1.01

(b) Esperanza—On heavy soil.

Co. 213.	T. 2020.	Ba. 11569.	T. 1198.	B. 156.	Uba.	B.H. 10 (12).	Mean.	S.E.
29.94	29.07	26.12	26.06	24.59	23.37	23.9	26.14	7.1

(c) Brechin Castle—On light to medium lands.

I.C.T.A. 36.	B. 417.	B.H. 10 (12).	T. 1198.	Ba. 11569.	T. 917	Mean.	Standard error.
27.50	23.39	24.60	24.39	22.96	22.00	24.47	7.04

(d) Waterloo—On poor medium lands.

Ba. 11569.	Co. 213.	B. 156.	Uba.	P.O.J. 213.	B.H. 10(12).	S.C. 12/4.	T. 2020.	T. 1198.	B. 417.	Mean.	S.E.
30.7	30.03	28.2	27	24.8	24.5	23.8	22.5	22.5	18.8	25.29	5.0

Sugar figures will not be available until the 1932 crop is harvested.

COCONUT SURVEY AND WILT DISEASE.

77. The Coconut Survey, undertaken primarily for the purpose of obtaining definite information relating to the incidence of coconut wilt, was completed at the end of 1931. Over 1,900 properties were inspected and wilt was found on approximately 400.

78. During the year losses from this disease have been heavy, and it is certain that in a number of districts, where conditions are favourable for the disease, further deaths will occur as young fields reach the critical age.

79. The survey consisted of inspections of coconut estates and the filling in on prepared forms of data relating to the acreage under coconuts, the age of fields, the occurrence of wilt, the type of soil and subsoil, the cultural treatment, and moisture conditions.

80. The most important economic fact revealed by the survey is the non-occurrence of wilt in the more important coconut areas, such as Icados, Mayaro and Cocal, where the coastal belts, on which coconuts are grown, consist for the most part of free-draining sandy soil, often backed by lagoons.

81. Turning to the conditions under which the disease has been found, it can be stated broadly that the soils are for the most part of a heavy character, but there are complicating factors that make it impossible, at the present stage of our investigations, to point with confidence to the exact cause or causes of the occurrence of wilt. For example, the disease has been found on free-draining light soils; and, on the contrary, healthy fields have been seen on very heavy soils. Of particular interest in this connection are the following instances of fields of coconuts that have passed the age when the disease generally makes its onslaught:—

- | | | | |
|---|----|----|--|
| A.—Age 26 years; soil heavy clay; no artificial drainage | .. | .. | No Wilt. |
| B.—Age 23 years; soil very heavy clay undulating; countour drains | .. | .. | No Wilt. |
| C.—Age 50-60 years; soil heavy clay; fair artificial drainage;
no cultivation | .. | .. | No Wilt. |
| D.—Age over 20 years; soil sandy loam; little organic matter; trees
poor yielders, but no deaths. Neighbouring field similar soil but
more organic matter and more soil moisture; trees dying from
Wilt. | | | |
| E.—Age 23 years; soil sandy to clayey loam—No Wilt. Soil is similar
in physical condition to estate one mile distance where coconuts
have died from Wilt. | | | |
| F.—All fields 18 years old. Four types of soil:— | | | |
| (1) Red clay surface and subsoil | .. | .. | No Wilt. |
| (2) Brown clay surface and subsoil | .. | .. | No Wilt. |
| (3) Black clayey loam surface soil—Brown clay subsoil | .. | .. | No Wilt. |
| (4) Black clayey loam surface soil—Marl subsoil | .. | .. | Serious losses
from Wilt for
5 years past. |

82. Results up-to-date indicate the importance of intensive chemical and physical study of soils on which the disease occurs, as compared with those on which coconuts do not suffer from wilt.

83. Mr. Stell, Mycologist, Mr. J. de Verteuil, Agronomist, Mr. F. M. Bain, Chief Plant Inspector, and the County Agricultural Advisers have all taken an active part in different phases of the work, and I desire to acknowledge as well the assistance rendered by Professor F. Hardy of the Imperial College of Tropical Agriculture and by a number of planters including Captain W. F. Watson, O.B.E., Mr. E. A. Robinson, Mr. Romer Johnstone and Mr. Stanhope Lovell.

DEVELOPMENT OF THE GRAPEFRUIT INDUSTRY.

84. During the year under review, as in the past, the Department has maintained a very close connection with the development of the grapefruit industry, which is now emerging from the infant stage; and it is gratifying to be able to report that material assistance has been given, from one angle or another, to those engaged in, or contemplating, the growth of this crop.

85. Mr. R. O. Williams, Economic Botanist, was one of those who took an active part in the initial formation and organization of the Co-operative Citrus Growers' Association, and the preparation of the plans for the Central Packing House and the selection of the machinery were based on his advice. As a Government representative on the Board of Directors, Mr. Williams keeps in close touch with the work of the Association.

86. It was considered highly important that the Association should, in its early stages, have the whole time assistance of an officer familiar with the methods adopted in packing houses in Florida and Government approved of such an officer being engaged by the Department as a temporary measure each season for three years. Mr. Collier Jones was selected to fill the post and arrived in the Colony in August. His services were placed at the disposal of the Association for the erection of the Machinery in the Packing House and for practical supervision of the handling, grading and packing of fruit.

87. The grapefruit industry of this colony possesses an important fundamental advantage: practically all the trees under cultivation are the same variety, which permits of a uniform type of fruit for export. The selection by the Department some years ago of the Marsh variety, instead of, say, the Duncan, has in the main proved satisfactory. The fruit keeps well on the trees, is of good quality, and, according to experiments at St. Augustine, the variety has proved the highest yielder.

88. In 1931, over 6,000 grapefruit plants were distributed at a charge to the purchaser of 12 cents per plant. Since 1917 over 50,000 budded citrus plants, mostly Marsh grapefruit, have been sent out by the Department, and, in addition, budwood has been supplied and propagators loaned to a number of those who grew their own stocks.

89. The services of the Economic Botanist have been much in demand for advice regarding the suitability of land for citrus.

ST. AUGUSTINE NURSERY AND CITRUS STATION.

90. The year has been one of considerable activity at St. Augustine. As a result of the transfer of the Government Nursery from St. Clair, the lay out of the St. Augustine property had to be entirely re-organized. Thirty acres have been set aside for nurseries and stock plants; forty-three acres are to be given over to a grapefruit and orange orchard for experimental trial of different stocks and methods of cultivation; and the balance—some thirty odd acres—will be utilized for general crops. The task of laying out the new nurseries and at the same time making preparation for the citrus experiments threw additional duties on the staff.

91. Owing to the fact that the soil at St. Augustine is not typical of that on which cane is commonly grown in the island, the area formerly under cultivation to this crop is being gradually used for other purposes, with the exception of a small block that will be retained for the trial of new varieties and for their multiplication prior to distribution to estates.

92. The investigations in progress for the purpose of producing a lime resistant to withertip disease were concentrated during the year mainly on field trials of two of the 1932 hybrids. One of these, T.1, shows promise as regards yield and general field characters and samples of oil from it were prepared for market tests. The transfer of the Nurseries caused a set back to the growth of the backcrosses.

93. In 1931 the distribution of economic plants amounted to 71,438, including 15,209 cocoa, 6,022 grapefruit and 35,813 limes, for which a sum of £740 was realized. The sale of canes brought in £907.

94. In the report of the Economic Botanist is a detailed account of the various branches of work and a summary of the programme of citrus experiments.

GOVERNMENT STOCK FARM AND VETERINARY WORK.

Government Stock Farm.

95. An account of the work at the Government Stock Farm will be found in the report of Dr. H. V. M. Metivier the Officer-in-Charge. The routine duties were efficiently carried out and the animals suffered little from any form of disease. The milk production for the year was 30,500 gallons of which 27,010 gallons were sold to Government institutions.

96. To give effect to the policy of distributing each year to private stock owners a number of well bred animals, the Annual Sale was held in May and a sum of \$2,650 was realized.

97. Continued progress was made with the important work of developing a Friesian-Zebu cross—a class of animal that has given definite evidence of its suitability for Trinidad conditions and that promises to meet the requirements of tropical countries for hardiness and milk production. Were ample funds available for the purchase of suitable types whenever available, it would be possible to speed up more rapidly this line of work.

98. A consignment of Black Head Persian sheep were imported from South Africa for the Farm and for a number of persons anxious to test this breed of sheep.

99. The cost of the operating expenses of the Government Stock Farm was £6,263 and the revenue amounted to £6,637.

100. On the educational side, the Stock Farm played a prominent part at the Agricultural Exhibition in February, when a model dairy was staged by officers of the Farm; lectures were given by Dr. Metivier and Dr. Shannon during Health Week; and information of a practical nature was imparted to visitors to the Farm during the year.

101. Active assistance was given by both Dr. Metivier and Dr. Shannon in furthering a scheme initiated by the Livestock Committee of the Agricultural Society for the registration of pure bred livestock in the colony.

Paralytic Rabies.

102. In the report of the Government Veterinary Surgeon will be found an interesting account of paralytic rabies, a disease that since 1925 has been the cause of considerable loss to livestock owners, and which was responsible for reported deaths of 413 cattle and horsekind during the year under review. Formerly the disease was believed to be a form of Botulism.

103. The pathological investigations undertaken by Dr. Pawan, as well as the assistance obtained from abroad, are described in some detail in a publication by the Medical Department in which the history of the disease is reviewed by Dr. Lassalle, primarily from the aspect of its relation to human beings.

104. When the late Mr. Montgomery, at the time Adviser in Animal Health to the Secretary of State, visited the Colony in February, 1931, he took the keenest interest in the disease, the cause of which was at the time still uncertain, and under his guidance a scheme of investigational work was laid down. The Government Veterinary Surgeon was at the time due for leave, but was detained in order that he should carry out the necessary work. Various inoculation experiments were made and material was sent to Dr. W. H. Andrews of the Imperial Bureau of Animal Health.

105. As related in his report, Dr. Metivier had the extraordinary good fortune to get possession of three rabid bats that flew during the day into the poultry compound at the Government Stock Farm and were captured. With material from these he inoculated a calf, a guinea-pig, and a rabbit all of which developed typical symptoms of the disease, and he was thus able to establish beyond doubt the connection between the bites of bats and the fatal disease attacking livestock in this island.

Swine Fever.

106. During the year outbreaks of Swine fever occurred in three localities, but owing to the prompt measures undertaken by the Government Veterinary Surgeon the spread of the disease was satisfactorily checked.

DISTRICT AGRICULTURAL WORK.

107. The normal duties of the District Agricultural Advisers during the year may be summarized as follows:—

- (1) General advice on agricultural matters.
- (2) Inspection of properties mortgaged to the Agricultural Bank.
- (3) Certain restricted duties under the Plant Protection Ordinance.
- (4) Inspection of School Gardens.
- (5) Valuations for the Public Works Department.

108. Special work during the year included :—

- (1) Inspection of properties in connection with the Coconut Survey.
- (2) Propaganda to encourage the growth of food crops for family use.

109. The Advisers assembled at Head Office once a month and their work was regularly discussed with the Director and from time to time with one or other of the technical officers of the Department.

110. Many and varied are the calls on the time of the Advisers, and there is a tendency for their work to be too diffuse, but importance is attached to special attention being given each year to some particular project. In 1931 much time was devoted to the Coconut Survey which entailed visits to over 1,900 properties on which coconuts are grown. The larger proportion of these was inspected by the Advisers. Critical examination was made of each field with a view to recording different kinds of diseases present and full enquiries were instituted regarding the cultural methods adopted. The systematic investigation had the three-fold advantage :—

- (1) Of placing useful information at the disposal of the Department.
- (2) Of widening the crop knowledge of the Advisers.
- (3) Of bringing the Advisers into close relations with a number of cultivators.

111. In Tobago the Agricultural Adviser concentrated his efforts on the task of developing agricultural co-operation ; much assistance was given by this Officer to the thirteen Agricultural Credit Societies, to the new Co-operative Lime Factory, and to the Pembroke and Roxborough Cacao Fermentaries.

AGRICULTURAL CO-OPERATIVE SOCIETIES.

Agricultural Credit Societies.

112. There are thirty-eight societies of this class ; of this number twenty-three are under the supervision of the Ste. Madeleine Company ; two are independent societies in Trinidad ; and thirteen are in Tobago under the guidance of the Agricultural Adviser.

113. The conduct of the affairs of the two independent societies in Trinidad has been far from satisfactory, but the detailing at the end of the year of an officer, with headquarters at St. Clair, for the special purpose of extending the numbers and usefulness of Credit Societies in Trinidad will enable the Department to push on with this branch of its duties.

Tobago Producers' Association.

114. This society has confined its activities largely to indirect assistance of the general movement towards co-operation in Tobago.

Tobago Lime Growers' Co-operative Association.

115. The Lime Factory established by this Association commenced operations during the year and proved of much benefit to those who had limes and who had been unable to market them profitably in the past.

Pembroke Cocoa Fermentary, Tobago.

116. This society again had a successful year and the Cocoa Planters' Association through whom the produce is shipped, speak in high terms of the quality of the cocoa prepared at the Fermentary.

Roxborough Cocoa Fermentary, Tobago.

117. The Fermentary at Roxborough was formed towards the end of the year.

Co-operative Citrus Growers' Association of Trinidad and Tobago.

118. Reference has been made elsewhere to the important part that this Association promises to play in the development of the grapefruit industry. The membership includes practically all persons owning grapefruit cultivations, and the greatest credit is due to the Board of Directors for their management of the affairs of the Association.

AGRICULTURAL EXHIBITION.

119. Officers of the Department, and in particular, the Assistant Director, the Officer-in-Charge of the Government Stock Farm, and the Economic Botanist, devoted a considerable amount of time to assisting with the organization and the management of the Agricultural Exhibition, which was held under the auspices of the Agricultural Society in February. Various educational exhibits were staged by the Department.

AGRICULTURAL BANK

120. The Director of Agriculture acted as Chairman of the Agricultural Bank from January to June. As usual, the Agricultural Advisers undertook the inspection of properties mortgaged to the Bank.

COCOA RELIEF COMMITTEE.

121. In June the Director of Agriculture was appointed Chairman of the Committee entrusted with the administration of loans under the Cocoa Industry Relief Ordinance of 1931.

REPRESENTATION AT CONFERENCES ABROAD.

122. The Assistant Director of Agriculture represented the Colony at two Conferences held in London in 1931—the Conference of Directors of Agriculture and the Imperial Sugar Conference.

123. At both of these Conferences matters of much interest were discussed and important resolutions were passed. Acceptance of the recommendations approved at the Directors' Conference will do much to vitalise the work of Colonial Departments of Agriculture, and it will be of the greatest benefit to the West Indies if effect is given to the scheme formulated at the Imperial Sugar Conference for the development of sugar research, aided by Imperial Funds.

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

124. During the year close relations have been maintained with the Imperial College of Tropical Agriculture, and I desire to acknowledge the indebtedness of the Department to the Principal and to the members of the staff of the College for their assistance and ready co-operation in various branches of work.

III.—REVENUE AND EXPENDITURE.

125. Details of the expenditure and revenue are set out in Table A. The total expenditure during 1931 was £45,267 as compared with £43,483 in the previous year. As an offset to the expenditure, the revenue amounted to £14,908 in 1931, of which the Stock Farm was responsible for £6,637, River Estate for £2,553 and the St. Augustine Nurseries and Station for £1,718. The fees collected by the Veterinary Division amounted to £1,180.

126. The transfer of the Nurseries to St. Augustine involved additional expenditure during the year. The continued spread of witchbroom and the urgent need for preventing this disease from getting out of control has necessitated the maintenance of a large staff of Inspectors, and this service, combined with the cost of measures against mosaic of sugar cane and cocoa beetles, absorbed a sum of £5,975. The upkeep of the Royal Botanic Gardens and other gardens and of Government Pastures and the Queen's Park Savannah cost £3,559. A contribution of £1,951 was made to the Sugar Cane Investigation Committee.

127. Owing to the financial depression, it was not possible for Government to make provision for strengthening the departmental staff on the scientific side, and the vacant post of Agricultural Chemist had to remain unfilled.

IV.—STAFF.

128. In March, Mr. Louis Scheult retired on having reached the age limit and the Department lost an officer who had taken the keenest interest in his duties and in whose knowledge of cocoa cultivation the public had much confidence. Mr. J. de Verteuil, Agricultural Chemist, was appointed Agronomist with wider duties.

129. The following new appointments were made during the year:— Mr. C. K. Hutchinson, Agricultural Adviser; Mr. Collier Jones, Citrus Packing House Expert; Mr. N. A. Redon, Clerk, St. Augustine Nursery; and Miss S. M. Atteck, Clerk.

130. The following officers were absent from the Colony on vacation leave:— Mr. S. M. Gilbert, Assistant Director, July to October; Mr. F. Stell, Mycologist, April to December; and Dr. D. M. Lumsden, Manager, Government Farm, Tobago, May to October.

131. In conclusion, it gives me much pleasure to record the keenness with which the officers of the Department carried out their duties during the year.

E. J. WORTLEY,
Director of Agriculture.

Port-of-Spain.

REPORT OF THE DEPARTMENT OF AGRICULTURE, 1931.

DIVISIONAL REPORTS.

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DIVISION OF BOTANY.

REPORT BY THE ECONOMIC BOTANIST.

Staff.

The transfer of the plant nursery from St. Clair to St. Augustine, on account of the former being required for building purposes and the development of St. Augustine Experiment Station, largely for citrus experimental work, necessitated re-arrangements as regards staff.

2. Mr. R. O. Williams, previously Superintendent, Royal Botanic Gardens, and Assistant Botanist, was appointed Economic Botanist and Mr. F. C. Buthn, previously Curator of the Royal Botanic Gardens, appointed Manager of the St. Augustine Nursery, both appointments were effective from 1st January, 1931. The post of Curator, Royal Botanic Gardens, was vacant for the whole year, the duties being discharged departmentally, principally by Mr. F. C. Buthn.

3. Mr. A. E. Joseph was promoted to the post of Field Assistant, St. Augustine Experiment Station, and Mr. Eugene Atherton took up his duties as Overseer, St. Augustine Nursery as from the 1st May.

4. No definite appointment to the post of Office and Field Assistant, St. Augustine Experiment Station, was made, but the duties are being performed by Mr. A. A. Brunton formerly Clerk and Storekeeper. Mr. N. A. Redon who was appointed to the post of Clerk took up his duties on the 19th May.

5. Miss C. Seheult, Herbarium Assistant, was granted six months vacation leave commencing 16th July and Mrs. M. A. Palmer was appointed to act.

Royal Botanic Gardens and Government House Grounds.

6. *Drought Effect.*—The dry season was unusually severe and the water service consequently restricted, causing much damage to a number of the older trees. The nutmeg ravine, planted from trees brought from St. Vincent in 1824, was almost totally destroyed, 16 trees which survived the 1926 drought being lost.

7. Two old trees of *Mangosteen* and the two large specimens of *Amherstia nobilis*, for which the gardens have long been noted, suffered severely and had to be heavily pruned. *Herrania albiflora* and two *Cupressus* were amongst the other losses.

8. Several palms died, the most important being *Phoenix dactylifera*, two *Versaffeltia splendida*, one *Seaforthia elegans*, one *Areca Catechu*, and two *Guilielma speciosa*. The large male specimen of *Lodoicea Seychellarum* was attacked by beetles and died.

9. *Flower Garden.*—Seasonal rains in June did much to restore the appearance of the gardens, the flower garden being particularly attractive a few weeks after the drought had broken. *Mussaenda erythrophylla*, *Pentas coccinea* and *Malvaviscus grandiflora*, three introductions of recent years, were particularly effective. The collection of *Cannas* appeared to benefit by the severe check received from the drought and were a mass of flower during the latter part of the year.

10. *Lawns.*—Portions of the lawns in both gardens had to be re-turfed owing to damage caused by mole crickets and chinch bug. A small motor mower was purchased.

11. *Donors.*—The Department is indebted to the following persons and institutions for gifts of plant material:—

Local.—Mrs. H. R. McClean, Messrs. G. F. Huggins, O.B.E., J. E. Seheult and H. Rapsey.

Abroad.—Director, Royal Botanic Gardens, Kew; Bureau of Plant Industry, Washington; Director of Agriculture, British Guiana; Mr. V. Millen, New Zealand; Mr. C. A. Purpus, Mexico.

St. Clair Nursery.

12. The transfer of all movable plants and material was completed and all nursery work is now dealt with at St. Augustine. As it was not possible to make the actual transfer of nursery sales until 1st August permission was obtained to utilize at St. Clair a portion of the St. Augustine Nursery vote. The only work undertaken at St. Clair from that time was the care of certain mango and citrus trees required for stock purposes and the maintenance of sanitation measures.

St. Augustine Nursery.

13. *Site.*—Thirty acres of the old sugar station were allocated for nursery purposes.

14. *Removal Expenses.*—An extraordinary vote of £600 was provided for removal of the St. Clair nursery and the lay-out of the land at St. Augustine; the Public Works Department administered a vote of £3,445 for buildings and water service.

15. *Propagation Compound.*—Two acres were selected for the actual propagation compound, *Cinnamomum camphora* being established to the south and east of it for the purpose of a windbreak. Reinforced concrete pillars were erected and covered with bamboo rods and palm leaves for protecting such plants as require shade.

16. *Buildings.*—The nursery buildings were erected to the west of the propagation compound. They consist of a crate store, carpenter's shop, tool room, store room, watchman's room, two potting sheds, a seed room, two half-span and one span roof glasshouses and a two-roomed office. At the eastern end of the Nursery residences for the Manager and Overseer were erected.

17. *Water Service.*—A supply of water was provided from the St. Joseph River by means of a Petter engine and Pomona Pump which forces it to a 15,000 gallon tank 18 feet from the ground, from which it is distributed by a conveniently arranged system of pipes.

18. *Orchard Plots.*—The trees propagated at St. Clair in 1930 in readiness for removal were planted in several plots principally for the purpose of supplying propagating material. The total list of varieties, including the two acres planted in 1932, is now as follows:—

	No. of Varieties.	No. of Plants.	Area, acres.
Avocados	7	56	1.50
Citrus:			
Grapefruit	8	100	
Oranges	13	118	
Manderines	7	35	
Tangelos	5	10	
Limes	29	60	
Miscellaneous	10	16	
		— 339	4.96
Coconuts (dwarf)	1	10	.14
Mangoes	15	43	.97

18. The Manager reports on the routine work of the Nursery as follows:—

19. *Plant distribution.*—“The number of plants distributed was 71,438 in 1931 as compared with 98,840 in 1930. Owing to low market prices the distribution of cocoa plants decreased by 26,400 and coffee by 10,980; the sale of grafted mango plants increased by 381, seedling limes by 6,870, and miscellaneous fruit trees by 1,326.

20. “Orders for grapefruit plants were received and executed *pro rata* as soon as the plants were available; 6,022 were distributed as compared with 4,534 in the previous year. There were 3,500 small plants remaining in the beds at the end of the season. Such portions of the 1931 orders which were not filled are being carried forward to 1932 and it is hoped that with improved weather conditions and the completion of the removal of the nurseries that a greater number of plants will be distributed in 1932. Two Wardian Cases of various varieties of oranges and grapefruit plants were prepared and despatched to the Fijian Department of Agriculture in September. The British Guiana and Barbados Departments of Agriculture have been regularly supplied with consignments of budwood.

21. *Revenue.*—“Revenue for all plants and other products was £740 17s. 0½d. compared with £1,007 6s. 0½d. in 1930, the decrease in revenue being due to the reduction in price of grapefruit plants from 30 cents to 12 cents and the small demand for cocoa and coffee seedlings.

22. A detailed list of plants, seeds, cuttings, &c., distributed is given below:—

Cacao:					
Seedlings					15,209
Coffee:					
Robusta					216
Fruit:					
Oranges (budded)				654	
Grapefruit (Marsh) do.				5,959	
Assorted grapefruit do.				63	6,676
Mangoes (grafted)				952	
Avocados (budded)				520	
Limes				35,813	
Miscellaneous				2,256	
Bananas				56	39,597
Timber trees				512	
Other economic plants				297	
Decorative plants				8,931	9,740
Total number of plants					71,438
Budwood				10,600	
Cuttings				259	
Seeds:					
Coffee				44 lb.	
Miscellaneous			222 pkts. and	600 lb.	
Seeds (countable)				12,250	
Fruit				3,284	
Soil				22 loads.	

23. *Sour Stocks.*—“An area of approximately 5 acres has been planted up with 35,000 sour orange plants for use as stocks for budding grapefruit and oranges. The season has been good for transplanting these but the rainy weather being continuous it has proved the worst that I have experienced for the development of scab (*Cladosporium citri*) on the young growth; this disease destroys the growing point and causes the young plants to make an abundance of side shoots instead of developing into tall plants, thus causing delay in budding operations. Spraying with Bordeaux Mixture did not control it owing to continuous heavy rain.”

24. *Loan of Propagators.*—"Men trained in budding have been loaned to several estates who have grown their own stock plants, and quite a large number of budded citrus plants have been distributed in this way."

25. *Lime Propagation.*—"The demand for seedlings of the West Indian Lime is still maintained. Past experience in sowing lime seeds in the open at St. Clair in the rainy season proved a failure. As a further trial, a seed bed of approximately $\frac{3}{4}$ of an acre in size was prepared on a very sandy portion of the Nursery at St. Augustine; the seeds sown in drills germinated well, but damping off fungi caused severe losses. Spraying with Bordeaux Mixture saved a great number, but, owing to the rain, large numbers of seedlings were lost. The seedlings that survived were attacked with Wither-tip (*Gloeosporium limeticolum*) which caused the loss of many others. Potting was commenced whilst the seedlings were small but Wither-tip continued to prove very destructive. Beds have been prepared and several thousands transplanted for sale as bare root plants. In a normal season I consider the two above-mentioned fungi may be controlled by spraying."

Citrus Experiment Station.

26. *Site.*—A portion of the St. Augustine Experiment Station, comprising about 40 acres, and up to the present utilized for sugar-cane, was allocated for grapefruit and orange experimental work. A survey and lining of the land was kindly undertaken by Mr. Dumanoire, Acting Sub-Intendant of Crown Lands.

27. *Programme.*—A general programme of experiments was prepared with assistance from Messrs. S. M. Gilbert and P. E. Turner and later submitted for critical examination to the Field Experiments Committee appointed by the West Indian Conference of Agricultural Officers. It was also discussed by Mr. Gilbert, whilst on leave, with experts at Rothamsted and East Malling.

28. *Principal Experiments.*—The scope of the principal experiments and the acreage occupied is briefly as follows:—

	<i>acres.</i>
<i>(a) Grapefruit:</i>	
1. <i>Stocks.</i> —Tests of sour seville, sweet seville, rough lemon and "wild" grapefruit from known trees as stocks for Marsh	4.00
2. <i>Bud Selection.</i> —Marsh, Duncan, and Foster are being tested for nursery propagation	10.68
3. <i>Bud Insertion.</i> —Height of insertion of bud and its relationship to gummosis	1.00
4. <i>Root Systems.</i> —Tests of the relative merits of straight, crooked and bench-rooted stocks .. .. .	.31
5. <i>Cultural.</i> —Various cultural treatments including green manures.. .. .	6.00
6. <i>Fertilizers and Manures.</i> —Trials of various fertilizers and organic manures alone and in combination	12.00
<i>(b) Oranges:</i>	
7. <i>Stocks.</i> —Test of sour seville, sweet seville, rough lemon and "wild" grapefruit from known trees as stocks for Washington Navel, Valencia and Pineapple	2.80
8. <i>Bud Insertion.</i> —Height of insertion of bud and its relationship to gummosis .. .. .	.70
<i>(c) Limes:</i>	
9. <i>Hybrids.</i> —Plot tests of selected hybrids	1.00
10. <i>Back Crosses.</i> —Study of back crosses of Trinidad hybrids and West Indian Lime .. .. .	.50
<i>(d) Stocks:</i>	
11. Investigation of sour seville, sweet seville, rough lemon and "wild" grapefruit as seedlings, as layers and as buds on seedlings from the same tree	2.00

29. *Stocks.*—The stocks utilized are all from known parents. Seeds were sown during February, March and April and transplanted in nursery beds from May to July preparatory to budding. One series of rough lemon had grown sufficiently large by November to bud and this was done.

30. *Scions.*—The scions are mostly from trees at St. Augustine from which the yields are known since bearing commenced in 1926.

31. *Cultivation.*—A start was made with draining and round-ridging the land under the supervision of Mr. L. A. Brunton and carried on as far as funds and clearance of the land of cane permitted. The work completed to date was as follows:—

19.91 acres drained	.. cost \$ 8.53 per acre.
9.94 acres round-ridged	.. cost 33.17 per acre.

32. *Variety Trials* (1923).—The two-acre block of grapefruit and orange varieties planted in 1923 has cropped well and made considerable profit. The complete return of average yields of each variety and receipts and expenditure of the plot from date of planting are given below:—

Yields, Average Number of Fruit per tree.

				GRAPEFRUIT.			
				<i>Marsh.</i>	<i>Foster.</i>	<i>Walters.</i>	<i>Duncan.</i>
1926-27	..	..	..	46	35	33	13
1927-28	..	..	..	119	89	59	30
1928-29	..	..	..	275	280	196	217
1929-30	..	..	..	378	259	359	184
1930-31	..	..	..	394	355	278	315
Total	..	..	..	1,212	1,018	925	759
				ORANGES.			
				<i>Jaffa.</i>	<i>Parson Brown</i>	<i>Valencia.</i>	<i>Navcl.</i>
1926-27	..	..	..	8	33	7	4
1927-28	..	..	..	26	52	42	24
1928-29	..	..	..	235	426	276	14
1929-30	..	..	..	724	343	372	26
1930-31	..	..	..	655	381	382	35
Total	..	..	..	1,648	1,235	1,079	103
<i>Costings :</i>				<i>Expenditure.</i>			
				<i>Receipts.</i>			
				<i>8 c.</i>			
				<i>6 c.</i>			
1923	..	..	..	..	..	99 37	—
1924	..	..	..	..	..	44 25	—
1925	..	..	..	..	..	43 26	—
1926	..	..	..	..	..	90 62	6 12
1927	..	..	..	..	..	106 08	52 10
1928	..	..	..	..	..	115 96	131 24
1929	..	..	..	..	..	135 58	280 41
1930	..	..	..	..	..	269 89	516 68
1931	..	..	..	..	..	252 93	602 66
Total	..	..	..	..	..	\$1,157 94	\$1,589 21

N.B.—Does not include cost of land, supervision or interest on capital.

Reaping costs are much higher than in a commercial orchard due to recording yields and sizes.

Lime Breeding.

33. *Trinidad Hybrids*.—A field study of T.1 and T.6, two of the 1925 hybrids, which were planted in half-acre plots at St. Augustine in 1929 show that under those conditions T.1 makes good growth and crops well but that T.6 is susceptible to die-back in the dry season.

34. *Yields*.—The following is a record of yields of T.1 at St. Augustine:—

				Yields, 1931.	
<i>Date Planted.</i>	<i>Month</i>	<i>No. of Limes.</i>	<i>Total Weight.</i>		
July to Sept., 1929.	April	184	24 lb.	Green and ripe limes picked from trees.	
	May	246	27 lb.	do.	do.
	June	2,199	205 lb.	do.	do.
	July	479	46 lb.	do.	do.
	August	2,372	238 lb.	do.	do.
	September	1,918	198 lb.	do.	do.
	October	{ 1,420	166 lb.	do.	do.
		{ 359	36 lb.	Yellow limes gathered from the ground.	
	November	1,960	223 lb.	do.	do.
	December	2,409	338 lb.	do.	do.
Total Yield		13,546	1,501 lb.	= 3,002 lb. = 18.76 barrels per acre.	

Yield of Ecuelled Oil :

535 lb. equal 3.34 barrels of ripe and full green limes picked from trees yielded 10.5 ounces of oil equal 3.14 ounces per barrel.

597 lb. equal 3.73 barrels of yellow dropped limes yielded 5.5 ounces of oil equal 1.47 ounces per barrel.

Yield of Distilled Oil :

185 lb. equal 1.15 barrels of green and ripe limes picked from trees yielded 6 ounces of oil equal 5.21 ounces per barrel.

Messrs. Alston & Co. kindly undertook the crushing and distillation.

35. *Samples for Market Reports.*—Distilled and hand-pressed samples together with representative samples of both types of West Indian Lime Oil collected from several factories in Trinidad were forwarded to the Imperial Institute late in the year for examination and report.

36. *Juice and Acid Tests.*—Messrs. Alston & Co.'s distillation of T.1 on 3rd July gave the following results:—

Weight of limes	..	185 lb.
Juice obtained	..	4.9 gals.
Acidity	..	11.98 ozs. per gallon.
Essential oil	..	6 ozs.

37. Professor Hardy of the Imperial College of Tropical Agriculture made another examination of the juice in December and reported 10.92 ozs. of citric acid per gallon.

38. *Trials on Private Estates.*—Mr. Harold Fahey has planted out about 1,200 trees of T.1 at Erin for trial, Mr. H. Rapsey is testing it at Aripo, and Mr. G. F. Huggins at Macqueripe.

39. *Back Crosses.*—The transfer of the nurseries made it necessary to re-propagate the 1928 series of back crosses between Trinidad hybrids and West Indian Lime thus causing a temporary set-back to this phase of the work. Only those showing resistance to wither-tip were kept and these are now established at St. Augustine for observation. The most interesting series of seedlings, from a variability point of view, so far as can be seen at present are from the cross T.1F. + West Indian M.

40. The following is a list of those back crosses and their parentage which have been transferred to St. Augustine:—

	Parents.	Selected No. of seedlings.	Total No. of plants.
T.1 M +	W.I. F	6	18
T.4 M +	W.I. F	8	18
T.5 M +	W.I. F	14	36
T.6 M +	W.I. F	13	36
T.7 M +	W.I. F	12	18
W.I.M +	T.1 F	9	18
W.I.M +	T.6 F	2	4

MINOR CROPS.

41. The year being one of depression for the main agricultural crops of the Colony many were the enquiries received as to the cultivation, preparation for market and financial prospects of other crops. Considerable time has been devoted to these investigations. The following is a list of the principal crops and products studied:—Bananas, and their by-products, figs and flour; Tung Oil; Derris; Fibres; Tomatoes; Citrus and other fruit pulps, juices and preserves; Ginger; Ground Nuts; Essential Oils; Cashew Nuts. Details of the work upon the more important of these follow:

Bananas.

42. *Advisory Work.*—In connection with the work of the New Agricultural Export Industry Committee circulars dealing with methods of banana cultivation were prepared and attention given to the areas planted experimentally with Governor bananas, three or four visits being paid to each estate. Particulars of the plots are as follows:—

Estate.	Acres.	Months Planted.
St. Augustine Experiment Station	5½	.. June and July.
Caroni Estate	5	.. July.
Waterloo Estates, Ltd.	10	.. July.
Usine Ste. Madeleine	7	.. July-August.
Woodford Lodge	5½	.. August.
Orange Grove	5½	.. October.
Total	38½	

43. *Uniformity of Plants.*—The limited supply of planting material made it practically impossible to get a uniform type of plant as regards size on any estate. It is hoped, however, that it will be possible to obtain a measure of uniformity by pruning methods, and the field and written advice given to date on this subject in consultation with Mr. L. A. Brunton have been made with this end in view.

44. *Progress.*—Good growth may be reported for most of the plots, particularly those in which legumes have been interplanted. The St. Augustine plot is being utilized for the following experiments:—

- Planting distances.
- Types of planting material.
- Planting methods.
- Pruning methods.

45. *Fertilizer and Manurial Trials.*—Mr. P. E. Turner of the Imperial College of Tropical Agriculture kindly drew up a scheme for trial by request.

46. *Fruit Shipments.*—Preliminary discussions on this subject with the Leyland Line of steamers are in progress.

47. *Other Investigations.*—The Department is indebted to Mr. Harold Fahey for bringing to its notice what he described as a "giant governor banana". This we have since had under investigation in the field and cold store, through the kind co-operation of Professor Cheesman, Dr. McGuire and Dr. Wardlaw of the Imperial College of Tropical Agriculture and opinions vary as to its identity. Whilst it may ultimately prove to be the Congo banana, a variety known in Trinidad for many years, it is considered of sufficient importance to develop for further small scale trials. This is being done.

48. *Brazilian Bananas.*—In 1928 the Director of Kew kindly obtained at our request plants of the Brazilian varieties *Ananica* and *Mestica*, and placed them in quarantine at Kew. An outbreak of disease in 1930 in the quarantine house made it necessary to destroy them. A re-importation was made by Kew in 1931 with the idea of forwarding suckers to Trinidad in due course. It is hoped that better luck may favour this importation as the Department is most anxious to test these varieties on a commercial scale, especially *Ananica*, or the "Banana d'agua", which is shipped in large quantities from Brazil.

Tung Oil Plants.

49. *Introduction and Distribution.*—Seeds of *Aleurites Fordii* and *Aleurites montana* were received at various times in 1930 and 1931 through the kind offices of the Director, Royal Botanic Gardens, Kew, and the Senior Horticulturist, Bureau of Plant Industry, Washington. Fifty-seven plants of *A. Fordii* and one hundred and thirty-one of *A. montana* were raised. Some of each of these have been distributed to the following persons or places:—

Imperial College of Tropical Agriculture	..	..	..	St. Augustine.
Marper Estate	..	..	..	Department of Agriculture,
St. Augustine Experiment Station	..	..	..	do. do.
River Estate	..	..	..	do. do.
Messrs. F. and A. Agostini	..	..	..	Brasso, Caparo and Rio Claro.
Mr. W. S. E. Barnardo	..	..	..	St. Augustine.
Hon. A. B. Carr	..	..	..	Caparo.
Mr. C. Fleming	..	..	..	Sangre Grande.
Mr. G. F. Huggins	..	..	..	Macqueripe.
Mr. E. E. Monceaux	..	..	..	Cumuto.
Mr. H. Rapsey	..	..	..	Caura.
Mr. T. L. M. Orde	..	..	..	Tobago.
Mr. J. de Verteuil	..	..	..	Chaguanas.
Mr. H. Fowler	..	..	..	San Fernando.

50. *Progress.*—*A. Fordii* is a sub-tropical plant of Central and Western China and there is no record of its having been successfully cultivated in the Tropics; the seedlings raised in Trinidad have not grown well. *A. montana* occurs naturally farther south than *A. Fordii*, and the early growth of the seedlings in Trinidad is more promising.

Derris malaccensis.

51. *Introduction.*—*Derris elliptica* introduced into Trinidad some years ago grows well and in 1930 a request was made to Kew to try to obtain plants of *Derris malaccensis* for trial in Trinidad because of its higher degree of toxicity. A wardian case of both erect and climbing forms arrived in June, for which we are indebted to Kew and the Malayan Department of Agriculture. They have been partly distributed to the Trinidad Leascholds, Ltd., at Pointe-a-Pierre and partly planted at St. Augustine.

General.

52. *Co-operative Citrus Growers' Association.*—Much time was spent in assisting fruit growers with the organization of a Co-operative Citrus Growers' Association, which is aided by a loan of £5,900 granted by Government in 1930. This work entailed assistance in respect to the framing of the Association's bye-laws in consultation with the Acting Crown Solicitor, and innumerable details in connection with the choice of site and erection of the packing-house at Laventille, as well as the selection and designs of packing material. It is satisfactory to note that the machinery is that detailed in my report on a visit to Florida and Porto Rico in 1929.

53. I was nominated by His Excellency the Governor to the Board of Directors on the 7th January, 1931, and appointed Chief Fruit Inspector under the Ordinance to control the export of grapefruit and budded oranges.

54. *Visits to Estates.*—Estate work in connection with grapefruit was considerable and covered inquiries as to choice of land for orchards, cultural and manurial treatment and control of pests and diseases. During the latter part of the dry season a fair amount of damage was caused by the Black Fruit Fly, *Anastrepha serpentina*, but it is thought that this was due to unusually dry weather conditions. Mr. F. W. Ulrich of the Imperial College of Tropical Agriculture has assisted the Department with advice on this subject.

55. *Tobago Lime Growers' Co-operative Association.*—A visit was paid to Tobago for the purpose of attending the annual meeting of the Tobago Lime Growers' Co-operative Association and at their request addresses were given on the manufacture of citrate of lime, and field and packing-house demonstrations dealing with the export of green limes. Subsequently Mr. Gordon Brinkley, the Manager, came to Trinidad to study the process of making citrate and the Tobago Lime Growers' Co-operative Association and the Department of Agriculture are much indebted to Mr. George Lee, proprietor of the Carenage Lime Factory, for help given in this and other connections during the year.

56. *Agricultural and Industrial Exhibition, Port-of-Spain*.—Attendance at numerous meetings of the Exhibition Committee and the Grounds and Buildings Committee and assistance in general in many ways took up considerable time in the early part of the year. An attractive display of fruit varieties was staged by the Botanical Division in the main Departmental Exhibit.

57. *Toronto Exhibition*.—A selection of large plants of grapefruit, cacao, cane and coffee were placed in boxes and sent to the Toronto Exhibition at the request of the Permanent Exhibition Committee. Pamphlets advertising several of the principal crops of the Colony were also prepared.

58. *Tobago Gardens Inspection*.—An inspection of the Tobago Botanic Gardens and the selection of grapefruit trees for budwood was made in September to October.

59. *Visit to Grenada*.—Two weeks were spent in Grenada during which time detailed arrangements were made for soil and cacao surveys preparatory to visits by the officers of the Imperial College of Tropical Agriculture. Other work attended to during the visit was an inspection and a report on the suitability of certain lands for grapefruit, an investigation into citrus nursery methods, a revision of the Prize Holdings Rules, &c.

60. *Citrus Students*.—Mr. Lang, an officer of the Grenada Department of Agriculture whilst in Trinidad for the purpose of studying Witchbroom, was given instructions in citrus nursery and field work.

61. Captain Beckett of the British Guiana Department of Agriculture spent a week in Trinidad for the purpose of similarly studying citrus.

62. *Demonstrations, Lectures, &c.*—Budding and grafting demonstrations by Mr. F. C. Butlin and a rubber demonstration by Mr. L. A. Brunton were arranged for the students of the Imperial College of Tropical Agriculture at the request of the Principal.

63. A lecture on grapefruit was given to the Agricultural Society, Arima, on the 2nd July by the Economic Botanist.

64. Mr. F. C. Butlin conducted as usual a series of lectures and demonstrations on gardening to the 1st, 2nd and 3rd year students of the Tranquillity Training College, and held an examination at the end of the last term.

65. *Trees on Government lands*.—The trees under the control of the Department were attended to as usual and many dead branches, the result of the long dry season, were pruned. Trees on the following lands under the control of the Public Works Department were also attended to:—

Eastern Boys' School, St. Ann's Asylum, Colonial Hospital, St. James Barracks, Powder Magazine, Public Works Department Headquarters, Government Printing Office and General Post Office.

Herbarium.

66. *Collections and Identifications*.—A total number of 165 specimens were collected from various parts of Trinidad during the year. Many of these were sent in by the Forestry Department for purposes of identification and are useful additions to the collections. The Director of the Royal Botanic Gardens, Kew, and the New York Botanical Garden have, as in the past, kindly assisted with identifications.

67. The recent additions to the collections necessitated the addition of another cabinet.

68. A commencement was made to incorporate all foreign collections under one system to facilitate workers.

69. *Passiflora*.—All specimens of this genus were loaned to Mr. E. P. Killip of the Smithsonian Institution, Washington, by request. A brief synopsis of the Trinidad species was subsequently presented by him.

70. *Aegiphila*.—Mr. H. N. Moldenke of the New York Botanical Gardens borrowed all the material of this genus for monographic purposes.

71. *Bromeliaceae*.—Dr. Lyman B. Smith of Harvard University has all the material of this family on loan.

72. *Lauraceae*.—Mr. R. L. Brooks, Deputy Conservator of Forests, Trinidad, has made a study of this family in conjunction with Dr. J. Burtt-Davy of the Forestry Institute, Oxford, and has prepared a paper in which are incorporated notes dealing with most of the specimens in the herbarium.

73. *Filices*.—The Venerable Archdeacon Hombersley continues his studies. Acknowledgment of assistance is accorded to Dr. William R. Maxon of the Smithsonian Institution for assistance with fern identifications.

Flora of Trinidad and Tobago.

74. This work was continued as time and opportunity permitted. Part IV of Volume I covering the greater portion of the *Rosales* was issued in August, pp. 197-308, price 4s. 6d. It includes the whole of the *Leguminosae*.

75. The manuscript of the latter portion of the *Rosales* and a small portion of the *Myrtales* covering the families *Rhizophoraceae* and *Combretaceae* was sent to Kew for revision.

I have the honour to be,

Sir,

Your obedient Servant,

R. O. WILLIAMS,
Economic Botanist.

REPORT OF AGRONOMIST.

My duties of Agricultural Chemist nominally ceased on 20th March, 1931, when I was appointed Agronomist and Superintendent of Experiments at River Estate in addition to the post of Officer in charge of Marper Estate.

2. During the year a certain amount of analytical work, consisting of testing 522 seedling canes and 1,370 samples of milk from the cows at the Government Farm, was performed.

3. For convenience, my report is divided into the following sub-heads:—

- (i) Cacao Experiments at River Estate.
- (ii) Marper Estate.
- (iii) Manurial Experiments on Private Estates.
- (iv) General.

Coconut Wilt.
Seedling canes.

I.—CACAO EXPERIMENTS AT RIVER ESTATE.

The experimental work at River Estate consists of:—

- (a) Shade Reduction.
- (b) Distance Spacing Experiments.
- (c) Propagation Experiments.
- (d) Seedlings from Heavy Bearing Tree No. 4027.
- (e) Colour of Pods Experiment.
- (f) Manurial Experiments.

Shade Reduction Experiments.

(2) These were started in 1910 (a) in Field 5 and (b) in Fields 20 and 21.

(3) *Field 5*.—The cacao trees were 35 to 40 years old (1910), planted 15 feet apart and fairly regularly shaded with Anauco Immortel. Three blocks of approximately three acres each were marked out and in August, 1910, all the shade trees were cut out from one block, 50 per cent. from the next and none from the third block. Ordinary cultural operations were performed up to 1925, but in May of that year 1½ acres in each section were given the same fertilizer treatments. The detailed results of these treatments will be found at page .

4. *Results of Shade Reduction.*

(a) Average for 15 years (1911-25), before manuring.

	Full Shade.	Partial Shade.	No Shade.
	3.15 acres.	3.25 acres.	3.07 acres.
Lb. commercial cacao per acre per annum ..	645	805	748

(b) Average for six years (1926-31), after manuring 1½ acre in each section.

	Full Shade.	Partial Shade.	No Shade.
Lb. commercial cacao per acre per annum ..	517	855	731

5. *Fields 20 and 21*.—The cacao trees in Field 20 were seven to nine years old (1910) and in Field 21 one to two years older. They were planted 12 feet apart and regularly shaded with Bucare Immortel. Three blocks of approximately 2½ acres each were marked out in both fields. All the Immortel shade trees were cut out from Field 20 in October-November, 1910, but no shade trees were cut out from Field 21. Field 21 was a better field at the commencement of the experiment and Field 20 suffered a serious setback from the drastic removal of shade and a severe drought which followed in 1911-12. Ordinary cultural operations were performed up to 1925, but from that year two blocks in Field 20 were used for manurial experiments.

6. *Results*.—(a) Average for five years (1912-16) period during which the cacao trees suffered from the removal of shade and drought of 1911-12.

		Full Shade.	No Shade.
		7.52 acres.	7.40 acres.
Lb. commercial cacao per acre per annum	—Block I	451	338
	Block II	424	201
	Block III	403	264
	Average for three blocks	426	267

(b) Average for nine years (1917-25) after "No Shade" plots had recovered.

		Full Shade.	No Shade.
Lb. commercial cacao per acre per annum	Block I	747	783
	Block II	680	483
	Block III	589	551
	Average for three Blocks	672	605

(c) Average for 14 years (1912-25) from the start of the experiment.

		Full Shade.	No Shade.
Lb. commercial cacao per acre per annum	—Block I	641	624
	Block II	588	382
	Block III	522	448
	Average for three Blocks	583	484

modified and combined with manurial experiments.

Distance Spacing Experiments.

7. These consist of two sections, in Field 18, (a) plots planted in 1914 and (b) plots planted in 1922.

8. *Experiments started in 1914.*—Four plots of approximately an acre each were planted, in October, 1914, with seedlings one year old, at distances of 12, 14, 16 and 18 feet apart respectively. The seedlings were raised in bamboo pots from mixed seed obtained from heavy bearing trees of the Forastero type, producing beans of good size and quality. Immortel shade trees were planted in the usual manner between every two rows of cacao trees.

9. *Results.*—Cropping started in 1918 and for the first six crops the plot planted 12 feet apart, gave the highest yield. During the following eight years, with one exception, *i.e.*, 1929, the highest yield has been obtained from the plot planted 14 feet apart. The average yields for 14 years (1918-31), *i.e.*, from the first year of bearing are given below.

	12 × 12 ft. 304 trees.	14 × 14 ft. 231 trees.	16 × 16 ft. 174 trees.	18 × 18 ft. 130 trees.
Lb. commercial cacao per acre per annum	414	404	345	314

The crops for the plots planted at 16 and 18 feet apart, respectively, have been steadily increasing during the past five years and for 1931 the yields are practically the same as those for the plots planted 12 feet and 14 feet apart.

Yield for 1931.

	12 × 12 ft.	14 × 14 ft.	16 × 16 ft.	18 × 18 ft.
Lb. commercial cacao per acre per annum	692	709	695	680

10. *Experiments started in 1922.*—Three plots of approximately an acre each were planted, in July, 1922, with seedlings one year old at distances of 6, 8 and 10 feet apart, without Immortel shade. The seedlings were raised in a nursery and each plot contains

40 per cent. of trees raised from tree No. 808 of field 5.					
30	Do.	do.	do.	1285	do.
15	Do.	do.	do.	716	do.
15	Do.	do.	do.	646	do.

These parent trees are a good type Forastero and heavy bearers.

11. *Results.*—Cropping started in 1926. The plot planted 6 feet apart has given the highest yield every year up to date, but it should be pointed out that the soil, on which the trees are planted ten feet apart is of inferior quality.

Average for 6 years (1926-31).

	6 × 6 feet. 1,210 trees.	8 × 8 feet. 680 trees.	10 ft × 10 ft. 436 trees.
Lb. commercial cacao per acre per annum	269	205	95

Yield for 1931.

Lb. commercial cacao per acre per annum	468	451	191
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Propagation Experiments.

12. The object of the experiment is to test the comparative merits on an estate scale of seedlings, budded and grafted cacao trees. Six plots, of approximately one acre each, were planted as follows in November-December, 1914:—

With Immortel Shade.

- (a) Cacao budded at stake.
- (b) Cacao budded in Nursery.
- (c) Cacao seedlings grown at stake.
- (d) Grafted cacao.

No Immortel Shade.

- (e) Cacao budded at stake.
- (f) Cacao seedlings grown at stake.

The planting distance throughout is 12 feet by 12 feet, and in the No Immortel Shade section, the usual ground or temporary shade has been planted.

13. In order to make the results a real test of the value of budded or grafted plants as compared with seedlings, the buds and grafts were taken from the same trees as those which supplied the pods for growing the seedlings. Twenty-nine heavy bearing trees, of the Forastero type, producing cacao of good quality were selected for obtaining seed, bud-wood and grafting material for the respective plots. Each plot contains 10 plants raised from each of 28 selected trees and seven plants from the 29th tree. Similarly, the stocks for budding and grafting on were raised from 15 of the largest heavy bearing trees of the hardy Calabacillo type and the same proportion of plants from each tree has been used in each plot.

14. *Results.*—The average results for 14 years (1918-31), *i.e.*, from the first year of bearing and for 1931 are given below.

					<i>Lb. commercial cacao per acre per annum.</i>	
					1918-31.	1931.
<i>With Immortel Shade.</i>						
(a)	Budded at Stake	..	..	..	358	600
(b)	Budded in Nursery	..	..	..	320	587
(c)	Seedlings at Stake	..	..	..	369	565
(d)	Grafted	..	..	..	340	546
<i>Without Immortel Shade.</i>						
(e)	Budded at Stake	..	..	..	305	376
(f)	Seedlings at Stake	..	..	..	338	387

Seedlings from Heavy Bearing Tree No. 4927.

15. The average yield of this parent tree for the four years 1913-16 was 332 pods per annum. In 1917, a plot of 178 stakes was planted, 12 feet apart, with seed from this tree. The average yield of the progeny for eight years (1924-31) amounted to only 556 lb. of cured cacao per annum. The yield for the first two or three crops was apparently not recorded.

Colour of Pods Experiment.

16. The object of this experiment is to try and ascertain :

(a) Whether cacao trees raised from parent trees bearing yellow pods are more, or less, prolific than those raised from trees bearing light-red or dark-red pods. The experiment is being made with seedling and budded trees respectively.

(b) Whether a better yield per acre would be obtained by having two trees at the same stake, one raised from trees bearing yellow pods and the other dark-red pods. This experiment is also being made with seedling and budded trees. There are two plots of budded trees. On one plot, buds from trees bearing yellow and dark-red pods are on separate stock, on the other both buds are on the same stock.

17. The plants required were raised in a nursery and planted out in July, 1921, in part of Field 25, when they were one year old. There are 50 cacao trees in each plot, spaced 13 feet apart, without Immortel shade.

18. *Results.*—The average yield for eight years (1924-31), *i.e.*, from the first year of bearing and for 1931 are as follows :—

					<i>Lb. commercial cacao per acre per annum.</i>	
					1924-31.	1931.
(a)	Seedlings from yellow pods	..	..	..	200	331
(b)	Do. light-red pods	..	..	..	165	246
(c)	Do. dark-red pods	..	..	..	197	309
(d)	Single bud from yellow pods	..	..	..	139	255
(e)	Do. light-red pods	..	..	..	190	170
(f)	Do. dark-red pods	..	..	..	495	712
					<i>Yellow.</i>	<i>Red.</i>
(g)	Two buds on same stock, one yellow and one red	..	..	80	205	285
(h)	Two buds on separate stock, one yellow and one red	..	..	77	121	198
(i)	Two seedlings at same stake, one yellow and one red	..	..	36	110	146

The proportion of yellow and red pods reaped for the 1931 crop is practically the same as the average for the eight years.

Manurial Experiments.

19. The main object of the experiments is to attempt to obtain increased yields of cacao at a profit. The experiments fall into four categories :—

- (i) Experiments in Co-operation with Messrs. Imperial Chemical Industries, Ltd.
- (ii) Experiments in Co-operation with the Cyanamid Company.
- (iii) Pen-Manure Experiments.
- (iv) Mulch Experiments.

20. *Experiments in Co-operation with Messrs. Imperial Chemical Industries Ltd.*—These comprise (a) the Original and (b) the More Recent Experiments.

21.—(a) *The Original Experiments (1925) at River Estate.*—These were started in October, 1925, in co-operation with the British Sulphate of Ammonia Federation, subsequently Messrs. Nitram Ltd. and now Messrs. Imperial Chemical Industries (Fertilizer and Synthetic Products) Ltd.

22. The fertilizer substances are applied by the Firms, but the cost of application and of keeping yield records are borne by the proprietors. Three applications of the fertilizers have been made, one in December and the others in May, 1928 and 1930 respectively.

23. The experiments are being made in Fields 5 and 20. In Field 5 the experiments are being made under full shade, partial shade and no shade conditions. Crop records of *individual trees* are being kept for heavy, medium and poor bearers treated with the various manurial combinations. The experiment in Field 20 is on a larger scale and consists of a single plot under no shade conditions, treated with a complete fertilizer, but records of *individual trees* are not kept.

24. *Results.*—The treatment accorded to each plot and the average profit per acre per annum, for six years (1926-31), are set out below. Cacao has been valued at 10 cents per pound.

<i>Treatment per acre 1925, 1928 and 1930.</i>				<i>Full Shade.</i>	<i>Partial Shade.</i>	<i>No Shade.</i>
				<i>\$ c.</i>	<i>\$ c.</i>	<i>\$ c.</i>
250 lb. Sulphate of Ammonia	..	...	...	Loss.	1 57	7 97
250 lb. Sulphate of Ammonia	}	..	..	0 49	0 39	19 49
150 lb. Mineral Phosphate						
100 lb. Sulphate of Potash						
250 lb. Sulphate of Ammonia	}	..	..	Loss	Loss	0 32
100 lb. Sulphate of Potash						
250 lb. Sulphate of Ammonia	}	..	..	1 05	Loss	7 35
150 lb. Mineral Phosphate						
576 lb. Sulphate of Ammonia	..	..	..	Loss	Loss	2 35
1,152 lb. Sulphate of Ammonia	..	..	..	Loss	Loss	Loss
1,728 lb. Sulphate of Ammonia	..	..	..	Loss	Loss	Loss

The fertilizer treatment in Field 20 consists of 250 lb. Sulphate of Ammonia, 150 lb. Mineral Phosphate and 100 lb. Sulphate of Potash. The profit obtained is \$0.29 per acre per annum, for the same period.

25.—(b) *The More Recent Experiments (1930) at River Estate.*—The object of the experiment is to obtain information as to the best time for applying a complete fertilizer to cacao trees. The trials are also being made under full shade, partial shade and no shade conditions. The first application of fertilizers, consisting of 250 lb. Sulphate of Ammonia, 150 lb. Mineral Phosphate and 100 lb. Sulphate of Potash per acre, was made at the following periods:—

(a) In January. (b) In May. (c) In September, and (d) In May and September, 1930, respectively, the latter being a double application.

26. *Results.*—The yields obtained for the first crop (1931), after manuring, indicate that the early application (January) is the most suitable and that the double application (May and September) has given better financial results than the single applications made in May and September respectively.

27. *Experiments in co-operation with the American Cyanamid Co.*—Trials with Ammo-phos (Grade 20/20) supplied by the above firm are being made in Fields 5 and 3A, at River Estate. Both fields are lightly shaded and the object is to test this new fertilizer, both alone and in conjunction with Potash. The trials for Field 5 are on single plots.

28. *Results for Field 5.*—The treatment given to each plot and the average profit per acre per annum for four years (1928-31) is as follows:—

<i>Treatment per acre, 1927 and 1931.</i>				<i>Profit per acre, per annum.</i>	
				<i>\$</i>	<i>c.</i>
300 lb. Ammo-phos	}	4 31
100 lb. Sulphate of Potash					
400 lb. Ammo-phos	Loss.
400 lb. Ammo-phos	}	5 39
100 lb. Sulphate of Potash					

29. *Experiment in Field 3A.*—Two adjacent trees grouped together and drawn at random to form 4 plots of 16 trees each for manuring and a similar number of plots for control. A complete fertilizer consisting of 300 lb. Ammo-phos and 100 lb. Sulphate of Potash per acre was applied in August, 1931. Crop records are not yet available.

30. *"Pen-Manure" Experiments.*—These were set out at the same time as the "Ammo-phos" plots with the object of comparing the effects of applying pen manure in three different ways to cacao trees. Pen Manure is valued at \$1.20 per acre and it was applied at the rate of 15 tons per acre in June, 1927 and May, 1931.

31. *Results.*—The average results for four crops (1928-31) tend to show that broadcasting and burying the manure are preferable to applying it as a mulch or in trenches around the trees. The increased crop obtained does not, however, pay for the manure and cost of application, when cacao sells at 10 cents per pound.

32. *Mulch Experiments.*—Two blocks of 12 plots each have been marked out in Field 25, for mulching trials. The natural yield of each tree is being recorded for three years from 1931, before starting the treatments.

II.—MARPER ESTATE.

General.

1. *Cultivation*.—The greater part of the estate has been cutlassed twice. Ground shade has been supplied in all open spots and gardens have received special attention. Missing cacao trees, through most of the fields, have been replaced.

2. *Pruning*.—Fields 1, 2, 5, 6, 7 and 8 were thoroughly pruned from May to July and suckers taken out between September and November. Fields 3, 4, 9 and 10 were lightly pruned from July to September.

3. *Drainage*.—Main drains and ravines in Fields 8 and 10 have been dug and small drains are being re-opened. All drains in Fields 1, 2, 3, 4 and 5 have been cleaned.

4. *Windbreaks and Hedges*.—A hedge of *Dracaena fragrans* has been planted on the northern, southern and eastern boundaries of the estate as well as on the top of two ridges for forming wind-belts. A row of crappo plants has also been planted on either side of the hedges on the ridges.

5. *Witchbroom*.—All diseased tissues have been cut out once a month and burnt. The total number found was 251,997 or 2,684 per acre. The heaviest Witchbroom incidence occurred in February, when 97,492 diseased tissues were cut out and destroyed. The cost of cutting out and burning affected material, is \$6.21 and supervision \$1.02 per acre.

6. With the exception of specially labelled brooms, which are allowed to remain on the trees for experimental purposes, mushrooms or fruiting bodies, were found only on immature black pods. Records for ascertaining the cost and practicability of ridding the trees of small black pods are being kept and the results will be found under the Experimental Section.

7. *Thrips*.—Thrips were conspicuous chiefly where shade had been reduced for experimental purposes, in connection with Witchbroom control, and on the thinly shaded portions of the estate. On the badly affected areas two or three changes of leaf resulted at short intervals and a large proportion of the young fruit withered.

8. Cacao beetles, squirrels and rats were scarce and easily controlled. Owing, however, to the heavy rains of October, November and December a large number of black pods (*Phytophthora*) were obtained, especially in the more heavily shaded fields.

9. *Crops*.—The crop reaped for the year was 30,911 lb. of plantation cacao and 1,408 lb. of black cacao and siftings, as against 39,170 lb. plantation, and 2,201 lb. black cacao and siftings for 1930. The decreased crop is attributed to the failure of the end of the year crop, due to Thrips, and also to black pods. The produce is disposed of through the Cocoa Planters' Association of Trinidad Ltd., and the plantation cacao realised \$7.59 as against \$10.11 per fanega for 1930.

10. The rainfall on the estate for the year has been 97.38 inches of which 22.02 inches were registered in December.

Experimental Work.

11. The chief objects of the experiments are to ascertain the effect of the various treatments on Witchbroom incidence and on crop production. All results are given for the experimental year, i.e., from 1st September, of one year to 31st August, of the following year. Crop yields are given in pounds of commercial cacao and Witchbroom incidence in numbers of affected material per acre.

12. The experiments may be classified under four heads:—

- (a) Cultivation Experiments.
- (b) Manurial and Lime Experiments.
- (c) Spraying Experiments.
- (d) Other Experiments.

Cultivation Experiments.

13. These consist of draining and shade reduction on (a) flat lands or vega, and (b) on undulating land. Details were given in the annual report for 1930. The first and second instalments of shade trees were cut out from July to October, 1930 and 1931 respectively, but the latter would have no effect on the results for the first year ending 31st August, 1931, which are as follows:—

14. *Results on Vega:*

	25% Shade Reduction.		16½% Shade Reduction.	
	Crop.	Witchbroom.	Crop.	Witchbroom.
No drains	288	2,095	374	2,653
Drains 25 feet apart	591	4,250	516	2,794
Drains 50 feet apart	398	6,060	468	5,925
Drains 100 feet apart	268	2,076	295	1,533

15. *Results on Undulating Land:*

	16½% Shade Reduction.		No Shade Reduction.	
	Crop.	Witchbroom.	Crop.	Witchbroom.
No drains	390	3,248	483	992
Drains 25 feet apart	422	3,110	386	1,703
Drains 50 feet apart	404	1,009	357	1,079
Drains 100 feet apart	309	2,032	494	1,364

MANURIAL AND LIME EXPERIMENTS.

16. The manurial and lime trials occupy 17 acres of land, partly vega and partly undulating, under ordinary shade conditions. The cacao trees are 20 to 25 years old and there are 250 trees to the acre. Details of the trials are given in the Annual Report for 1930. There are 25 cacao trees in each plot, drawn at random, and five replicates of each treatment.

17. Results.—The average results, for the five replicates, for one year only (1931) are given below.

Nitrogen Series—Vega.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
N ₁ =250 lb. Sulphate of Ammonia	435	5,510
N ₂ =500 lb. do. do. do.	428	7,376
N ₃ =750 lb. do. do. do.	476	7,152
N ₀ =No Manure	440	7,892

Potash Series—Undulating Land.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
K ₁ =100 lb. Sulphate of Potash	404	1,612
K ₂ =200 lb. do. do. do.	426	1,488
K ₃ =300 lb. do. do. do.	559	1,440
K ₀ =No Manure	364	1,834

Phosphate Series—Undulating Land.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
P ₁ =325 lb. Superphosphate	513	1,956
P ₂ =650 lb. do. do. do.	546	1,484
P ₃ =975 lb. do. do. do.	481	2,242
P ₀ =No Manure	423	1,712

Nitrogen and Potash Series—Vega.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
N ₁ K ₁	387	7,096
N ₂ K ₂	420	7,384
N ₃ K ₃	429	6,382
N ₀ K ₀ (No Manure)	408	7,554

Nitrogen and Phosphate Series—Vega.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
N ₁ P ₁	447	4,856
N ₂ P ₂	423	8,232
N ₃ P ₃	390	8,930
N ₀ P ₀ (No Manure)	314	5,596

Potash and Phosphate Series—Undulating Land.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
K ₁ P ₁	543	88
K ₂ P ₂	611	156
K ₃ P ₃	570	248
K ₀ P ₀ (No Manure)	562	162

Complete Fertilizer Series—Undulating Land.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
N ₁ K ₁ P ₁	606	1,160
N ₂ K ₂ P ₂	688	2,104
N ₃ K ₃ P ₃	688	1,968
N ₀ K ₀ P ₀ (No Manure)	528	1,098

Lime Series—Undulating Land.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
Ca ₁ =5 tons Pulverised limestone	602	800
Ca ₂ =10 tons do. do. do.	658	1,148
Ca ₃ =20 tons do. do. do.	605	920
Ca ₀ =No lime	521	856

Lime Series—Vega.

Treatment per acre.	Lb. Commercial Cacao.	Witchbroom.
Ca ₂ =10 tons Pulverised limestone	495	10,872
Ca ₀ =No lime	440	8,192

Spraying Experiments.

18. These comprise :

- (a) Liquid sprays, consisting of Cooper's Fungicide, Bordeaux Mixture, Agrisol, and Amberene. Vermorite and Cooper's Bordinette are to be tried from January, 1932.
 (b) Dust sprays consisting of Kolodust, Kolokol, Olite Sulphur and Cupryl Powder.

19. These experiments are planned with the object of trying to find an efficient fungicide for controlling Witchbroom, leaving aside, for the time being, the question of cost. Six brooms are to be labelled in 1932 and left on the trees, in each experiment, for ascertaining whether the various treatments would have any effect on mushroom production.

Liquid Spraying.

20. *Cooper's Fungicide* : Two plots of one acre each were sprayed with Cooper's Fungicide (1 lb. to 20 gallons of water), using approximately two gallons per tree. Three applications were made, viz.:—in May, 1930, February and October, 1931. Two one-acre plots are kept for control.

21. *Results* : The results for 12 months ending 31st August, 1931, are as follows :—

				<i>Lb. Commercial Cacao.</i>	<i>Witchbroom.</i>
Cooper's Fungicide	E ₉ .. .. .	..	..	430	3,971
	E ₈ .. .. .	..	..	488	2,564
Control	E ₇ .. .. .	..	..	524	2,740
	E ₆ .. .. .	..	..	550	1,976

The results for September to December, 1931, show that there has been a greater reduction in Witchbroom incidence for the control plots than for the treated plots compared with the corresponding period of 1930.

22. *Bordeaux Mixture* : Two plots of one acre each were sprayed with Bordeaux Mixture (strength 5. 5. 50), using approximately two gallons per tree. Three applications were made, viz.: in September, 1930, February and October, 1931. Two one-acre plots are kept for control.

23. *Results* : The results for 12 months ending 31st August, 1931, are as follows :—

				<i>Lb. Commercial Cacao.</i>	<i>Witchbroom.</i>
Bordeaux Mixture	E ₃ .. .. .	..	..	531	1,559
	E ₂ .. .. .	..	..	513	1,655
Control	E ₄ .. .. .	..	..	553	1,838
	E ₁ .. .. .	..	..	391	6,425

Control plot E₁ adjoins a small proprietor. The results for September to December, 1931, show that there has been a greater decrease in Witchbroom incidence for the control plots than for the treated plots, compared with the corresponding period of 1930.

24. *Agrisol* : Four trees each were sprayed respectively with a 5 per cent. solution of three brands of Agrisol on 27th October, and 3rd November, 1930.

25. *Results* : All the cacao flowers, young fruit and moss on the trees were destroyed. Witchbroom incidence was not reduced but the cacao crop was practically ruined. It took 6 to 8 months before the trees recovered and started to produce blossoms and fruit. A small black pod producing mushrooms was relieved of the fruiting bodies and thoroughly wetted with a ten per cent. solution of Agrisol. After three weeks the pod had produced a fresh crop of mushrooms. Experiments with Agrisol have been discontinued.

26. *Amberene* : This is a liquid Sulphur fungicide obtained from Messrs. W. J. Craven & Co., Worcestershire. It is being tried on two plots as follows :—

- (a) Plot of 143 trees sprayed monthly from August to October, 1931, one gallon "Amberene" to 150 gallons of water, at the rate of two gallons per tree. From November sprayings are being made twice a month, about 1½ gallons per tree.
 (b) Plot of 94 trees sprayed monthly from September, 1931, one gallon "Amberene" to 100 gallons of water, at the rate of two gallons per tree.

27. *Results* : So far, there has been no reduction of Witchbroom incidence on these plots and mushrooms were found on small black pods, after three sprayings had been done. Moreover, the treatments are harmful to the flowers and young fruit of the cacao trees. It is probable that after spraying, oxidation takes place and sulphurous acid is produced. The leaves on the trees have an unhealthy appearance and moss is not destroyed. The sprayings are to be continued for a few months more.

Dusting Trials.

28. *Kolodust* : This sulphur fungicidal dust was obtained from the Niagara Sprayer Co., New York. One hundred and seventy-one trees (Plot 39) were dusted monthly from December, 1930 to March and in June, 1931 (five applications), at the rate of seven pounds of dust per acre. The control (Plot 42) carries 165 trees.

29. *Results* : Crop records for 12 months ending 31st August, 1931, and Witchbroom incidence from 1st January to 30th September, 1931, are as follows :—

				<i>Lb. Commercial Cacao.</i>	<i>Witchbroom.</i>
Kolodust	..	..	..	377	2,226
Control	..	..	..	334	2,703

30. *Kolokil*: This sulphur dust and lead arsenate fungicide was also imported from the Niagara Sprayer Co. Two hundred trees (Plot 27) were dusted monthly from December, 1930, to March and in June, 1931 (five applications) at the rate of five pounds of dust per acre. The control (Plot 28) carries 135 trees.

31. *Results*: Crop records for 12 months ending 31st August, 1931, and Witchbroom incidence from 1st January to 30th September, 1931, are given below.

	Lb. Commercial Cacao.	Witchbroom.
Kolokil	651	4,906
Control	788	5,868

32. *Olite Sulphur*: This sulphur fungicide has been imported from Messrs. W. J. Craven & Co., Worcestershire, and it is being tried on:—

(a) A block of 8.2 acres (Plot 43) containing 2,086 cacao trees. The dust has been applied monthly, from August to October, 1931, at the rate of 13 lb. per acre. From November the quantity of dust has been increased to 20 lb. per acre. A plot of 50 trees within this block is being dusted twice a month at the same rate.

(b) On Plot 39 (previously Kolodust). *Olite Sulphur* at the rate of 20 lb. per acre, has been applied twice a month from September, 1931.

33. *Cupryl Powder*: This is a copper-lime fungicidal dust, which was also imported from Messrs. W. J. Craven & Co. It is being tried on:—

(a) Plot 27 (previously Kolokil). The dust is being applied twice a month from September, 1931, at the rate of 20 lb. per acre.

(b) Plot 41, containing 163 trees. Monthly applications have been made from August, 1931, at the rate of 18 lb. per acre.

(c) Plot 40, containing 772 trees. Monthly applications have been made from August, 1931, at the rate of 18 lb. per acre. Fifty trees in this plot are being dusted twice a month at the same rate.

34. *Results*: The treatments with *Olite Sulphur* and *Cupryl Powder* have not been made for a sufficiently long period to obtain results.

Other Experiments.

35. These consist of:—

- Topping or reducing height of trees.
- Drying and dropping of brooms.
- Picking off and destroying black pods on trees.
- Mature pods affected with Witchbroom.
- Percentage of trees not affected with Witchbroom.

36. *Reducing Height of Trees*: The object of this experiment is to facilitate the search for Witchbroom and reduce the cost of cutting out, also to observe the effect on crop production. One acre containing the tallest cacao trees was divided into two equal parts. The cacao trees on one of the plots were topped in July, 1930, at 12 feet, and on the other at 16 feet from ground level. Two plots of one acre each, on either side of the treated plots, are kept as controls.

37. *Results*: The cost of cutting out Witchbroom has been slightly reduced, but the yield of the trees has been affected. Crop records and Witchbroom incidence for the year ending 31st August, 1931, are as follows:—

	Lb. Commercial Cacao.	Witchbroom.
Topped at 12 feet	290	3,082
Topped at 16 feet	390	1,604
Control E4	553	1,838
E6	550	1,976

38. *Drying and Dropping of Brooms*: Ten green, *i.e.*, fresh vegetative brooms, were marked on the 11th of each month, from March, 1930, for twelve months, and allowed to remain on the trees to determine the length of time which elapses before:—

- The brooms turn brown or dry.
- Decay sets in and the dropping of the broom.
- The brooms produce mushrooms of fruiting bodies, and
- To ascertain the number of mushrooms which may be produced by one broom and incidentally the period of maximum production.

These special brooms are examined twice a day, and any mushrooms found are picked off and destroyed as they make their first appearance. With the exception of one broom marked in January and two in February, 1930, all the brooms had dropped by 31st March, 1932.

39. *Results*:

(a) *Drying of Brooms*: A few brooms dry up after 14 days; the majority between 20 and 28 days, others within 42 days and two brooms took 55 and 65 days, respectively, before they had dried.

(b) *Decay and Dropping of Brooms*: The decay and dropping of brooms depend, to a large extent, on their situation on the trees; the greater the protection from wind and drops of rain the longer they adhere to the trees. The shortest period which elapsed before a broom naturally fell off a tree was 61 days. It is not unusual for brooms to remain on trees for a year; 640 and 660 days, respectively, being the longest period noted.

(c) *Mushroom Production*: The shortest period before a broom produced mushrooms was 94 days, i.e., thirteen weeks after the appearance of the broom. Generally mushroom production begins shortly after the fifteenth week. Several brooms produced no mushrooms, although they remained on the trees considerably longer than fifteen weeks. Out of the ten brooms labelled in November and December, 1930, six and three, respectively, produced no mushrooms. Similarly, four of the brooms labelled in January, 1931, produced no mushrooms. The highest number of mushrooms produced by a single broom, before it dropped, was 215 and mushrooms may continue to be produced at the point of junction with the tree, if not properly cut out. One broom (January, 1931 series) which had not dropped on 31st March, 1932, produced 280 mushrooms. Mushrooms were produced every month of the year, but maximum production occurred in December, January and February. A fair number was also produced in May, June and September, whilst the other months were comparatively lean. The table below gives the number of days which elapsed before the first and last broom dropped, before the first and last mushroom was produced and the number of mushrooms produced by each set of ten brooms, respectively.

Date Brooms marked.	First Broom dropped.	Last Broom dropped.	First Mushroom produced.	Last Mushroom produced.	Total Mushrooms.
1930					
(1) March	300	660	156	656	484
April	87	640	125	639	717
May	115	521	94	519	333
June	98	601	113	601	236
July	151	381	110	371	36
August	63	327	126	..	27
September	135	474	142	469	73
October	132	405	112	394	128
(2) November	91	461	183	461	180
December	200	408	127	398	247
1931					
January	139	*	140	*	*
February	61	*	179	*	*

(1) Four brooms were cut out in error by the Witchbroom gang.

(2) Two brooms were broken off by an Immortel branch.

* Results not yet available.

40. *Picking off Black Pods*: Apart from specially labelled brooms, mushrooms on Marper Estate have only been found on immature or small black pods on the trees and on the ground. In order to ascertain the effect and cost of ridding the trees of these black pods, a plot of four-fifths of an acre (Plot 45) was worked quarterly from December, 1930, and another plot of half an acre (Plot 44) is being similarly treated from December, 1931.

41. *Results for Plot 45*:

Date.	No. of Black Pods.	Cost.	
December, 1930	5,000	3 men at 50 cents, 1 woman at 30 cents....	\$ 1.80
March, 1931	1,782	4 men at 40 cents	.... 1.60
June, 1931	565	2 men at 40 cents	.... .80
September, 1931	576	2 men at 40 cents	.... .80
	<u>7,923</u>		<u>\$ 5.00</u>

No mushrooms have been found on this plot, but the cost of \$6.25 per acre is too high for practical purposes. With a view to reducing this cost two other plots of 2½ acres each situated in the most highly infested Witchbroom area are to be worked annually from 1932, viz.: in May and during the Indian Summer. It is also proposed to work the balance of the estate once a year, about October.

42. *Per cent Mature Pods affected*: Records of mature pods affected with Witchbroom were started in March, 1931, when it was observed that several pods were attacked. Plots which were expected to give a high, medium and low incidence were selected.

43. *Results*: The results for March to December, 1931, are as follows:—

HIGH INCIDENCE.			
	Total Pods.	Pods Affected.	Per cent affected.
Plot 28	2,816	230	8.16
Plot 44	2,324	228	9.81
MEDIUM INCIDENCE.			
Plot 46	2,273	93	4.09
LOW INCIDENCE.			
Plot 47	4,826	121	2.50

Practically all the affected pods were obtained for the March and April pickings. The above percentages would have been much less, if records for January and February had been available, as large picks were made and there were very few diseased pods.

44. *Percentage of Trees not Affected with Witchbroom*: Witchbroom incidence and crop records are being kept for 4,289 individual trees, in the manurial section. From these records it has been possible to ascertain the percentage of trees which have not been affected with Witchbroom during the year, on vega and on undulating lands. The symbols N₁, K₁, P₁, &c., denote the various treatments accorded to the plots and these will be found under the manurial section. There are 125 trees under each treatment and the results are given below.

Series.	Treatments.			Control.	Whole Series.
	N ₁	N ₂	N ₃		
Nitrogen (Vega)	4.80	4.80	7.14	4.00	5.19
Lime (Vega)		C ₂		4.80	5.20
Nitrogen and Potash (Vega)	N ₁ K ₁	N ₂ K ₂	N ₃ K ₃	12.00	13.20
	15.20	12.00	13.60		
Nitrogen and Phosphate (Vega)	N ₁ P ₁	N ₂ P ₂	N ₃ P ₃	10.40	8.93
	11.11	6.35	7.87		
Potash (Undulating) ..	K ₁	K ₂	K ₃	15.62	21.76
	26.98	22.22	22.05		
Phosphate (Undulating) ..	P ₁	P ₂	P ₃	21.09	18.16
	16.41	14.61	20.63		
Potash and Phosphate (Undulating)	K ₁ P ₁	K ₂ P ₂	K ₃ P ₃	69.05	74.16
	77.34	76.80	73.44		
Complete Fertiliser (Undulating)	N ₁ K ₁ P ₁	N ₂ K ₂ P ₂	N ₃ K ₃ P ₃	24.80	30.74
	33.60	32.80	31.75		
Lime (Undulating) ..	C ₁	C ₂	C ₃	39.20	37.70
	38.09	40.80	32.81		

III. MANURIAL EXPERIMENTS ON PRIVATE ESTATES.

These experiments are being made under the supervision of the Department of Agriculture. The manurial experiments at La Vega and Endeavour Estates are in co-operation with Messrs. Imperial Chemical Industries, Ltd., who supply the fertilizers, but the cost of keeping records and of applying the fertilizers is borne by the proprietors of the estates.

Manurial Experiments on Cacao.

2. *Experiments at La Vega Estate.*—The experiments at La Vega are being made on *whole fields*. Crop records of each field are known for the past thirty years. There are two sets of experiments (a) one started in 1925 and (b) the other started in 1930.

3. *Experiment started in 1925.*—The manured and control fields are 5½ acres each. There are 270 cacao trees per acre, shaded with the usual number of immortal trees. The manured field "Nelson" is 60 to 70 years old and the control field "Philip" 30 to 50 years old (1926). A complete fertilizer consisting of:—

250 lb. Sulphate of Ammonia
150 lb. Mineral Phosphate
100 lb. Sulphate of Potash

per acre was applied to field "Nelson" in December, 1925, May, 1928 and 1930 and it is to be repeated every alternate year. No beneficial results were obtained from the above treatment for the first four crops (1926-29), and as it was ascertained that the soil was acidic, an application of 5 tons pulverized limestone per acre was made in April, 1930.

4. *Results.*—No increase of crop has been obtained for the fertilised field previous to the application of lime (1926-30). The sixth crop (1931), *i.e.*, the first after liming shows an increased yield of 73 lb. commercial cacao per acre, over and above the yield for the control field. But, this increase is not sufficient to pay for the fertilizers plus cost of liming when cacao sells at 10 cents per pound.

5. *Experiment started in 1930.*—The manured field "St. Luce" is 14.58 acres and the control field "Real" 8.42 acres. There are 276 cacao trees to the acre, approximately 40 years old (1930). The immortal population is on the light side, practically corresponding to partial shade conditions. Both fields are comparatively low cropping fields. The manurial treatment is the same as that of the 1925 experiment, but without lime.

6. *Results.*—Crop results for the first year after manuring (1931), show an increased yield of 52 lb. commercial cacao per acre for the manured field, over and above that for the control field. This increase just covers the cost of manuring when cacao sells at ten cents per pound.

Manurial Experiments on Coconuts.

7. *Experiments at Endeavour Estate.*—This estate is situated at Chaguanas and is typical of a large area of old sugar-cane land planted in coconuts. The soil is flat, deep, well drained and varies from a sandy loam to a clay loam. The trees are late in coming into bearing but yield an average crop of 3,000 to 4,000 nuts per acre, when they are approximately 18 years old.

8. The experiments are being made on *whole fields* whose previous cropping records are known. Details of the experiments were given in the Annual Report for 1928. They fall into two categories.

(a) *Sulphate of Ammonia Experiments.*—These were started in December, 1925. The object is to ascertain the pecuniary benefit of a normal dressing of Sulphate of Ammonia alone, and in conjunction with Potash and Phosphates.

(b) *Ammonium Chloride Experiments.*—These were inaugurated in 1928, at the request of Messrs. Nitram, Ltd., who wished to test the relative value of Ammonium Chloride and Sulphate of Ammonia as a source of nitrogen for fertilising coconut palms. Ammonium Chloride is also being tried in conjunction with Potash and Phosphates.

9. The average annual rainfall, for an adjoining property for the past 10 years, is 61.90 inches.

10. *Results of the Sulphate of Ammonia Experiments.*—All the fields have given an increased crop above their respective *natural yields* for five years previous to manuring. The increase shown by the control fields is 1,377 nuts, but that shown by the manured fields (Nos. 1, 4 and 7) is 702, 490 and 318 nuts per acre per annum, respectively, over and above that of the control field, for the five crops subsequent to manuring. This additional increase of crop is more than sufficient to pay for the cost of manuring when coconuts sell at \$17.50 per 1,000. At this price, the average profit obtained, for five crops (1927-31) per acre per annum, is as follows:—

Treatment per Acre, 1925, 1927, 1929 and 1931.				\$	c.
Field 1	(250 lb. Sulphate of Ammonia)	..	..	8	33
Field 7	{ 250 lb. Sulphate of Ammonia } { 100 lb. Sulphate of Potash }	..	..	3	13
Field 4	{ 250 lb. Sulphate of Ammonia } { 150 lb. Mineral Phosphate } { 100 lb. Sulphate of Potash }	..	..	..	53

11. *Results of the Ammonium Chloride Experiments.*—Two crops have been reaped since the application of manures and the yields obtained show that all the plots have given an increased yield above their respective *natural yields* for four years previous to manuring. The increase shown by the control field is 1,382 nuts, but that shown by the manured fields (10^E, 6^S and 10^W), is 52, 234 and 416 nuts per acre per annum, respectively, over and above that of the control field, for the two years after manuring. The manured fields (14^E, and 14^W), show a smaller increase than the control field. The average pecuniary results per acre per annum for the two crops (1930 and 1931), when coconuts sell at \$17.50 per 1,000 are as follows:—

Treatment per Acre, 1928 and 1930.				\$	c.
Field 14 ^E	(206½ lb. Ammonium Chloride)	..	..	..	Loss.
Field 10 ^E	{ 206½ lb. Ammonium Chloride } { 100 lb. Sulphate of Potash }	..	..	..	Loss.
Field 6 ^S	{ 206½ lb. Ammonium Chloride } { 150 lb. Mineral Phosphate } { 100 lb. Sulphate of Potash }	..	..	..	Loss.
Field 14 ^W	{ 250 lb. Sulphate of Ammonia } { 150 lb. Mineral Phosphate } { 100 lb. Sulphate of Potash }	..	..	1	81

IV. GENERAL.

Coconut Wilt.

A comprehensive series of experiments were started on Waterloo Estate with a view to throwing light on the cause of the Wilt disease of coconuts. The experiments consist of:—

- Manurial trials.
- Trimming of leaves and firing of crowns of palms.
- Preserving moisture during dry season.
- Removing the crop from the palms.
- Dusting trials.

Regular inspections were made of the plots and records made of wilt affected trees.

2. This work will be reported in detail elsewhere.

Seedling Canes.*Trinidad Seedling Canes.*

The testing of seedling canes this year was confined to the new seedlings raised in 1929 and to those raised in 1927 from which plot results were being obtained for the first time. As in former years the work was performed in a small improvised laboratory at the Government Farm where the canes were crushed in a small Chattanooga mill. Owing to the pressure of work in other directions, seedlings raised previous to 1926 were not tested. It has been our experience at St. Augustine, that the seedlings which give juice of good quality for the first and second plantings maintain this characteristic in future years. After this has been determined, field returns are of greater importance.

2. *Seedlings raised in 1927.*—The seedlings raised in 1927 were grown in plots for the first time and the juice tested in April, 1931, when they were 18 months old. Eighty-three of these seedlings gave better results than B.H. 10(12). The two best are T. 5234 and T. 5232. They gave 66.12 and 59.40 tons of cane with an indicated sucrose in the juice of 8.07 and 7.89 tons per acre respectively. They are followed by T. 4794, T. 4849, T. 5390 and T. 4907 with 54.45, 59.40, 49.50 and 49.50 tons of cane containing 6.96, 6.80, 6.78 and 6.42 tons of sucrose in the juice respectively. T. 4891, T. 5049, T. 4887 and T. 4932 come next in order of merit. They gave a yield of 39.60 to 44.55 tons of cane containing from 5.17 to 5.89 tons, of indicated sucrose in the juice per acre. Thirty-six other varieties gave a yield of from 29.70 to 42.07 tons of cane containing from 4.00 to 4.82 tons of sucrose in the juice. These and thirty-seven other varieties have given better results than B.H. 10 (12), grown in the same field and under similar conditions. The results for B.H. 10 (12) are as follows: 28.46 tons of cane containing 1.928 lb. of sucrose per gallon giving 3.37 tons of indicated sucrose in the juice per acre. Forty-six of the seedlings gave juice containing over 2 lb. of sucrose per gallon of which seven exceeded 2 lb. per gallon.

3. *Seedlings raised in 1929.*—The juice from seedlings raised in 1929 was tested in April, 1931, for the first time. Ninety-two of these were selected for their combined characters and analytical results for plot trials. The majority of these were raised from T. 735 and B.6835, the parent which produced B.H. 10 (12). Owing to the curtailed area now available at St. Augustine, for sugar cane trials, a drastic cut had to be made in the selection of these seedlings for plot trials.

J. DE VERTEUIL,
Agro nomist.

GOVERNMENT STOCK FARM, TRINIDAD.**General.**

Dr. J. L. Shannon, D.V.M., Assistant Officer-in-Charge, who proceeded on leave to Barbados for 3 months at the end of last year, returned to the Colony in January and resumed his duties on 1st February.

2. The rainfall increased considerably during the last six months of the year. The total recorded was 69.86 inches as compared with 45 inches in 1930. The lowest rainfall recorded was .08 of an inch in the month of March and the highest 13.94 inches in the month of July.

3. Owing to the heavy rains the grass fields and pastures were quite green during the latter part of the year and there was no necessity to cut Uba cane for fodder. The good pasturage was made full use of again this year by turning the dairy herd out again all night as well as part of the day. The Zebu herd remained at pasture day and night but were still brought into the dairy stanchions once daily to be fed their concentrates as well as to be handled.

Water Supply.

4. The Public Works Department completed the work for the new water supply from the St. Joseph River for all purposes on the Farm except for the use of the quarters of the staff. The supply for the staff is still taken from the St. Joseph Waterworks. A Blake's Ram has been placed in a concrete enclosure adjoining the St. Joseph River as it runs through the Farm to the south of the main buildings and a dam has been built across in order to feed the ram. The water is pumped into a 12,000 gallon tank on the top of two unused silos and this gives quite a good pressure throughout the dairy and the other buildings.

Grass Land Experiment.

5. In conjunction with the Chemical Division of the Imperial College of Tropical Agriculture an experiment was started on pasture land improvement using the randomised plot method. The artificial manures employed were Muriate of Potash, Buccaneer Phosphates, Sulphate of Ammonia and Ground Limestone. Owing to the very heavy rainfall the experiment had to be unfortunately abandoned as the growth of weeds on the plots got beyond control.

Lay out of Grass Land Plots.

Ca	=T. 1.	
Ca+N	=T. 2.	
Ca+NP	=T. 3.	(Six $\frac{1}{3}$ acre plots—8 acres—(Repeated 4 times))
Ca+NK	=T. 4.	
Ca+NPK	=T. 5.	
Nil	=T. 6.	

3 3,733 lb. Ca 37 lb. N 75 lb. P	5 3,733 lb. Ca 37 lb. N 75 lb. P 56 lb. K	4 3,733 lb. Ca 37 lb. N 56 lb. K	1 3,733 lb. Ca	2 3,733 lb. Ca 37 lb. N	6 —
4 3,733 lb. Ca 37 lb. N 56 lb. K	1 3,733 lb. Ca	3 3,733 lb. Ca 37 lb. N 75 lb. P	6 —	5 3,733 lb. Ca 37 lb. N 75 lb. P 56 lb. K	2 3,733 lb. Ca 37 lb. N
1 3,733 lb. Ca	2 3,733 lb. Ca 37 lb. N	6 —	5 3,733 lb. Ca 37 lb. N 75 lb. P 56 lb. K	3 3,733 lb. Ca 37 lb. N 75 lb. P	4 3,733 lb. Ca 37 lb. N 56 lb. K
5 3,733 lb. Ca 37 lb. N 75 lb. P 56 lb. K	3 3,733 lb. Ca 37 lb. N 75 lb. P	4 3,733 lb. Ca 37 lb. N 56 lb. K	2 3,733 lb. Ca 37 lb. N	6 —	1 3,733 lb. Ca

Ca = Calcium (Ground Limestone) applied 1st June, 1931.

N = Nitrogen (Sulphate of Ammonia) applied 1st June, 1931.

P = Phosphate (Buccaneer Phosphate) applied 15th June, 1931.

K = Potash (Muriate of Potash) applied 15th June, 1931.

Ca, 5 tons per acre ; N 1 cwt. per acre ; P 2 cwt. per acre ; K $1\frac{1}{2}$ cwt. per acre.

CATTLE.

6. No new importations of pure bred stock were undertaken during the year : the small pure bred herd of Holstein Friesian cattle has been maintained solely for the purpose of breeding pure bred bulls.

7. The breeding experiments by crossing Holstein Friesian bulls with Zebu cows have been continued and this work was referred to by Mr. John Hammond, M.A., of Cambridge University at the last World's Dairy Congress in Copenhagen during the year. The experiment was taken a bit further this year by only breeding selected Zebu cows (those that give a better milk supply and are more docile) to the pure bred Holstein Friesian bull " King Butter Girl Walker " whose worth as a sire of heavy milkers has been fully proved. Further, his $\frac{1}{2}$ bred and $\frac{3}{4}$ bred daughters have been inbred to him so that the $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{7}{8}$ grades will be of an excellent type. Special attention is being paid to the selection of the different grade bulls for the breeding in each grade in order to compare results. Small herds of $\frac{1}{2}$ and $\frac{3}{4}$ grades have been established and it will be possible to start a $\frac{7}{8}$ herd in 1932.

8. The testing of young bulls of the different grades by breeding them to a few heifers early has been continued and in order to give them sufficient exercise (as it is impossible to turn them all out to pasture) arrangements have been made to work them for a short period each day in bullock carts.

9. It was hoped that financial aid would be given to this Institution by the Empire Marketing Board, following Mr. John Hammond's visit, for carrying out the work with the Holstein-Friesian-Zebu crosses, but owing to the reduction of the grant of the Empire Marketing Board it seems improbable that such help will be given.

10. Sixty-five privately owned cows were bred to the pure bred bulls on the Farm during the year at a service fee of \$2.00, in addition to the Farm owned cows. Owing to the closing down of the Paradise Pasture at San Fernando the Government decided to rent the bulls (a pure and a high grade) to the Ste. Madeleine Sugar Co. at the same rate (\$4.00 per month for each bull) as to the Warden of the district, and to have them stationed at Union Hall. The Arima Pasture has also been closed down, but a cocoa proprietor in that area has purchased a pure bred Holstein Friesian bull and has opened his pasture to the public.

11. At the Annual Sale 11 grade bulls averaged \$53.00 ; 12 grade heifers \$55.00 ; and 7 grade cows \$55.00.

12. In the Port-of-Spain area four pure bred Holstein Friesian bulls and three grade bulls of the same breeding stood for service at the Bull Service Station and two of the pure bred bulls were turned out to pasture—one at St. Ann's and one at Mucurapo—every night during the year. At the Station 46 cows were bred to pure bred bulls during the year and 180 cows to grade bulls.

13. The average number of head of cattle on the Mucurapo Pasture during the year was 55 per month and 25 per month in the case of the St. Ann's Pasture.

14. *Dairy Herd.*—The amount of milk produced by this herd was 30,500 gallons which was 2,622 gallons more than last year. The Public Institutions were supplied with 27,000 gallons. The dairy cows were again fed on a basis of 4 lb. of concentrates to a gallon of milk using Saint's (Barbados) production formula of 1 lb. each of cottonseed meal, oilmeal, bran or pollard and molasses (starch equivalent 2.5 containing .6 protein). The following changes were however made. Whenever local peas were available at a cheap figure, pea meal was substituted for cottonseed meal, the local coconut meal was used in equal parts with Linseed meal and British Guiana rice meal was substituted for bran or pollard. This new ration worked out quite satisfactorily and a mineral mixture made up of 2 lb. each of salt and air slaked lime and 1 lb. sterilized bone meal flour was placed in each 100 lb. of concentrates. Cows were dried off by reducing their concentrates and milking them less frequently and as soon as they were dry they were placed on a 4 lb. ration of concentrates daily, made up of equal parts of coconut meal and rice meal until a week before calving when they were put back on the fresh cow ration. This herd was turned out for most of the day and all night, but were brought in at 6 a.m., fed their concentrates, washed, and then milked. They were again brought back to their stanchions at mid-day, fed the other half of their concentrates, and then given about 40 lb. of green grass or 20 lb. of Uba cane or canetops, depending on the season of the year. The cows have kept much cleaner when turned out in this way and their condition throughout the year has been excellent. During the year imported calf meal was used instead of the home made one as it was more convenient for use and the results were satisfactory. On two or three occasions when merchants could not supply the meal, the local made gruel (equal parts of rolled oats, linseed meal, corn meal and flour; boiling 1 lb. of the mixture in water and adding sufficient water to make a gallon when warm) was substituted.

15. The milk yield of every cow in the dairy was taken daily in a record of production book. The fat content was tested by the Agronomist once monthly for every cow as well as the mixed milk from the herd.

16. *Zebu Herd.*—Among the visitors to the Farm this year were Mr. Sadler and Major Armstrong of the Standard Oil Company of New York who are both interested in the Armstrong Herd of Texas and are very keen on Zebu cattle. These two gentlemen spent two mornings at the Farm taking photographs of the stock, chiefly the Zebu cattle, and this Institution is indebted to them for a fine collection of pictures which they had enlarged and forwarded to the Farm on their return to the U.S.A. They bought for their herd during their visit three young pure bred bulls and six pure bred heifers.

17. Before their shipment to New Orleans by one of the boats of the Aluminum Line, these cattle were quarantined at the Farm for sixty days and were entirely tick free and in excellent health when shipped. They were all shipped in newly made crates and an East Indian lad from the Farm, who cared them during their quarantine period, accompanied them to New Orleans.

18. The Zebu bull "Babool II" still continues to produce a very fine lot of calves and he is very much admired by all visitors to the Colony.

19. The following animals were sold from the herd during the year :	\$	c.
Three young pure bred Zebu bulls to Major Armstrong, U.S.A. at \$240.00 each	720	00
Six young pure bred Zebu heifers to Major Armstrong, U.S.A. at \$132.00 each ..	792	00
Two pure bred Zebu bulls to Mr. Chappelaine of Venezuela at \$240.00 each ..	480	00
Two young pure bred Zebu bulls for shipment to Cuba by Canadian Bank of Commerce at \$240.00 each	480	00
	<u>\$2,472</u>	<u>00</u>

20. During the year a Committee of the Animal Husbandry section of the Agricultural Society inspected the herd and drafted a few high grade Zebus into a foundation stock herd for pure bred breeding.

21. *Sussex Cattle.*—The trio of Sussex cattle have stood up to local conditions quite well and the cows were again in good condition and heavy in calf at the end of the year. The bull calf born at the end of last year has grown well, and is now stall fed.

22. Of the four Zebu Shorthorn cows bred to the pure bred Sussex bull two calved bulls and two heifers, and together with the bull from the grade Hereford cow born last year, there is now a nucleus of grade beef animals at the Farm. Selected grade bulls born on the Farm will be shipped to Tobago for the improvement of their beef cattle as soon as possible.

23. *Health.*—The casualties were less this year than last year. There was only one case of paralytic rabies (described formerly as Botulism). Five calves died from pneumonia and two from diarrhoea. There was one death due to each of the following:—Old age and debility, Tympanites and Tuberculosis. Three weak calves died shortly after birth and three animals died as a result of injuries.

24. During the year 97 cows calved normally and seven aborted. The death rate in calves was again low due to the regular dosings with Copper Sulphate which controls parasitic infestation.

Horsekind.

25. The thoroughbred chesnut horse Bachelor's Tut foaled in 1925 by Bachelor's Double out of Miss Tut Tut was leased from Mr. W. A. Murray for one year to take the place of Golden Eaglet who was not used during the season due to skin disease. Bachelor's Tut stood for service for the whole season at San Fernando and had 27 mares bred to him. The stallion Daddy stood for service at the Farm and at San Fernando for the months of February and March and had 15 mares bred to him. He was then sent to Tobago and stood in the island ward for service from the 20th March

until the middle of July. The stallion K.P. was stationed in Tobago for the early part of the season and was returned to Trinidad at the end of March when Daddy relieved him there; at the Farm he was bred to five mares. K.P. was sent again to Tobago at the middle of July. Nelsweep stood for service at the Farm for the whole season and had four mares bred to him. The fees charged for the service of all these stallions was \$10.00 each. The Jack Donkey Stallion Emperor had to be destroyed following an attack of Haemoglobinuria and another Jack Donkey (imported from Missouri) was purchased from Mr. Francis Mendes, Goldsboro, Tobago, to take his place. Emperor I had five mares bred to him and Emperor II two mares—the fee in both cases was \$7.50. The smaller Jack Donkey Barbados Joe, received 13 donkeys at \$1.00 each and four mares at \$5.00 each during the year. The brood mares Nellie and Cavel foaled during the year a colt in each case by Daddy and were both rebred to K.P. The brood mare Marama foaled a colt by Nelsweep and was rebred to the Jack Donkey.

26. The thoroughbred brood mare Saturnia purchased last year foaled during the year a filly by Daddy and this was given to Mr. W. A. Murray in exchange for the services of Bachelor's Tut. Saturnia was rebred to Daddy and was again heavy in foal at the end of the year.

27. At the Annual Sale a two year old filly by Irish Pride and the two foals by Daddy out of Cavel and Nellie respectively were sold and realised a total of \$134.00; one mule filly by Emperor I out of Andiquilla was also sold and realised \$30.00.

28. Three mares, Wistaria, Pretty Polly (Tobago ponies) and Maraquita (American imported) were transferred from the Constabulary to the Government Farm. Wistaria was bred to Nelsweep and the other two mares to the Jack Donkey Emperor.

Pigs.

29. During the year 53 sows were sent to the Farm for service; the service fee was \$1.50 each.

30. At the Annual Sale 25 young pure bred Large Black and Berkshire pigs realised \$298.00 or approximately \$12.00 each. The highest price was \$20.00 for a young Large Black Sow.

31. Private sales of pigs during the year realised \$166.00 making a total of \$464.00 for all pig sales during the year.

Dairy and Mutton Goats.

32. Thirty-five does were bred to the buck "Prince Perfection" (Saanen) during the year at \$1.50 each. At the Annual Sale a doe, a goatling, a buckling and three buck kids (all Saanen) were sold and realised \$68.50.

33. The death rate in the young kids from the small herd of lop-eared Indian hornless goats (mutton breed) was rather high during the year due to goitre and steps were taken to treat the does in kid with Potassium Iodide during the period of gestation and better results are expected from three does due to kid early in 1932.

34. The monthly dosing of all goats with Copper Sulphate solution during the year has been again successful in keeping the goats free from internal parasites.

Black Head Persian Sheep.

35. Eighty of these sheep (72 ewes and 8 rams) were landed in the Colony in December of last year consigned to the Department of Agriculture for distribution throughout the West Indies, Demerara and Venezuela. They were imported from South Africa and were from the well-known breeders Messrs. John H. Biggs & Sons, Graaf Rienet, C.P. The sheep were drawn for and all were handed over to their owners early in the year. The Farm's consignment was made up of five ewes and 2 rams and breeders in Trinidad and Tobago also purchased some more. The others have been distributed to the Leeward and Windward Islands, Demerara and Venezuela. Several lambs were born during the year and on some estates, notably at Cedros and Couva in Trinidad, some excellent lambs have been produced by crossing the rams of this breed with local sheep. At the Annual Sale two ewes and two lambs were offered at an upset price of \$80.00 but were not sold. They were eventually sold to the Government of Montserrat.

Poultry.

36. At the Annual Sale 30 lots of pure bred Rhode Island Reds, Barred Plymouth Rocks and White Leghorns realised \$199.00 and for private sales of poultry during the year \$53.62 was received.

37. The number of eggs laid during the year was 5,639 and the revenue obtained from this source was \$357.30.

38. At the Annual Exhibition the method of rearing chicks on wire instead of the ground in order to reduce mortality due to parasitic infestation was demonstrated.

Sale of Stock.

39. The Annual Sale of Livestock took place on the 29th May. In spite of the depression in trade the attendance was excellent but the prices realised were lower than last year. The receipts from this sale were \$2,650. Private sales of stock realised \$2,964.48 making a total of \$5,614.48 for last year.

Public Pasture and Stabling of Animals.

40. The public pasture at the Farm was kept closed again during the year due to "Paralysis" Disease (Rabies) in the neighbourhood. A few cows were however admitted to the different herds of the Farm for breeding to special bulls, and some mares sent to the donkey stallion were also pastured. Mares, cows, sows, does and ewes sent for breeding purposes were also stabled throughout the year. The revenue from the stabling and pasturing of animals amounted to \$1,203.01.

REPORT OF THE VETERINARY DIVISION.**General.**

Mr. Eustace Montgomery, M.R.C.V.S., Adviser in Animal Health to the Secretary of State for the Colonies, visited the Colony during his tour of inspection of the British West Indies and British Guiana and stayed in Trinidad for ten days. During his stay in the Colony he inspected the Government Farm, the Government Bulls standing for service in Port-of-Spain and other districts, the Abattoir, and the Quarantine Stations in Port-of-Spain, all cold storage plants, the Constabulary horses, the City Council's Transport Train, three Dairy Plants and livestock on several plantations. Arrangements were also made for tours of inspection of two edible oil and lard factories, where large quantities of coconut meal are made and the factory of the Ste. Madeleine Sugar Co., Ltd. The Adviser in Animal Health was also very interested in the new form of paralysis disease in livestock (100 per cent. mortality)—paralytic rabies in which the dog plays no part—occurring in livestock and in man. This condition was responsible for a heavy mortality in animals in 1929, 1930 and again in 1931 and after he had seen cases and made post mortem examinations himself, Mr. Montgomery advised that material from the central nervous system of animals should be sent to Dr. Andrews, Director of the Imperial Bureau of Animal Health, Weybridge, and that certain inoculation experiments should also be carried out there.

2. During his stay in the Colony, the Adviser in Animal Health called on all those interested in the meat business especially in connection with the building up of trade between British Guiana, which he had just toured and Trinidad. Mr. Montgomery also visited the Imperial College of Tropical Agriculture where he saw the Commissioner of Agriculture for the West Indies who was also acting Principal of the College at the same time: he had interviews with the Surgeon-General and Dr. J. L. Pawan, who was engaged in the Laboratory work of this new animal disease (paralytic form of rabies) in the Colony.

3. Mr. Montgomery's valuable report on his tour of inspection was published shortly after his return to England.

4. During the year the Veterinary Surgeons Registration Board held seven meetings and two persons were registered under section 6 (2) and one under Section 6 (3). The Board also dealt with three cases that had been refused registration and had appealed to the Governor: in all cases the decision of the Board was upheld. The correct meaning of the wording of the Ordinance in relation to unqualified persons applying for registration Section 6 (3), was also the subject of a debate in the Legislative Council during the year but the Council confirmed the ruling of the Registration Board. Capt. E. E. Maclachlan, M.R.C.V.S., one of the members of the Board, proceeded on leave to the United Kingdom from 14th July to 1st November and Dr. J. L. Shannon D.V.M., was appointed to act for him. Mr. Mahomed Dhein, the Secretary of the Board, was also granted three months local leave and Mr. Ali Hosein of the Department of Agriculture acted for him.

5. The Agricultural Society held an exhibition early in the year at the Princes Building, Port-of-Spain, in which livestock played an important part. The Exhibition was however held again during the Sugar crop season and it was therefore impossible for the Companies far away from town to take part. The Exhibition was therefore deprived of a number of excellent livestock exhibits from the Ste. Madeleine Sugar Co., Waterloo Estate and Woodford Lodge Estate. The model dairy plant exhibited by the Government Stock Farm was of great educational benefit to the public in general. The Government Veterinary Surgeon was Chairman of the Livestock Committee and also acted as a judge in several classes.

6. The Animal Husbandry Committee of the Agricultural Society held two meetings during the year and the Government Veterinary Surgeon and four other members of the Committee visited the Sugar Plantations for the purpose of registering foundation herds of zebu cattle. There are now three foundation herds of zebu cattle registered besides the pure bred herd at the Government Stock Farm.

7. The Government Veterinary Surgeon proceeded to Grenada in the month of March for the purpose of visiting the Island of Carriacou in connection with a scheme for livestock improvement referred back to the Colonial Secretary for further information by the Colonial Development Fund Committee. During his stay in Grenada the Government bulls standing for service in different parts of the Island were inspected by him.

8. Owing to the absence on leave of the Manager of the Government Stock Farm, Tobago, the Government Veterinary Surgeon paid two visits of inspection to the island-ward during the year, inspecting the Farm, the new Abattoir and the Constabulary horses. During his tour of duty in Grenada and Tobago, all Veterinary duties in Trinidad were performed by Dr. J. L. Shannon, D.V.M., Assistant Officer-in-Charge, Government Farm, Trinidad.

9. The Veterinary Medical Association held three meetings during the year and one of these meetings was specially held to get all Veterinary Surgeons in the Colony to meet the Adviser in Animal Health to the Secretary of State for the Colonies and to discuss the peculiar form of paralysis disease seen in livestock during 1929, 1930 and 1931.

Proclaimed Diseases.

10. *Anthrax*.—During the year no cases occurred. Four specimens were received for examination but they all proved negative.

11. *Foot and Mouth Disease*.—There were again no importations of cloven footed animals from countries where the disease exists. Frozen meat, however, was again imported in large quantities from the Argentine, Brazil and Uruguay during the year and as this meat arrived without any Veterinary Certificates the matter was again taken up with the Adviser in Animal Health during his visit to the Colony. This Division had already pointed out the risks of introducing Foot and Mouth Disease and Swine Fever to Government many years ago, but the Secretary of State to whom the report was submitted decided that the chances of introducing disease were negligible. On the advice of the Adviser in Animal Health to the Secretary of State, new regulations under the Diseases of Animals Ordinance were made by the Governor in Executive Council at the end of the year and came into force on 1st January, 1932. The Regulations are in two parts and are cited as the Importation of Frozen Carcases and Boiling of Animal Foodstuffs Regulations, 1931.

PART I.

Restriction on the Importation of Frozen Carcases.

(1) Frozen carcases of animals from South America (with the exception of British Guiana and Venezuela shall not be landed in the Colony unless accompanied by a certificate signed by a Government Veterinary Surgeon or Examiner of Animals and countersigned by the British Consul, Vice-Consul or Consular Officer stating that such animals have never suffered from Foot and Mouth Disease in the case of all animals and Swine Fever in the case of pigs and are from a district which is free from such diseases.

(2) No frozen carcases of animals shall be landed in the Colony except in conformity with the last preceding regulation and until the certificates accompanying the same shall have been countersigned by the Government Veterinary Surgeon and Examiner of Animals of this Colony.

PART II.

Precautions to be adopted in regard to certain Animal Foodstuffs.

(3) Every person having in his possession or under his charge:—

(a) any meat, bones, offal or other part of the carcase of an animal; or

(b) any swill; or

(c) any other broken or waste foodstuffs which have been in contact with meat, bones, offal or other part of the carcase of an animal,

shall before he allows any such articles to be brought into contact with or fed to animals or before he sells or otherwise disposes of them to any other person cause such articles to be boiled.

12. *Tuberculosis*.—The testing of cattle with Tuberculin in accordance with the new Regulations brought into force in January, 1929, was discontinued this year as this Division was fully occupied investigating the peculiar form of rabies existing in livestock in the Colony. All bovine animals imported, with the exception of those for immediate slaughter, were however tested with tuberculin at the port of entry provided they did not arrive with the certificates required by law. There were no reactors.

13. *Glanders and Epizootic Lymphangitis*.—No cases occurred.

14. *Swine Fever*.—There were three outbreaks during the year. The first one occurred at Valencia Road in the County of St. Andrew, the second occurred at St. Ann's in the County of St. George and the third in Manzanilla in the County of St. Andrew. It was discovered on investigation that the pigs in the first outbreak were brought from St. Ann's where the second outbreak occurred and as a matter of fact they had left that area in an infected condition. Strict quarantine restrictions were enforced in all cases and all sick and in contact pigs were slaughtered, compensation being paid to the owners. The first two outbreaks occurred during the month of May and the last outbreak in September. Some blood taken from a slaughtered pig in the St. Ann's area was sent to the Director of the Imperial Bureau of Animal Health and he reported the presence of the Swine Fever virus in the blood.

15.—*Rabies*.—During the year 15 dogs were imported from countries other than Great Britain and were quarantined for three months at the Government Quarantine Station and for three months more at the owners' residence, provided the owner made satisfactory arrangements for the detention of the dog at his residence.

16. No feline animals were again quarantined during the year.

Non-Proclaimed Diseases.

17. *Paralysis Disease in Livestock*.—This disease which in former years was described as Botulism was again prevalent in the southern part of the Colony chiefly in the Williamsville, Princes Town, Erin, Cedros, Couva and Montserrat areas, but cases also occurred in the Manzanilla district and in the Caparo Valley. The Government Pathologist, Dr. J. L. Pawan, whilst investigating a peculiar disease in human beings in which the typical symptoms were an ascending myelitis, discovered cell inclusion bodies in the brain of those that had died of the disease and these findings were confirmed by Dr. Hurst of the Lister Institute, London, and Dr. Flexner of the Rockefeller Institute, New York.

These experts were of the opinion that the disease in man was paralytic rabies. The brain of affected animals that died of paralysis also showed similar inclusion bodies on further investigation and it is now decided that the disease both in man and animals (formerly described as Polio-myelitis and Botulism) is a peculiar form of paralytic rabies in which the dog plays no part. During the visit of the Adviser in Animal Health to the Colonial Office these facts were laid before him and on his advice material was sent to Dr. Andrews of the Imperial Bureau of Animal Health, London, who at once started to investigate the disease. All classes of livestock are affected and the death rate is 100 per cent. : a similar form of paralysis in poultry in affected areas is being investigated now.

In animals besides the ascending paralysis which is characteristic of all cases, typical bulbar symptoms are very often seen as well as in some cases marked excitement. Dr. Hurst pointed out that a similar rabies-like disease had been occurring in Southern Brazil for some years and here the carrier of the disease was believed to be the bat. This Division received through the Adviser in Animal Health very valuable literature on this Brazilian condition and other similar diseases from the Imperial Bureau of Animal Health during the year and it was of great help in the work involved. In the Brazilian outbreak it was alleged that affected bats behaved in a peculiar manner very often flying about in the day-time and steps were at once taken to get any bats showing such extraordinary behaviour in affected areas. Six such bats were procured—all fruit eating bats (*Artibeus Trinitatis*)—and they all proved to be affected. Three of them were caught at the Government Stock Farm and an emulsion of their brains and salivary glands when injected subcutaneously into a guinea pig, a rabbit and a calf produced typical symptoms of the disease. The Government Pathologist proceeded to the United Kingdom on sick leave at the end of the year and had an opportunity to discuss the disease with Dr. Andrews as well as Dr. Hurst in London. An attempt will be made during 1932 to control the disease in infected areas with rabies vaccine. Owners of animals have also been advised to use bat proof enclosures for their livestock in affected areas and also to illuminate their pens. During the year the number of cases reported in livestock was 413.

18. *Bovine Piroplasmiasis, or Red Water Fever.*—A few cases occurred but they were all in pure bred imported livestock that had never become thoroughly acclimatised and had developed the disease again after their resistance for some reason or the other (chiefly calving) had been lowered.

19. *Pneumonia in calves.*—Cases again occurred during the year on all the large dairy farms and the pure bred calves were most susceptible to the condition. A few cases yielded to treatment, however, and the preventive measures chiefly the disinfecting of calving boxes, calf pens, as well as the sterilizing of feeding pails have helped to control the condition.

20. *Parasitic Gastritis, Pneumonia, &c.*—This condition was again controlled by a regular dosing of Copper Sulphate during the rainy season. Inasmuch as better attention is paid to the handling of young stock they are stronger and in this way resist infection.

21. *Contagious abortion in Cattle.*—A few cases occurred chiefly in the large dairies and the methods of control advocated—the establishment of a maternity ward and the segregation of all aborting animals for 60 days—is responsible for controlling the condition.

22. *Ulcerated Lymphangitis.*—Very few cases were seen during the year.

23. *Nervous Disease in Sheep.*—A peculiar disease in sheep on Constance Estate, Cedros, was investigated during the year. About 50 per cent. of the affected lambs died and it was observed that the others continued to show peculiar nervous symptoms even as adults. The animals were all very excitable and, when driven, the affected ones suddenly collapsed in a fit from which they would soon recover. Several post mortem examinations were made but there were no lesions of interest. The disease turned out to be a mineral deficiency condition as the lambs stopped showing these excitable symptoms as soon as the flock received a mixture of sterilized bone meal flour (1 lb.) air slaked lime (2 lb.) and common salt (2 lb.) in every 100 lb. of the feed.

24. *Strangles and Influenza.*—These conditions are chiefly seen in imported equidae from Venezuela and the U.S.A., but the importations were fewer during the year and not many cases occurred.

25. *Granular Sores in Donkeys.*—This condition was again chiefly confined to the southern part of the Colony and the cane farmers' donkeys are the animals that are affected. With the preventive measures recommended, the disease is not so common.

26. *Tetanus.*—Very few cases were reported.

Importation of Animals.

27. The following animals were imported into the Colony during the year and inspected:—Cattle, 6,594; Water Buffaloes, 16; Horses, 80; Mules, 84; Donkeys, 23; Dogs, 61; Pigs, 2,498; Sheep, 1,164; Goats, 3,841; Jaguar, 1; Deer, 2; and Cats, 1.

28. *Quarantine Station.*—The following animals were admitted to the Quarantine Stations during the year:—Cattle, 6,489; Mules, 5; Horse, 1; Goats, 181; Sheep, 72; and Pigs, 41. One ox died from peritonitis; one sheep and three goats were trampled and one died from Heat Stroke.

29. The revenue received by the Government for the services of the Government Veterinary Surgeon for inspections of animals and for the supervision of the Quarantine Detention Station amounted to £1,180.

H. V. M. METIVIER,
Government Veterinary Surgeon.

RIVER ESTATE--REPORT OF THE MANAGER.

The year was a very unfavourable one from most aspects and adverse weather conditions again prevailed. All crops were short, while prices of most continued on the decline. Thrips and cacao beetles were particularly active and widespread in their depredations, while pod rot and Rosellinia root disease exacted their usual toll. There was a prolonged dry season lasting well into the end of May. On 12th April there was a serious outbreak of fire which caused considerable anxiety and expense. This fire which lasted several days occurred on, and was confined to, the adjoining St. Lucien Estate on our southern boundary and had not very prompt and active measures been adopted by the River Estate gangs very serious damage would have resulted to our Timber and Cacao cultivations. The first real shower of the wet season fell on 27th May. There was one heavy flood on the 27th November which caused extensive damage to the river banks and will necessitate some expenditure to repair. The rainfall for the year was 71.84 inches of which amount only 8.72 inches fell from 1st January to 31st May.

2. The cacao crop was short and amounted to 1,008 bags of 165 lb. each as against the previous year's crop of 1,083 bags. The crops during the last five years have been as follows:—

1927.	1928.	1929.	1930.	1931.
1,318	1,085	1,411	1,083	1,008

giving an average of 1,181 bags.

The crops during the previous five years were as follows:—

1922.	1923.	1924.	1925.	1926.
847	1,250	918	1,169	829

giving an average of 1,002 bags. The five years average increase of 179 bags may be regarded as satisfactory.

3. The average price paid by the Cacao Planters' Association to whom all produce was, as usual, delivered was roughly \$7.30 per fanega for 1st grade cacao which is the lowest average ever obtained in the history of River Estate and has seriously affected the year's revenue.

Revenue and Expenditure.

4. The total revenue for the year was £2,553 19s. 0½d. and the total expenditure £4,850 6s. 2½d. This expenditure includes the sum of £570 9s. 3½d. spent on timber cultivation and on crops other than cacao. Other items which accounted for fairly heavy expenditure were the following:—

	£	s.	d.
1. Repairs to and painting of buildings	102	10	5
2. New quarters for head driver	83	17	2
3. New roads and bridges	75	15	7½
4. Experimental work	81	6	0½
5. Expenses in connection with survey	39	10	7
6. Purchase of a new mule	31	5	0
7. Miscellaneous expenditure in connection with visitors, Agricultural Exhibitions, other public services, and telephone rent	103	13	5½
	<u>£ 517</u>	<u>18</u>	<u>3½</u>

A detailed survey of the whole estate was started towards the end of 1930 and will be completed early during 1932, the cost being distributed over the three years.

Cacao Cultivation.

5. During the year our usual progressive working programme was continued with and much progress was made with cultivation, roads, bridges, repairs to and painting of buildings. The trenching, manuring and supplying of Field No. 10 which had been started late during 1930 was completed and this field has been transformed from an almost derelict one two years ago to quite a presentable and good yielding one at present. The whole of the eastern section of Field No. 3A which is intersected into two almost equal parts by the Diego Martin river was trenched without the addition of pen manure, all surface material and hedge cuttings being utilized to fill the trenches. About one half of the western section on the other side of the river was trenched in the usual way with the addition of pen manure, while the remaining portion has been treated with artificial fertilizers. There are, therefore, three different cultural methods being tried out in this field the whole of which has been supplied with plants of trees Nos. 969 and 1386 two of our best pedigree stock. The individual yield of every tree in this field is being recorded. About one-third of field No. 17 which has always been a poor yielder was trenched without the addition of pen manure as also a portion of Field No. 1 which was getting into bad condition. The thorough trenching of Field No. 21 with heavy applications of pen manure was started late in the year and will be completed early during the present year. On the whole a larger area was intensively worked during 1931 than during any one year previously and good results may be anticipated during the next few years.

6. The usual routine work on all other fields was well maintained, 1,270 feet of the natural surface trace dividing fields 10 and 11 was bouldered and gravelled and the three old wooden bridges in this trace have been replaced by re-inforced concrete structures. It is proposed each year to build a few concrete bridges and so gradually do away with the wooden ones.

RIVER ESTATE.

Rainfall returns for the year 1881.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1 ..	.00	.00	.03	.00	.00	.00	.00	.00	.75	.00	.00	.22	
2 ..	.09	.12	.00	.00	.00	.00	.19	1.05	.00	.34	.31	.03	
3 ..	.00	.18	.00	.00	.00	1.52	.32	.00	.00	.29	.09	.32	
4 ..	.00	.00	.00	.00	.00	1.06	.66	.16	.00	.00	.11	.00	
5 ..	.22	.00	.00	.20	.00	.55	.10	.00	.00	.23	.11	.32	
6 ..	.00	.00	.00	.05	.00	.00	.35	.70	.00	.00	.95	.21	
7 ..	.05	.18	.00	.00	.00	.00	.38	.36	.05	1.21	1.52	.34	
8 ..	.05	.27	.00	.00	.00	.00	.00	.01	.05	.00	.00	.20	
9 ..	.00	.00	.00	.00	.00	.00	.00	1.40	1.58	.00	.00	.00	
10 ..	.00	.00	.00	.00	.42	.00	.16	.31	.00	.00	.00	.02	
11 ..	.00	.00	.00	.00	.00	.00	.24	.10	.00	.00	.15	.00	
12 ..	.00	.00	.00	.00	.07	.00	.00	1.20	2.70	.70	.00	.00	
13 ..	.00	.35	.00	.00	.00	.00	.00	1.30	.05	.00	.00	.00	
14 ..	.00	.00	.00	1.32	.00	.00	.20	.64	.00	.32	.00	.00	
15 ..	.00	.06	.00	.70	.00	.00	.30	.00	.00	.05	.00	.36	
16 ..	.00	.00	.00	.09	.00	.19	1.27	.00	.50	.00	.00	1.10	
17 ..	.00	.05	.00	.00	.34	.00	.16	.00	2.20	.80	.22	.20	
18 ..	.00	.00	.00	.00	.00	.00	1.25	.00	.00	.00	.82	.00	
19 ..	.00	.00	.00	.00	.00	.05	.29	.41	.00	.00	.00	.00	
20 ..	.02	.00	.00	.00	.00	.55	.00	.00	.00	.00	.00	1.55	
21 ..	.15	.00	.00	.00	.00	.00	.26	.00	1.88	.00	.91	.00	
22 ..	.31	.00	.00	.00	.00	.22	2.28	.35	.25	.00	.25	.00	
23 ..	.00	.00	.00	.00	.00	.20	.00	.88	.00	.00	.77	.00	
24 ..	.00	.00	.00	.00	.00	.83	.00	1.00	.55	.05	.00	.27	
25 ..	.00	.12	.00	.29	.00	.18	.41	.00	.00	.00	.00	.13	
26 ..	.00	.00	.00	.00	.12	.33	1.45	.19	.00	.52	1.37	.55	
27 ..	.27	.00	.00	.00	.82	.39	.26	.56	.35	1.60	.68	.19	
28 ..	.31	.00	.00	.00	.00	.35	.83	.54	.00	.00	.00	.00	
29 ..	.00	..	.00	.00	.45	.00	.35	.06	.00	.05	.15	.36	
30 ..	.26	..	.00	.00	.76	1.10	.22	.00	.00	.00	.18	.10	
31 ..	.00	..	.00	.00	.00	..	.02	.00	..	.18	..	.12	
	1.73	1.33	.03	2.65	2.98	7.52	11.95	11.22	10.91	6.34	8.59	6.59	71.84

RIVER ESTATE.

Abstract of Expenditure for the year ending 31st December, 1931.

	Details.	Amount.	
		\$ c.	\$ c.
STAFF :			
Manager	2,160	00
Overseers, drivers and watchman	2,797	25
Manager's travelling, messengers, &c.	497	82
			5,455 07
MAINTENANCE :			
Roads, bridges and hedges	373	50
Water service and river	35	82
Repairs to and painting of buildings	492	10
Supplies—tools, bags, &c.	380	16
Yard	601	63
Pasture	111	14
Destruction of vermin (squirrels, beetles, ants, &c.)	187	71
Sundries—including telephone rent, entertainment of visitors, public services and expenses in connection with Agricultural Exhibition	497	63
			2,679 69
TRANSPORT AND STOCK :			
Labour—Stock keeper, grass cutters, grass fields	655	30
Maintenance—Stock feeds, repair carts, harness, shoeing, clipping and purchase of stock	787	13
Produce—Motor lorry (including gasolene, oil, repairs, chauffeur and attendant)	1,460	86
			2,903 29
NON-RECURRENT—A.			
New building	402	52
New roads and bridges	363	75
Surveyor and assistant	189	74
			956 01
NON-RECURRENT—B.			
Clearing new land	71	26
Liming and planting	13	36
Weeding and cutlassing	52	10
			136 72
COCOA CULTIVATION :			
Draining	105	60
Cutlassing and weeding	2,060	73
Pruning	1,060	28
Supplying cacao and ground shade	346	61
Manuring, trenching, mulching, &c.	1,490	21
Plant sanitation—digging and burning diseased trees and burying cocoa shells	366	94
Shade control	133	87
Nurseries (including budding work)	129	92
			5,694 16
MANUFACTURE :			
Reaping	1,783	92
Curing and bagging	544	15
			2,328 07
FRUIT CULTIVATION :			
Cultivation and nurseries	1,052	95
Reaping	12	48
			1,065 43
COFFEE :			
Cultivation	15	76
Reaping, drying and hulling	72	12
			87 88
LIMES :			
Cultivation and maintenance of roads	86	37
Reaping and transport	195	95
			282 32
TONCA BEANS :			
Cultivation	53	89
			53 89
TIMBER :			
Purchase of contracts and advances	717	24
Cultivation and maintenance of roads	531	47
			1,248 71
EXPERIMENTAL WORK :			
Labour	383	65
Materials	6	60
			390 25
		<u>\$23,281</u>	<u>49</u>
		<u>\$23,281</u>	<u>49</u>

RIVER

Annual Yield per acre for each

No. of Field.	No. of Bearing trees.	Half trees.	Quarter trees.	Supply trees.	Missing trees.	Total.	Age of trees.	Planting distance	Acreage.	Annual Yield per acre for each			
										1923.		1924.	
										No. of Bags of 165 lb. each.	No. of Bags per Acre.	No. of Bags of 165 lb. each.	No. of Bags per Acre.
1	4,862	283	645	649	74	6,513	21-27	12 x 12	21.7	53.33	2.4	37.33	1.7
2	2,020	126	549	1,345	83	4,123	51-87	15 x 15	21.7	44.72	2.0	30.66	1.4
3A	1,490	182	272	677	30	2,660	51-57	15 x 15	14.0	40.00	2.8	25.33	1.8
3B	1,383	221	339	280	7	2,230	51-57	15 x 15	11.7	30.66	2.6	21.33	1.8
4	5,141	257	430	62	1,128	7,018	41-52	12 x 12	23.3	47.33	2.0	48.33	2.0
5	2,082	170	343	334	13	2,942	51-57	15 x 15	15.4	68.68	4.4	50.33	3.2
6	5,452	337	436	769	46	7,040	21-27	12 x 12	23.4	102.66	4.3	61.33	2.6
7	3,447	477	545	422	56	4,947	21-27	12 x 12	16.4	61.33	3.7	44.00	2.6
8	5,275	910	1,094	182	684	8,145	21-27	12 x 12	27.1	84.00	3.1	51.39	1.8
9	4,327	866	1,044	1,231	60	7,528	21-27	12 x 12	25.0	66.66	2.6	53.33	2.1
10	3,016	414	905	536	119	4,990	21-27	12 x 12	16.6	32.66	1.9	22.66	1.3
11	2,070	161	510	398	63	3,202	21-27	12 x 12	10.6	20.66	1.9	14.66	1.3
12	3,130	621	1,390	89	1,113	6,352	21-32	12 x 12	21.1	31.33	1.4	21.33	1.0
13	3,438	279	740	72	758	5,287	21-32	12 x 12	17.6	59.33	3.3	44.00	2.5
14	989	293	425	..	400	2,107	51-57	12 x 12	7.0	11.33	1.6	6.66	.9
15	1,810	225	334	..	292	2,661	51-57	12 x 12	8.8	9.33	1.0	6.00	.6
16	3,457	346	987	32	954	5,776	21-57	12 x 12	19.2	24.33	1.2	16.00	.8
17	4,557	597	1,269	153	657	7,233	21-27	12 x 12	24.1	59.33	2.4	38.00	1.5
18	3,038	628	938	84	565	5,253	16-27	12 x 12	17.5	42.33	2.4	37.33	2.1
19	4,056	369	380	220	68	5,093	16-27	12 x 12	16.9	50.66	2.9	49.33	2.9
20	5,167	332	331	395	26	6,251	16-27	12 x 12	20.8	84.66	4.0	58.00	2.7
21	3,561	264	295	584	239	4,943	16-27	12 x 12	16.4	54.18	3.3	45.33	2.7
22	5,184	1,231	1,276	48	758	8,497	16-27	12 x 12	28.3	72.66	2.5	54.66	1.9
23	3,227	554	767	30	322	4,900	16-27	12 x 12	16.3	49.33	3.0	38.28	2.3
24	1,696	612	1,457	287	636	4,688	16-27	12 x 12	15.6	19.33	1.2	20.66	1.3
25	2,027	506	366	190	236	3,325	9-22	12 x 12	11.0	29.33	2.6	22.00	2.0
Totals	85,911	11,261	18,076	9,069	9,387	133,704	..	..	466.5	1,250.15	..	918.26	..
Total Average Yield per acre ..	..	..	..	..	..	..	..	..	..	..	2.6	..	1.9
<i>Age given above represents average ages in 1923.</i>													

ESTATE.

Field of Cacao, 1923 to 1930.

YIELD.															Average bags per acre for 9 years 1923-1931.
1925.		1926.		1927.		1928.		1929.		1930.		1931.		No. of bags per acre.	
No. of Bags of 165 lb. each.	No. of Bags per Acre.		No. of bags per acre.												
44.00	2.0	27.33	1.2	54.66	2.5	36.66	1.6	64.66	2.9	36.66	1.6	33.33	1.5	1.9	
48.00	2.2	31.33	1.4	46.60	2.1	32.00	1.4	56.00	2.5	37.33	1.7	35.33	1.6	1.8	
38.66	2.7	28.00	2.0	41.33	2.8	23.33	1.6	43.33	3.0	24.66	1.7	30.00	2.1	2.3	
30.66	2.6	19.33	1.6	32.00	2.7	24.00	2.0	30.66	2.6	16.00	1.3	20.66	1.7	2.1	
56.00	2.4	32.66	1.4	45.33	1.9	32.66	1.4	60.00	2.5	24.00	1.0	32.00	1.3	1.7	
60.66	3.9	43.33	2.8	67.33	4.3	45.66	2.9	75.33	4.8	35.33	2.2	50.00	3.2	3.5	
92.66	3.9	52.00	2.2	97.33	4.1	59.33	2.5	90.00	3.8	67.33	2.8	59.33	2.5	3.2	
60.66	3.7	35.33	2.1	73.33	4.4	56.66	3.4	68.66	4.1	66.66	4.0	61.33	3.7	3.5	
69.33	2.5	54.66	2.0	101.33	3.7	81.33	3.0	106.66	3.9	108.66	4.0	76.00	2.8	3.0	
48.66	1.9	46.00	1.8	73.33	2.9	54.66	2.1	78.66	3.1	78.66	3.1	69.33	2.7	2.5	
21.33	1.2	22.00	1.3	33.33	2.0	30.00	1.8	33.33	2.0	28.00	1.6	29.33	1.7	1.6	
16.00	1.5	13.33	1.2	20.00	1.8	19.33	1.8	26.00	2.4	20.66	1.9	13.33	1.2	1.6	
23.33	1.1	16.66	.7	32.00	1.5	27.33	1.2	35.33	1.6	41.33	1.9	26.66	1.2	1.3	
64.00	3.6	46.66	2.6	66.66	3.7	63.33	3.5	76.00	4.3	68.66	3.9	48.66	2.7	3.3	
6.66	.9	6.66	.9	10.00	1.4	8.00	1.1	10.66	1.5	9.33	1.3	6.00	0.8	1.1	
6.66	.7	5.33	.6	8.00	.9	11.33	1.2	11.33	1.2	11.33	1.2	10.00	1.1	0.9	
24.66	1.2	20.00	1.0	30.00	1.5	36.66	1.9	38.00	1.9	28.66	1.4	17.33	0.9	1.3	
44.00	1.8	21.33	.8	46.66	1.9	40.00	1.6	39.33	1.6	34.66	1.4	34.00	1.4	1.6	
32.66	1.8	33.33	1.9	52.00	2.9	48.00	2.7	43.33	2.4	36.00	2.0	36.66	2.1	2.2	
48.66	2.8	35.33	2.0	65.33	3.8	58.00	3.4	62.00	3.6	50.00	2.9	47.33	2.8	3.0	
72.00	3.4	50.00	2.4	74.66	3.5	80.00	3.8	85.33	4.1	60.66	2.9	68.00	3.2	3.3	
60.66	3.7	38.66	2.3	53.33	3.2	48.00	2.9	66.00	4.0	48.00	2.9	42.00	2.5	3.0	
92.00	3.2	61.33	2.1	76.66	2.7	76.66	2.7	88.00	3.1	66.66	2.3	74.00	2.6	2.5	
59.83	3.5	46.66	2.8	62.00	3.8	49.33	3.0	53.33	3.2	40.00	2.4	39.33	2.4	2.9	
24.00	1.5	15.33	.9	16.66	1.0	14.66	.9	26.66	1.7	21.33	1.3	23.33	1.4	1.2	
24.00	2.1	26.66	2.4	38.66	3.5	28.66	2.6	42.66	3.8	22.66	2.0	25.33	2.3	2.6	
1,169.24	..	829.24	..	1,318.58	..	1,085.58	..	1,411.25	..	1,083.23	..	1,008.60	..	..
..	2.5	..	1.8	..	2.8	..	2.3	..	3.0	..	2.3	..	2.1	..	

MYCOLOGIST'S REPORT, 1931.

Coconuts.

Wilt.—Inspection of the series of experiments referred to in the last annual report regarding the possibility of wilt being caused by a virus disease shows that the evidence is negative. Only two of the inoculated palms (one coconut and one Archontophoenix, Sp.) have died since the experiments were commenced. The coconut palm succumbed to little leaf affection; and apparently the Archontophoenix died as a result of Bud-rot. Apart from the above, the inoculated palms appear to be quite as healthy as the controls.

2. *Survey.*—This work has steadily progressed throughout the year and the field data is now practically complete. The work has been facilitated by finding temporary employment for two additional officers. It is hoped in the near future to analyse and classify the data.

Cacao.

Witchbroom Disease.

(*Marasmius perniciosus*).

3. Appended is a review of the position at the end of the year:—

It is extremely unfortunate that cacao prices have been so low during recent years. From figures kindly supplied by the Cocoa Planters' Association, one finds that the average prices paid for Plantation cacao for the years 1926 to December, 1931 are:—

1926	..	..	..	..	..	13 00	per fanega (110 lb.)
1927	..	..	..	..	..	15 75	do.
1928	..	..	..	..	..	13 21	do.
1929	..	..	..	..	..	11 00	do.
1930	..	..	..	..	..	9 33	do.
1931	..	..	..	..	..	6 87	do.

It will be seen from these figures that the price of Plantation cacao in 1931 was only a little more than half the average price in 1928, the first year of Witchbroom. Obviously, this state of the market has placed a great handicap on planters, just when a large amount of extra field work is required.

4. During the last decade, the cacao industry of Trinidad has had a large measure of attention. This applies particularly to the collection of statistical data and various economic considerations. Indeed, it may be said that the industry has been analysed and synthesized; pulverized at intervals throughout its history by Black Pod and Canker, by Thrips, by Cacao Beetles, by Vermin, by fires, and by excessive dry and wet periods. And now in addition to the above periodical troubles in different districts, it would seem that from various causes the industry is in the initial stages of encountering greater difficulties than ever before, if the most vigorous and unceasing attention is not given to the crop. Taken as a whole, the cacao industry of the colony is in an unsatisfactory condition. It may be noted, that, notwithstanding all its trials and setbacks, the colony crop has remained fairly stationary in the vicinity of 24,000 tons during the last ten years.

5. It is a matter for regret that though the data to which I have just alluded is abundant and well tabulated, there is an aspect of the local cacao industry which has not, so far as I am aware, been presented to the public in written form. It is an aspect which would require the services of planters of life-long experience to produce. We have such planters in Trinidad to-day and I suggest that they may yet oblige us. The aspect I refer to is a history and development of the cacao industry of the colony. Such a book would be very illuminating as regards the people in the industry at various periods; also of their ethnological and sociological associations; and it would give some insight respecting outside influences reacting on local matters. In a word, the book would deal essentially with the human complex and would, therefore, be a human document.

6. Another general observation one wishes to make, is that very little is known after all these years, of the fundamental features of the physiology of cacao trees. The subject is still in its infancy, and it is very important that its investigation should be prosecuted. In the absence of such knowledge, planters' practices are of necessity almost entirely empirical and no real guidance is available for growing the crop. The result is a multiplicity of cultural practices, generally lacking any correlation. I point this out because it has an important bearing on the mycology and pathology of the crop.

Witchbroom Incidence and Distribution.

7. Now to get closer to the subject. By the middle of 1928, a few hundred acres were found to be infected in two districts, viz.: the South Manzanilla vega and the Guaico-Tamana vega. These districts are known to most of the planters and so are their topographic, climatic and physical features. The worst infested properties are markedly low-lying, with a heavy rainfall, and a relative humidity approximating to saturation point at many periods of the year. The cacao trees in these areas are, on the whole, comparatively young, fairly well laid out, and high cropping. They were, as far as is known, the initial centres of Witchbroom disease in the colony. I need not redescribe in detail all the features of the incidence of infestation present in the middle of 1928. It will suffice to say that all stages of the affection were present, viz.: diseased twigs, cushions, and pods of all sizes. Moreover, the fructifications of the parasite were found on all these structures. From that

time onwards, there has been a continuous extension of the spread of the disease, usually from the infected estates to adjacent ones, and occasionally one has encountered distance spread of from 5 to 25 miles. In all probability, air-borne spores of the fungus, *Marasmius perniciosus*, are responsible for the onset of the disease on all affected properties. And to-day it is to be noted that some 100,000 acres, that is, half the cacao acreage of the colony, is reported to have the disease, or is classed as *suspect*. These figures require explanation. It must not be imagined that half the cacao trees in the colony are affected with the disease. As a matter of fact, only a very small percentage is attacked at present; the vast majority are still unaffected. This means that if strict vigilance is not exercised on properties where the disease is present, there will be an increase in incidence. No doubt however watchful planters are, there will be some increase of the vegetative phase of the trouble because of the difficulty of seeing and collecting all affected tissues. The great task is to try and keep the infection as light as possible and thus preserve the crop. It is extremely difficult to secure accurate data as regards incidence and intensity of infestation, but one can say in general terms, (a) that the worst areas are the low-lying, wet districts; (b) that the undulating lands, even in the near vicinity of the above, have practically only half or less than half the incidence; (c) that on the remainder of the properties, which probably constitute over 80 per cent. of the 100,000 acres classified as Witchbroom infected estates, the incidence is purely sporadic and mild. But it must be remembered that it is very doubtful in any centre where sporadic infection is present, that it can be exterminated.

8. A feature of great importance and of some consolation is that as one recedes from the extreme wet, low-lying districts to the extreme dry, elevated and undulating lands, the incidence shows a progressive decrease.

9. To give some idea of the incidence and distribution in a slightly different and more detailed manner up to the end of 1931, let me put the position in the following way:—

If 100,000 acres were actually infected, that would represent in round numbers, 30 million trees. From 1929 onwards, a count has been made on 26 representative estates in various parts of the Island where Witchbroom is present. These estates are widely separated and include very wet, wet, moderately wet, and comparatively dry districts. The total acreage of these 26 estates is about 10,000 acres, *i.e.*, three million trees. The returns show that the total number of infected trees on these estates in 1929 was 6,080; in 1930 the number was 18,078; and in 1931 the total was 58,000. By this method of calculation, it is found that at the end of 1931, the percentage of diseased trees on these 26 estates represents *two* per cent. But the potentially serious feature is that the number of infected trees is, on the average, trebled annually; and moreover, in the wet and very wet districts the number is much more than trebled each year. It is this aspect of cumulative effect which is so disturbing.

10. Witchbroom is now present in all districts, reckoning the whole of the Northern Range and the North Coast as a unit. And the danger zones at the moment are the contact points with this Range in Tucker Valley, Arima, Sangre Grande, and Matura. It is hoped that every possible effort will be made to keep incidence as low as possible.

Witchbroom and Crop Loss.

11. As pointed out earlier, pods and cushions affected with the disease were present from the time of the discovery of the trouble. It was the experience in Surinam and it is the testimony of Ecuador that crop losses steadily increase following the vegetative phase of the parasite. In the very wet, low-lying vegas in Trinidad crop loss is operating and it is by no means negligible. It is comparatively easy to detect and record loss due to Witchbroom on maturing pods and at the "breaking places"; but the most serious aspect of the matter is the injury to cushions and very small pods say up to one-quarter grown. This can result in serious loss. Moreover, the identification of small pods affected with Witchbroom is by no means easy until they produce fructifications (mushrooms); there are large numbers of failing small pods, and many of them are not attacked by the specific disease with which we are dealing. Further, in droughts and in continuous wet weather, large numbers of small pods are lost. This makes a gigantic problem. The ideal method would be, as advocated previously, the collection and destruction of all diseased pods. But to do this on medium sized and large estates on anything like economic lines, a first class crop of marketable cacao and a first class price would be necessary; and to-day the situation of the market is only half as good as it was 4 or 5 years ago.

The Witchbroom Fungus—an "All-weather" Parasite.

12. I do not think the fact that the witchbroom fungus possesses distinctive qualities has been sufficiently emphasized. What I wish to emphasize is this: When a spore of *Marasmius perniciosus*—and a diseased twig, or cushion, or pod can in its life's cycle produce 100 or more mushrooms and each mushroom gives rise to between 20 and 30 million spores—germinates on say, a vegetative bud and produces a typical "broom" that "broom" is to all intents and purposes quite happy regardless of the weather; in other words, this dreaded fungus is an "all-weather" parasite. What does this mean? It means that once the broom is in position on the tree, it remains there for 4 months to 18 months or longer, according to circumstances. No matter if the weather is dry or wet; no matter what the temperature; and no matter what factors are operating, the broom persists vegetatively until conditions of moisture are suitable for the production of fructifications. And a series of crops of mushrooms continue to be produced until the food reserves of the particular "broom" are exhausted.

13. It must not be imagined that all these spores which are produced in incredible millions, are deposited on susceptible cacao tissues. In Biblical phraseology, some fall on stony ground and some on fruitful ground. Those falling on stony ground perish; while those deposited on susceptible cacao tissues continue the spread of the disease. It is an amazing phenomenon, and I am not aware that anyone has yet undertaken to collect data, that the average sized cacao tree possessed a huge number of points of infection for the Witchbroom parasite. We do know, however, that individual affected trees have yielded numbers of 'brooms' varying from one to 1,000 and one, and they were by no means infested to a maximum extent.

Marper Estate and its Lessons.

14. This estate, comprising 93 acres in cacao, is located in one of the worst Witchbroom districts in the Island. Roughly speaking, half the estate is a low-lying vega and the remainder is undulating. Numerous small holdings, together with medium and large estates, are in the same L'Ebranche area and are more or less similarly orientated as regards flat and undulating lands. A series of experiments in disease control have been set up by our Department, the details of which can be consulted in Department Reports. It is too early to deduce many conclusions of real value at present, but this much may be said; (1) that nitrogenous manuring indicates increase in incidence of disease; (2) that of the 7 or 8 fungicides tried or being tried, Bordeaux Mixture is the most useful, but several fungicides in dust form have recently been used though not thoroughly tested. Lessons which I consider of importance taught by Marper Estate are:

- (a) That on the average, three weeks elapse before 'brooms' in the fresh, green stage, becomes dry and brown.
- (b) That 14 weeks or more is the time taken, on the average, before fresh, green brooms commence to produce mushrooms.

This information has become available by observing green brooms marked at monthly intervals throughout one year, thus encountering variable weather conditions. Such information should be useful to planters in that it indicates under the conditions of the experiment, the length of the innocuous period of brooms. Now it is well known that the main flushing period of cacao is February and March; this is supported by the data from the 26 estates already mentioned. A concomitant of this flushing, is the appearance of the main peak of brooms. Later in the year there occurs the Indian Summer at dates in the Calendar which are variable in different years, and this drier spell is also variable in duration. The flush during the Indian Summer is also accompanied by a rise in Witchbroom incidence. During any year there are other minor flushes in cacao and these are complicating factors. It seems to me that an extra intense and concentrated effort should be made to reduce these peaks before the diseased tissues get to the stage of mushroom production. Large numbers of brooms are difficult to locate and collect in the green stage, but knowing the period of innocuousness, more effective control work can be done *after* rather than *at* the actual peak periods. It is interesting in this connection to note that Stahel in Surinam found after much experimenting in pollarding trees and the use of fungicides, that the most effective method of control was collecting and destroying affected tissues. The great requisite is to get rid of, or reduce to as low a point as possible, all witchbroom tissues, be they brooms, cushions, or pods, before they produce mushrooms. Work will be far more effective if directed to achieve this end, in addition to destroying diseased mushroom bearing tissues.

15. Another striking lesson to be learnt from Marper Estate is that the incidence of Witchbroom on the vega is about $2\frac{1}{2}$ times that on the adjacent undulating land. The best authorities consider that spore discharge from mushrooms is in the late evenings when air-currents are from high ground to low ground and thus there is a tendency for the low-lying areas to be more heavily infested. Indeed, one is prompted to regard the L'Ebranche vega as being a kind of vortex where all the conditions favouring heavy infestation are present.

16. In a period of two complete years of working, 1930 and 1931, it is found that the cost of cutting and destroying Witchbroom at Marper is \$6.80 per acre per annum. As nearly as possible, monthly rounds are made in executing this work. It may appear that this figure is high, but I wish it to be realized that (1) large number of trees are under experiment and that experiments involve extra work and expense; (2) Marper Estate, like any other property, is liable to reinfection from outside. There can be no doubt that reinfection from outside is operating. Let me explain it in the following way:—

After continuous and systematic working, Marper Estate showed a mushroom population last month (December) of 177. During that month, the rainfall at Marper was 22.02 inches. It was a highly favourable period for mushroom production. Thus it will be seen that Marper mushroom population averaged 2 per acre. Counts have been made of mushroom population on several small areas in L'Ebranche vega other than Marper Estate during the month of December last, and the returns from one property show the figure of upwards of 1,000 sporophores (mushrooms) per acre. Between these sort of figures there is no doubt whatever that mushroom incidence varied throughout the whole of this valley area; and further, there can be no doubt that a somewhat similar state of affairs was in operation in the Guaico-Tamana vega. And it is to be borne in mind that these figures are only for one month; if the diseased tissues are not collected and destroyed, several crops of mushrooms will be produced at later periods. I am indebted to other members of the Department for some of the above statistics.

Summary.

17. To sum up, the cocoa planters in Surinam could hardly be blamed for the collapse of their industry. They were ignorant of the cause of the trouble. When the cause was determined, it was too late to retrieve the crop; infestation was general and heavy as is indicated by the loss of two-thirds of their marketable cacao. It is the testimony of Ecuador that in 10 or 12 years Witchbroom, together with monilia, has reduced their crop by fully 50 per cent. Apparently in Ecuador, the method of planting and the absence of cultivation render disease control impracticable. There was something like consternation in Trinidad in 1928 when Witchbroom was announced. It was not uncommon at that time for planters to visit the infested areas and remark that the crop seemed little affected. That was quite true. It has been the experience of all countries that crop losses do not operate in a pronounced manner for a few years. But make no mistake about the potential seriousness of the disease especially in wet, low-lying districts. It is a very common failing in any country for planters and others to omit to make an early and accurate diagnosis of their troubles. It seems to be the rule largely to ignore diseases and pests until losses are sudden and severe. One could cite many cases of this. A lime tree or a grafted mango tree in a yard often suffers loss of crop because of non-spraying. An outbreak of Red Ring in a coconut estate is often allowed to develop to the group infection stage before action is taken. A 1,000-acre field of sugar cane might easily be widely infested with mosaic disease before being detected. And it can be the same with Witchbroom in cacao. Because the woody tissues of the trees are unaffected by the disease at any time, and because crop loss is small in the early years, it is a common fallacy to suppose that the potential seriousness of the trouble is overrated. Trinidad planters were promptly notified when witchbroom gained a footing in the colony, and the Department has continuously been engaged in a publicity and educational campaign; local planters, therefore, should know the danger and the potential menace.

18. It must be noted that cacao trees have mass production of tissues susceptible to the Witchbroom parasite and that these tissues appear irregularly throughout the year. *Marasmius perniciosus*, the Witchbroom parasite, also possesses, as I have already mentioned, the modern habit of mass production, and this is followed by mass distribution and mass reinfection. Therefore, control efforts should be primarily directed to destroy the vegetative phase of the parasite which precedes and produces the mushrooms.

19. An attitude of saturated pessimism will not help, nor will an unqualified optimism. What is required is a balanced optimism combined with unceasing watchfulness and work.

Agricultural Exhibition.

20. This exhibition held at the end of February and beginning of March made an ideal occasion for the display of a comprehensive collection of the diseases of crops and ornamentals. The visiting public appeared to appreciate the educational nature of the exhibits.

Leave.

21. From the end of March to mid-December I was on vacation leave. I wish to acknowledge the help and assistance received whilst on leave from the Imperial Mycological Institute, London.

F. STELL,
Mycologist.

REPORT OF THE CHIEF INSPECTOR UNDER THE PLANT PROTECTION ORDINANCE.

My report for the year ending December, 1931, is submitted herewith.

2. The Plant Protection staff comprised 36 assistant inspectors distributed throughout the island as follows:—

Mosaic Disease.—Three assistant inspectors; one in the Northern belt and two in the Couva area.

Cacao Beetle.—Eight assistant inspectors, under the supervision of the Agricultural Advisers.

Witchbroom.—Twenty-five assistant inspectors under the direction of the Supervising Officer, Mr. Foster, and his assistant, Mr. de Boehmler.

3. The Agricultural Advisers have been responsible for carrying out Plant Protection work in their respective counties and the services of the assistant inspectors during the latter part of the year were utilized for general Plant Protection work.

4. During the month of December two assistant inspectors were taken on for the purpose of obtaining data in connection with Witchbroom spread in the island.

Control Work on Pests and Diseases.

Witchbroom.

5. This disease spread somewhat during the last year, 2,454 properties being known to be affected at the end of December. This was an increase of 602 properties over the corresponding number for December, 1930.

6. The usual seasonal variation in the numbers of brooms observed was exhibited during the year. There was a gradual increase of brooms at the beginning of the year, the peak reaching its maximum in March. There was then a gradual decline until June and then a further increase until September. For the remainder of the year there was a gradual falling off in the number of brooms observed. The worst affected areas are Manzanilla, Guaico-Tamana and Mundo-Nuevo.

7. The search instituted in the Northern Range during the latter part of the previous year, as a result of the discovery of the disease at Tucker Valley, was completed in February. Six hundred and forty-six properties with an area of 19,162 acres were inspected but no further Witchbroom was detected.

8. Lectures were held as usual throughout the island, the attendance in most cases being satisfactory.

9. Nine proprietors were prosecuted for either not notifying the disease or not complying with Plant Protection Orders.

Cacao Beetle :

10. Beetles were more prevalent this year than they have been for the past two years. The unusually long spell of dry weather experienced during the early part of the year was very conducive to their development. Due to the general depression proprietors were, in a good many cases, unable to institute proper control measures and in general there was a decline in efficiency in coping with beetle attacks. The increase in beetles was in a great measure due to the above mentioned causes.

11. The worst attacks were in the Fishing Pond and Southern areas, the most serious attack being in the Erin district. It was found advisable to post an inspector for work in the Erin district only, and coupled with the very wet weather experienced during the latter part of the year, a gradual decline in the severity of the attack was observed.

Mosaic Disease

12. This disease occurs in two main areas in Trinidad :

(a) Northern Area :—This area is made up of plots bordering the Eastern Main Road from the 4th to the 11th mile. A few plots only are seriously affected, the incidence of the disease being generally slight. One Assistant Inspector under the supervision of the Adviser for St. George has carried out regular inspections, and supervise the removal of infected stools.

(b) Couva Area :—This area comprise about 1,800 acres around Couva. During the year two Assistant Inspectors under the supervision of the Adviser for Caroni have carried out regular inspections.

13. The incidence of the disease is higher in this area than in the Northern Area. Some plots have been seriously affected but on the whole the incidence was less than for the previous year.

Parasol Ants.

14. Forty-eight complaints were dealt with in Port-of-Spain during the year. Of these three were on property belonging to public bodies. Work done in the country as follows :—

<i>Nests treated.</i>	<i>CS₂ used Ozs.</i>	<i>Plant Protection Order.</i>
711	17,218	124

Customs and Post Office Inspection Work.

15. During the year Mr. Farrell, Assistant to the Entomologist, was seconded for work at the Customs Department in connection with the inspection of plant material coming into the Colony. This arrangement has greatly facilitated the prompt delivery of plant material and has also resulted in greater efficiency in inspection.

F. M. BAIN,
Chief Inspector, Plant Protection Ordinance.

TABLE A.—Revenue and Expenditure.

	Expenditure.			Revenue.		
	£	s.	d.	£	s.	d.
HEAD OFFICE :						
Personal Emoluments	7,573	19	9	125	0	0
Travelling and Other Charges	1,753	14	0	20	0	0
Laboratory Expenses and Field Experiments	534	18	2½			
BOTANICAL DEPARTMENT, TRINIDAD :						
Personal Emoluments	111	7	9			
Maintenance and Improvements, Royal Botanic Gardens and St. Clair Experiment Station	1,285	6	6½			
Care of Trees on Government Lands	88	13	10			
Maintenance, Red House Grounds	86	0	11½			
Other Charges	213	0	1½			
BOTANICAL DEPARTMENT, TOBAGO :						
Personal Emoluments, Travelling	350	11	8			
Maintenance, Botanic Station and Government House Grounds	323	10	8	45	9	7
ST. AUGUSTINE NURSERY :						
Personal Emoluments	361	16	6½			
Maintenance, &c.	2,408	14	7	740	17	0½
Other Charges	257	12	5½			
RIVER ESTATE :						
Personal Emoluments	600	0	0			
General Maintenance, &c.	3,717	0	4	2,553	19	0½
Improvements	613	18	4½			
ST. AUGUSTINE EXPERIMENT STATION :						
Personal Emoluments	372	0	0			
Maintenance, Cultivation of Crops, &c.	2,043	3	4	977	13	4
GOVERNMENT FARM, TRINIDAD :						
Personal Emoluments	640	0	0			
Maintenance	4,973	19	8½	6,637	17	4
Purchase of Stock (Trinidad and Tobago)	650	0	0			
GOVERNMENT FARM, TOBAGO :						
Personal Emoluments	250	0	0			
Maintenance	624	12	5½	320	11	11½
GOVERNMENT VETERINARY SURGEON :						
Assistant Examiners and Contingencies	161	7	10½	1,180	0	0
QUEEN'S PARK AND PASTURES :						
Personal Emoluments	125	0	0	227	3	3
Maintenance	976	6	9			
DISTRICT SERVICE :						
Personal Emoluments, Travelling, &c.	3,836	5	0½			
PLANT PROTECTION ORDINANCE :						
Personal Emoluments	400	0	0			
Travelling, &c.	224	18	10			
Destruction of Pests on Crown Lands	132	7	2½			
Frog hopper Investigation	3,903	8	0½	1,951	14	0½
Mongoose Campaign	348	12	0	116	4	0
Cacao Beetle Campaign	1,221	18	3			
Witch broom Disease	3,996	5	0			
AGRICULTURAL CREDIT SOCIETIES :						
Personal Emoluments, Travelling, &c.	26	0	10½			
TOBAGO ABATTOIR :						
Maintenance, Travelling, &c.	80	12	5½	12	7	2
Total	£45,267	3	7½	£14,908	16	9

TABLE B.—Principal Agricultural Exports, Trinidad and Tobago.

	1930.		1931.	
	Quantity.	Value.	Quantity.	Value.
CACAO :		£		£
Raw Cacao	53,825,120 lb.	1,136,056	57,186,512 lb.	826,333
SUGAR CANE AND PRODUCTS :				
Vacuum pan, Grey Crystal	50,174 tons	522,096	61,390 tons	595,007
Do. White Crystal .. .. .	.. .. .	.. .. .	.. .. .	.. .. .
Do. Yellow Crystal	17,732 tons	238,431	23,721 tons	297,830
Molasses Crystal	1,229 tons	15,592	933 tons	10,146
Muscovado Sugar	4 tons	48	1 ton	7
Molasses	899,051 gals.	11,238	1,599,414 gals.	15,924
Rum	72,063 gals.	14,313	86,260 gals.	15,719
Bitters	22,698 gals.	38,065	15,700 gals.	27,288
COCONUT AND PRODUCTS :				
Coconuts	5,886,127 No.	25,830	4,487,875 No.	12,549
Copra	21,891,259 lb.	175,905	19,484,808 lb.	101,148
Coconut Oil	41,154 gals.	5,938	20,702 gals.	1,818
COFFEE :				
Raw Coffee	490,688 lb.	12,475	853,552 lb.	16,080
RUBBER :				
Raw Rubber	11,049 lb.	553	.. .. .	.. .. .
LIMES :				
Limes	178 brls.	228	83 brls.	128
Lime Juice	69,316 gals.	7,855	26,943 gals.	2,405
Lime Oil	1,647 gals.	19,457	2,413 gals.	32,071
Citrate of Lime .. .. .	.. .. .	.. .. .	21,589 lb.	257
GRAIN, PULSE, STARCHES, &c. :				
Corn (Maize)	44,738 lb.	257	156,935 lb.	564
Peas and Beans	913,747 lb.	8,867	577,031 lb.	2,783
FRUIT :				
Grapefruit	174,794 No.	960	350,530 No.	1,876
Oranges	1,813,254 No.	2,498	2,519,792 No.	2,711
Other Kinds .. .. .	.. .. .	113	.. .. .	96
MISCELLANEOUS :				
Plants and Seeds .. .. .	.. .. .	344	.. .. .	202
Spices (Nutmegs)	18,302 lb.	485	13,989 lb.	238
(Mace)	1,391 lb.	120	1,184 lb.	46
Honey	41,214 lb.	542	24,173 lb.	345
Live Stock	73 No.	1,169	65 No.	1,382
Hides and Skins	8,734 No.	6,821	4,969 No.	4,821
Leather (unmanufactured)	9,904 lb.	758	12,286 lb.	748
		£2,253,074		£1,970,582

TABLE C.—ANNUAL RAINFALL 1862 TO 1931, PORT-OF-SPAIN, TRINIDAD.
1862 to 1899 at the Royal Botanic Gardens. January, 1900 onwards at the closely adjacent
St. Clair Experiment Station.

YEAR.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	Annual Rainfall.	
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Inches.	
1862	..	.66	.77	.25	1.41	8.47	10.36	9.57	11.97	6.60	10.06	3.03	63.15	
1863	..	1.54	2.71	1.45	.85	1.26	9.12	10.12	10.53	12.11	6.24	4.30	66.80	
1864	..	2.51	.53	.36	.04	3.15	4.96	7.17	12.06	8.04	6.53	5.94	62.90	
1865	..	2.62	3.20	1.07	7.98	3.22	5.64	10.35	14.83	7.32	14.62	4.81	85.28	
1866	..	2.24	3.91	1.44	1.09	1.45	6.59	7.83	12.34	5.87	10.11	8.17	67.86	
1867	..	1.31	6.36	.83	1.32	2.33	5.30	12.20	15.21	10.45	7.87	.67	66.56	
1868	..	2.06	.82	3.20	.64	4.17	7.78	11.35	6.73	5.46	4.66	8.31	56.21	
1869	..	.08	.93	.74	.41	.69	5.52	10.17	8.74	8.86	5.15	6.30	53.46	
1870	..	2.61	.56	1.46	1.51	4.65	8.81	11.91	9.00	10.63	3.98	5.94	69.35	
1871	..	6.62	1.40	2.89	.92	3.97	8.84	11.73	12.97	7.87	4.37	10.73	75.58	
1872	..	1.45	.07	.74	.39	3.14	7.09	5.45	10.82	3.07	4.80	9.89	49.95	
1873	..	1.78	1.08	1.98	.53	..	4.31	5.04	8.37	5.80	10.34	3.48	44.02	
1874	..	3.47	1.96	3.67	5.16	2.51	12.28	12.28	11.20	9.38	6.42	3.66	76.28	
1875	..	3.39	.91	.56	.42	2.61	4.15	12.62	7.22	11.95	10.85	3.74	60.90	
1876	..	3.26	1.03	1.78	1.67	6.65	11.17	12.23	15.18	12.03	7.04	5.95	81.95	
1877	..	2.14	..	7.46	3.38	3.19	8.43	8.35	12.94	6.39	6.68	7.66	72.10	
1878	..	3.44	.70	..	3.22	4.99	5.78	5.42	8.88	11.15	5.89	8.72	61.24	
1879	..	1.52	2.76	4.56	3.03	3.08	14.92	6.86	10.35	6.15	3.54	4.28	65.43	
1880	..	11.72	6.53	.67	2.32	3.90	7.83	6.90	17.39	7.47	5.74	10.51	82.34	
1881	..	.57	.65	.23	1.60	4.66	11.05	7.82	10.90	10.59	3.36	12.06	65.72	
1882	..	1.33	2.38	.73	1.57	3.74	6.33	5.93	8.40	4.93	5.86	10.29	52.99	
1883	..	1.56	.71	.26	3.37	5.89	10.91	13.66	10.26	5.53	3.99	6.06	70.50	
1884	..	3.43	2.50	4.40	1.51	2.91	6.84	5.71	8.70	5.03	5.05	5.14	56.88	
1885	..	1.30	.89	1.49	.43	5.27	3.44	5.87	4.56	6.08	4.08	5.37	43.22	
1886	..	3.32	1.97	3.27	3.83	4.49	9.70	17.48	8.15	6.73	12.59	8.54	86.82	
1887	..	2.69	1.46	1.67	1.08	3.98	7.40	5.51	9.93	5.07	5.84	7.80	64.09	
1888	..	8.37	1.79	2.41	2.28	3.46	11.92	6.89	7.02	5.53	5.06	7.76	65.44	
1889	..	.94	.85	4.16	1.05	6.34	11.66	12.14	11.73	3.76	6.30	7.38	73.79	
1890	..	7.76	.51	2.09	7.62	5.14	9.68	12.89	11.65	3.37	10.98	5.93	82.90	
1891	..	3.17	.92	.03	1.44	2.54	5.54	11.88	4.26	7.44	5.77	6.66	53.74	
1892	..	1.93	2.19	1.85	7.59	11.55	16.26	15.55	9.21	3.57	11.49	5.40	91.28	
1893	..	3.43	1.85	.19	3.61	11.35	10.19	13.28	16.32	11.73	5.47	7.84	72.3	
1894	..	3.22	2.36	3.12	1.22	2.69	3.26	4.53	12.06	5.48	3.93	7.28	52.31	
1895	..	2.52	1.33	2.27	2.52	2.11	5.00	2.57	4.86	5.69	10.89	15.15	62.23	
1896	..	7.08	.88	1.59	2.33	1.62	10.29	6.35	7.66	6.46	6.05	9.81	66.45	
1897	..	1.67	.75	3.96	.26	5.58	11.19	13.88	7.90	9.83	8.87	9.39	77.68	
1898	..	3.05	2.18	2.10	1.17	1.49	6.46	5.87	10.55	7.13	6.15	9.13	58.85	
1899	..	1.95	1.82	1.00	.75	.52	7.63	4.44	8.45	2.18	6.34	8.07	46.76	
1900	..	3.56	.76	2.72	4.10	4.14	12.99	7.95	11.07	5.52	6.53	5.41	67.36	
1901	..	1.95	1.51	1.85	.35	6.45	9.21	8.38	7.53	4.26	4.97	7.93	59.22	
1902	..	2.56	.51	1.18	1.78	2.14	10.05	5.20	11.67	7.22	7.40	2.74	55.34	
1903	..	1.51	.68	1.54	2.17	.95	5.42	9.40	9.45	11.41	2.12	2.59	51.44	
1904	..	3.00	2.56	4.24	2.50	2.76	6.23	8.03	4.72	8.81	5.65	3.61	56.43	
1905	..	2.41	.59	3.74	1.79	4.34	6.01	9.49	11.09	10.43	6.94	10.69	71.68	
1906	..	.43	.50	.73	.46	7.96	10.95	11.42	8.55	6.54	6.80	5.00	64.98	
1907	..	5.22	.44	1.71	.09	4.58	11.01	11.02	5.77	7.76	7.65	10.69	70.04	
1908	..	.75	.45	1.79	.95	5.82	5.22	5.87	7.72	5.45	5.45	2.65	50.80	
1909	..	5.69	2.43	1.15	1.78	3.87	8.31	10.72	6.29	6.95	7.15	3.93	64.58	
1910	..	2.79	4.38	1.75	2.01	2.76	6.34	6.40	13.89	8.27	9.21	8.49	68.19	
1911	..	1.61	1.51	1.86	.74	1.27	7.15	5.20	13.68	4.03	10.22	3.57	54.37	
1912	..	.62	Nil.	.74	.03	2.18	7.54	12.16	5.56	5.87	2.73	6.28	49.35	
1913	..	2.80	.50	1.42	.42	1.79	2.80	2.86	6.48	6.52	3.51	8.81	39.53	
1914	..	.50	.61	1.28	1.01	2.05	7.34	5.05	9.15	7.80	6.14	7.61	54.12	
1915	..	2.10	.66	..	2.63	2.76	7.05	12.76	5.27	4.21	9.28	7.84	58.31	
1916	..	5.29	1.35	1.57	1.91	.94	10.30	8.04	11.57	10.78	6.68	9.32	69.73	
1917	..	1.17	3.06	1.38	.50	4.24	6.30	10.13	9.96	7.24	5.43	6.81	64.24	
1918	..	3.15	1.18	1.48	1.27	2.94	5.87	14.42	8.56	8.93	5.51	7.56	64.72	
1919	..	.62	..	1.78	1.67	3.50	6.78	5.17	6.82	7.96	7.79	8.42	57.18	
1920	..	1.39	1.66	.94	.28	.56	4.13	4.93	6.70	10.98	5.74	6.03	44.94	
1921	..	2.43	1.60	5.03	4.09	1.43	9.91	10.06	10.30	10.17	6.53	7.71	62.5	
1922	..	4.01	1.13	1.41	2.39	2.18	6.10	5.06	8.35	6.49	2.92	11.17	58.31	
1923	..	1.91	1.66	.96	2.97	1.46	3.48	10.76	9.37	6.23	4.41	7.38	57.91	
1924	..	1.54	.90	.14	1.11	.73	4.95	7.53	7.27	4.59	7.81	8.56	47.28	
1925	..	1.77	1.06	2.67	.10	1.21	4.20	7.58	8.87	6.37	5.85	5.36	49.40	
1926	..	.69	.39	.54	.23	2.12	5.26	5.25	10.85	11.20	14.78	9.71	68.58	
1927	..	4.71	4.44	3.62	5.04	7.15	6.95	9.40	11.67	9.11	6.13	5.64	81.07	
1928	..	4.22	.69	2.31	2.02	.67	5.75	8.07	8.66	7.36	9.13	8.42	63.24	
1929	..	.84	.84	1.78	.81	7.33	6.43	5.10	8.90	5.21	3.40	9.30	51.45	
1930	..	2.70	.08	.31	2.38	1.85	6.35	7.12	4.94	5.82	6.27	2.59	45.28	
1931	..	1.68	1.11	.07	.29	1.12	6.94	10.96	8.89	4.85	6.59	7.94	56.21	
Grand Total	..	188.67	103.35	126.14	130.23	241.95	535.16	611.48	686.47	510.41	466.22	497.34	334.94	4,412.36
Av. for 70 years	..	2.70	1.48	1.80	1.86	3.46	7.65	8.74	9.52	7.29	6.66	7.10	4.78	63.03