REPORT

ON

THE DEPARTMENT

OF

AGRICULTURE,

BARBADOS.

1919–20.

T. E. KING & CO.,
Printers to the Government of Barbados.

1921.

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FOR THE FINANCIAL YEAR 1919 1920.

STAFF.

Director of Agriculture.....John R. Bovell, I.S.O., F.C.S.
Assistant Director.....E. A. Bourne, B.Sc.
First Field Assistant.....Ernest H. Barrow.
Second Field Assistant.....M. O. Proverbs.
Assistant in Charge of Nurseries.....C. O. Haynes.
Chief Clerk.....Hugh O. Ramsey.
Second Clerk.....B. A. Niccolls.
Third Clerk.....J. G. Odle.

ESTABLISHMENT.

During the period under review Mr. J. R. Bovell, Director of Agriculture, was absent from the Island from September 30 to October 15, 1919. In his absence Mr. B. A. Bourne, B.Sc., Assistant Director, acted as Director of Agriculture. From April 1 to August 10, 1919, Mr. M. S. Goodman, First Field Assistant, acted as Assistant Director. On August 11, 1919, His Excellency the Governor appointed Mr. B. A. Bourne, B.Sc. to act as Assistant Director of Agriculture pending the approval of the Right Honourable the Secretary of State for the Colonies. The appointment was approved and Mr. Bourne was appointed as Assistant Director of Agriculture on September 1, 1919. In January 1919 a letter was received from His Excellency the Governor of Jamaica asking whether a suitable man could be found in Barbados to grow seedling sugar-canes in Jamaica. Mr. Goodman having signified his willingness to accept the appointment, left here on March 11, 1920, for Jamaica. Prior to his departure he obtained ten days vacation leave. Mr. Goodman was an officer of the Department from February 1, 1910 to March 10, 1920, during which time he performed his duties very satisfactorily and I would like here to record my appreciation of the ready help he always so willingly gave me. His leaving the Department was a distinct loss to it. On Mr. Goodman's resigning, Mr. E. H. Barrow, the Second Field Assistant was appointed as First Field Assistant, and Mr. M. O. Proverbs was appointed as Second Field Assistant on six months probation. On July 31, Miss M. E. Shepherd, Second Clerk of the Department of Agriculture tendered her resignation to accept a better appointment in the Royal Bank of Canada. When Miss Shepherd was appointed to the office of Second Clerk she was informed that she was not to expect any promotion in the Barbados Government Service, therefore as was to be expected as soon as she got an offer of a better appointment she accepted it. To show that Miss Shepherd was a very efficient clerk I may mention that since she has been to the Royal Bank of Canada she has already been promoted to a better appointment in the Superintendent's office in Trinidad at a salary of even more than twice as much as what she received when she first entered the service at the Bank. During the time that Miss Shepherd was in this Department she proved herself a very intelligent, capable, painstaking and hard-working official, and as in the case of Mr. Goodman, I would like to record my appreciation of the very ready assistance she always so willingly accorded me. Her leaving was a distinct loss to the Department. On Miss Shepherd resigning, Miss B. A. Niccolls was appointed as Second Clerk on six months probation from September 1. As Miss Niccolls had performed her duties very satisfactorily, His Excellency the Governor was pleased to confirm her appointment at the end of the six months probation. In March 1919, the Assistant in charge of the Nurseries, Mr. G. E. L. Spencer, applied for six weeks leave from March 6 and on April 14 a letter was received from him from Guadeloupe asking that his resignation be accepted as from the 16th of April, the date on which his leave expired, he having accepted a post of Second Field Assistant in the Planters' Sugar Experiment Station, where I understand his salary is £250 per annum, the use of a house and a motor cycle. His salary here was £100 per annum without house or cycle. Mr. Spencer who was a clerk in the Department of Agriculture before he was appointed Assistant in charge of the Nurseries at Codrington was a very capable and energetic officer and performed his duties very satisfactorily during the whole time he was an officer of the Department. Mr. Elliott H. Chandler who was acting for Mr. Spencer continued to do so until the appointment of Mr. Bourne as Assistant Director of Agriculture, when Mr. Ward who had been acting as Second Field Assistant was appointed as Assistant in charge of the Nurseries at Codrington. Consequent on Mr. Bourne's appointment Mr. Goodman reverted to his post as First Field Assistant and Mr. Barrow resumed his duties as Second Field Assistant. On March 5, 1920, I received a letter from Mr. Ward enclosing one from the Manager of Vaucluse

Factory informing him that he had been appointed as Head Overseer at that Factory, and asking that he be allowed to resign his post as Assistant in charge of the Nurseries from March 6. On Mr. Ward's resignation being accepted Mr. C. O. Haynes was appointed as Assistant in charge of the Nurseries on six months' probation from March 22. In May 1919 Mr. C. H. B. Williams, Third Clerk of the Department, tendered his resignation from the 15th of that month as he had accepted an appointment in the West Indian Oil Company. It might be mentioned that subsequently he was appointed as a clerk in the Planters' Sugar Experiment Station in Guadeloupe. On Mr. Williams resigning, His Excellency the Governor was pleased to appoint Mr. J. G. Odle as Third Clerk from June 16. Mr. Odle tendered his resignation on February 5, 1920 and up to the end of the financial year his successor had not been appointed.

EXPENDITURE.

	£	s.	d.
Salaries	1,898	13	7½
Incidentals for sugar-cane, cotton and other experiments ...	617	10	10½
Upkeep of Botanic Station	163	5	0½
Fumigation of Plants	14	15	3
Improving the breed of goats in the island	20	2	8
Pay and travelling expenses in connexion with sugar cane experiment plots	13	5	3
Purchase of apparatus, books, etc.	18	11	4
Exhibition (Local)	85	7	1
...	2,831	11	1½

RECEIPTS.

	£	s.	d.
Plants in pots	61	2	6½
Canes, cotton, cassava, yams, etc., grown on lands rented from Waterford Plantation	102	13	9½
Sundries:—Tamarinds sold from trees at Pavilion, etc. ...	2	6	7½
	166	2	4½

REPAIRS TO BUILDINGS, ETC.

During the year under review repairs were executed to the out buildings surrounding the nurseries for sugar canes and other plants at Codrington. The paling which also acts as a wind break and which was erected in 1899 had to be extensively repaired. As it was erected in 1899 it can be well understood that a great deal of it required renewing after twenty-one years service.

DISTRIBUTION OF PLANTS, CUTTINGS, SEEDS ETC.

The receipts for the sale of plants, etc., for the year 1919-20 amounted to £166 2. 4½. The plants and seeds distributed locally and abroad for the year are as follows:—

PLANTS.

Breadfruit	11	plants.
Casuarina	96	,,
Ficus Benjamina	27	,,
Fig	7	,,
Lemon	3	,,
Lime	43	,,
Mango (grafted)	179	,,
Miscellaneous	23	,,
Palms and ornamental plants	833	,,
Papaw	6	,,
Pear (grafted)	7	,,
Plants for Arbor Day	1,086	,,
Shaddock (budded)	8	,,
Sugar apple	2	,,

CUTTINGS, SEEDS, ETC.

Bengal beans	4	pts.
Cane cuttings (of these 23 barrels, 15 cases and 34 tin cylinders containing approximately 5,705 cuttings were packed in damp powdered charcoal)	21,833	plts.
Cotton seed	689½	lb.
Guinea corn seed	70	,,
Leguminous seed (for green manuring)	68	pkts.
Mahogany seed	2	brls.
Miscellaneous seed	4	pkts.
Tannias (of these 6 tin cylinders containing approximately 6 lb were packed in damp powdered charcoal)	100	lb.
Velvet beans	20	lb.
Yams	285	lb.

PLANTS, ETC. IMPORTED AND DISTRIBUTED LOCALLY.

				lb	oz
Beet	...	...	...	2	2
Cabbage	...	...	...	2	4
Carrot	...	...	...	2	0
Cucumber	...	...	...		1
Khol Rabi	...	...	...	1	8
Lettuce	...	...	...	1	10
*Onion	...	...	...		14
Parsley	...	...	...		2
Tomato	...	...	...		12
Turnips	...	...	...	1	0
Egg Plant	...	...	...		3

*6 oz of the obove onion seed was imported from Teneriffe.

EXPERIMENTS WITH SUGAR-CANES.

As a separate report was issued dealing with the sugar cane, manurial and other experiments there is no need to deal further with the activities of the Department of Agriculture in connection therewith in the Annual Report, particularly as of late years such a long time elapses before it is printed. The Annual Report for 1917 which was laid on the table of the House of Assembly on October 29, 1918 is, at the time of writing this, now being printed.

THE COTTON INDUSTRY.

Experiments for improving the quality and increasing the quantity of lint from the varieties of Sea Island cotton grown in Barbados were continued during the period under review. These experiments are carried out in two series. In the first series an effort is being made, by the selection of the best formed and most vigorous plants giving heavy yields of good quality lint to improve the strain of the Sea Island cotton originally obtained from the Sea Islands but which had deteriorated somewhat. In the second series an effort is being made in a similar manner to improve a native cotton which so far seems to be immune to all the insect pests with the exception of the cotton caterpillar (*Alabama argillacea*, Hubn) and all the fungoid diseases. The method by which these plants are selected has so often been given in previous reports that it is unnecessary to reproduce it here. As was mentioned in last year's report, His Excellency the Governor was pleased to allow twenty acres of cotton from the Sea Island selected strain mentioned above to be planted, (ten acres at the Government Industrial School and ten acres at the Lunatic Asylum Farm) so that seed of a good strain could be obtained by the cotton growers to plant the area usually grown in Barbados in cotton in recent years. It may also be mentioned that the yield at the Government Industrial School from the ten acres was 8,926 lb. of seed cotton while that from the Lunatic Asylum Farm was only 5,017 lb. *i.e.* 3,909 lb. less than that obtained from the Government Industrial School. The seed cotton from the Government Industrial School yielded 2,215 lint, while that from the Lunatic Asylum Farm yielded 1,290 lb., a difference in favour of the former of 925 lb. lint. At one time, judging from the appearance of the cotton plants at the Lunatic Asylum Farm there was every prospect of these giving the greater yield. Unfortunately, however, the then Farm Superintendent allowed the plants to be attacked by the cotton caterpillars. I understand that the Medical Superintendent called the attention of the Farm Superintendent to the matter at the time but without much effect, with the result that instead of the ten acres at the Lunatic Asylum Farm yielding about 10,000 lb. of seed cotton it only yielded 5,017 lb. As it is, the loss at the Lunatic Asylum Farm, at the price cotton was sold at locally during the ginning season, amounted to £312. With regard to the distribution of the seed of this improved strain of cotton during 1919, it may be stated that 689½ lb. were distributed. This is considerably less than the previous year, due to the very high price of sugar, which has caused practically nearly all owners of land to grow sugar canes in preference to any other crop.

Native Cotton.

The native variety of Sea Island cotton which has been mentioned in the last three annual reports continues to improve under the system of cultivation and selection carried out. As pointed out in the last annual report the improvement of native cottons in India on similar lines is giving very satisfactory results, and there is no reason why as good results should not be obtained with the native cotton in this Island. At the present time, as mentioned above, with the exception of the cotton caterpillar this strain of Sea Island cotton (native) has remained free from insect pests and fungoid diseases.

CASSAVA EXPERIMENTS.

The experiments with the varieties of cassava obtained from different countries, as well as a seedling variety obtained sometime previously were continued this year. The average weights obtained from the varieties are given in Table I.

TABLE I

RESULTS OF EXPERIMENTS WITH CASSAVA.

Variety.	Mean results per acre for five years, 1913-1915 and 1916-1919. lb.	Results per acre for 1919-1920. lb.
	Sweet Varieties.	
Trinidad No. 2	6,869	3,900
Special	* 6,171	4,880
Trinidad No. 1	6,168	8,120
Panama	5,728	12,161
Friendship	* 5,710	2,852
Helada	4,870	1,440
	Bitter Varieties.	
White Greenaway	12,381	13,534
Blue Top	11,993	7,200
	Barbados Seedling.	
Barbados No. 101	10,235	4,320

*For three years only 1916—1919.
*For one year only 1918—1919.

EXPERIMENTS WITH ECONOMIC COLOCASIEAE.

Experiments with the varieties of economic colocasiae that have given the best results in the past were continued during the period under review. Table II contains the results obtained from the Caladiums and Table III the results obtained from the Xanthosomas.

TABLE II

RESULTS OF EXPERIMENTS WITH ECONOMIC CALADIUMS.

Grown from Cormels.

Name.	Weight of Corms per acre, lb.		Weight of Cormels per acre, lb.	
	Mean for 4 years 1915-19 (1915-16-1918-19.)	1919-20.	Mean for 4 years 1915-19 (1915-16-1916-19.)	1919-20.
China Eddoe ...	952	... (1)	3,061	...
White Seal Top ...	1,519 (2)	1,789	4,808 (2)	5,716
Red Seal Top ...	...	5,184	...	6,048

(1) Germinated so irregularly, that these are excluded from the experimental results.
(2) For three years only, as in 1917-18 corms were used for planting purposes, owing to the fact that most of the cormels had rotted by the time the planting season came round.

TABLE III.

RESULTS OF EXPERIMENTS WITH ECONOMIC XANTHOSOMAS.

Name.	WEIGHT OF CORMS PER ACRE, lb.		WEIGHT OF CORMELS PER ACRE, lb.	
	Mean for 5 years 1914-19 (1914-15-1918-19)	1919-20.	Mean for 5 years 1914-19 (1914-15-1918-19)	1919-20.
Barbados	4,190	7,091	4,477	5,244
Roasting Eddoe	3,843	5,480	4,564	5,720
Geneb[illegible]lla	4,286	6,200	4,719	5,080
Rolliza	2,779	4,386	4 060	5,694
Nut Eddoe				

EXPERIMENTS WITH VARIOUS LEGUMINOSAE.

This year the cultivation of various leguminosae, both for edible purposes and for green manuring, was continued. A number of packets of seed of different kinds were distributed during the year to various planters. The results so far obtained with the different varieties are given in Table IV. It is, however, with regret, that I have to report again this year that no importance can be attached to the results obtained, owing to the prædial thief, whose depredations have practically rendered the results nugatory.

TABLE IV.

RESULTS OF EXPERIMENTS WITH LEGUMINOUS CROPS.

Name	No. of years under experiment.	WEIGHT PER ACRE UNSHELLED, lb.		WEIGHT PER ACRE SHELLED, lb.	
		Mean.	1919-20.	Mean.	1919-20.
Porto Rico No. 4	5	926	1,262	500	849
Cocal Pea	5	698	251	338	147
Canada Bean No. 2	5	455	861	246	250
Canada Bean No. 1	5	374	883	213	544
Iron Pea	4	1,838	1 154	694	671
Clay Pea	3	1,926	474	1,021	295
New Era Pea	2	1,242	1,612	739	753
Martinique Pea	2	981	258	653	172
Six Weeks Bean	...	...	1,312	...	984
Bush Bean	...	...	980	...	784

YAMS.

The experimental cultivation of yams was again continued during the period under review and the results are given in Table V. A number were distributed as usual for planting purposes on the condition that each person to whom they were distributed should distribute to other persons interested in the cultivation of yams a similar quantity the following year. This year another yam, the "Buck," has been added to the number under experimental cultivation. This yam has a delicious flavour and persons growing yams would be well advised to try and obtain a few for cultivation when the next planting season comes round.

TABLE V.

RESULTS OF EXPERIMENTS WITH YAMS.

Name.	No of years under experiment.	Weight per acre, lb.	
		Means for period under experiment.	1919—20.
Fenelle	5	12,273	6,948
Blanche Fenelle ...	5	10,265	6,130
Bottle Neck Lisbon ...	5	12,000	15,205
Crop	5	6,015	7,402
Grenada	5	6,446	3,917
Red Yam	5	11,908	7,081
Antigua	4	6,543	6,561
White Yam	5	5,501	6,734
Oriental	3	9,896	8,930
Seal Top	3	4,980	5,197
Horn	2	6,012	6,897
Buck	1	...	7,751

ONIONS.

Again this year, with the the kind help of the Editors of some of the local newspapers an offer was made to import onion seed from Messrs. Hamilton & Co. of Teneriffe, for persons desirous of obtaining it and orders were received for four ounces of white and two ounces of red onion seed. This year the seed was received on August 13th in quite good time for sowing. The small quantity of seed ordered is, I believe, due to the fact that the year before owing to the war, it arrived too late for sowing. The writer who purchased a little of the seed found the germination excellent and the crop very satisfactory.

MANGOES.

During the year 179 grafted mango plants were sold and as the sale of these plants has now been going on for some time, there ought to be a number of good varieties of mangoes obtainable within the next few years.

SHADDOCKS.

It was mentioned in last year's report that a number of shaddock plants were being grown from seed for the purpose of inserting buds of two very excellent varieties growing at Codrington House. I am glad to be able to report that during the year eight budded plants had been sold, and there were then a number of budded plants on hand for sale.

LIVE STOCK.

I regret to say that the donkey sire Don Cavalero which belonged to a syndicate of planters died on December 15th, 1919. This animal has done good service in improving the donkeys of the island. As soon, however, as shipping conditions become normal, it is to be hoped that those planters who imported Don Cavalero will replace him.

In 1910, a number of well-bred Holstein and Jersey bulls and cows were imported through the auspices of the Department of Agriculture from the United States of America for planters and others, and the effect of these importations can now be seen in the number of grade animals, especially of the former breed. As owing to the war it was impossible to import any fresh animals, nothing has been done since 1910, but no doubt as soon as shipping conditions become normal efforts will be made to import a further number of well-bred animals so as to continue the improvement of the milking breeds of cattle in the island.

As has been mentioned, since 1911 an effort has been made to reduce the infantile mortality, which is exceptionally high among the children of the peasants, by improving the milking capabilities of their goats by stationing in different districts of the island bucks of improved breeds. At the present time there are five such bucks stationed at the following places:—Seawell, Christ Church; Bayleys, and the Government Industrial School, St. Philip; Castle, St. Peter; and Bissex Hill, St. Joseph. These animals are effecting an improvement of the goats of many of the peasants of the island. It is time, however, that a fresh effort be made to import a further lot of bucks of the Saanen breed to continue the improvement.

ARBOR DAY.

This year Arbor Day was observed on August 4th, the August Bank Holiday, and 1,086 plants were distributed. As is customary a list of the plants available for distribution was published in the Official Gazette, and the Editors of some of the local newspapers were good enough to call attention to the fact that any one desirous of observing Arbor Day could obtain plants for that purpose, by applying to the Director of Agriculture. The following is a list of the plants that were offered for distribution :—

Achras Sapota, Linn.
Adenanthera pavonina, Linn.
Albizzia Lebbek, Benth.
Andira inermis, H. B. & K.
Anona muricata, Linn.
Anona squamosa, Linn.
Bauhinia tomentosa, Linn.
Bombax malabaricum, DC.
Pontia daphnoides, Linn.
Caesalpinia coriaria, Willd.
Cassia acutifolia, Delile.
Cassia bacillaris, Linn.
Cassia Fistula, Linn.
Cassia grandis, Linn.
Cassia javanica, Linn.
Cassia multijuga, Rich.
Cassia sp.
Cassia sp.
Casuarina equisetifolia.
Cedrela Toona, Roxb.
Coccoloba grandifolia, Jacq.
Copaifera officinalis, Linn.
Dalbergia Oliveri, Gamble.
Dalbergia ovata, R. Grah.
Dillenia sp.
Erythrina indica, Lam.
Guaiacum sanctum, Linn.
Hernandia sonora, Linn.
Hymenæa Courbaril, Linn.
Jacaranda ovalifolia, R. Br.
Lagerstroemia indica, Linn.
Lonchocarpus violaceus, H. B. & K.
Lysiloma Sabicu, Benth.
Mimusops Elengi, Linn.
Morus alba, Linn.
Paullinia barbadensis, Jacq.
Peltophorum Linnaei, Benth.
Peltophorum Vogelianum, Walp.
Piscidia Erythrina, Linn.
Pithecolobium latifolium, Benth.
Pithecolobium Samau, Benth.
Poinciana regia, Boj.
Prosopis juliflora, DC.
Prunus occidentalis, Sw.
Pterocarpus indicus, Willd.
Putranjiva Roxburghii, Wall.
Swietenia Mahogani, Linn.
Tabebuia pentaphylla, Hemsl.
Tamarindus indica, Linn.
Tecoma leucoxylon, Mart.
Tecoma serratifolia, G. Don.
Terminalia Arjuna, Wight & Arn.

In the past a large number of plants grown for distribution on Arbor Day had to be destroyed owing to the fact that persons did not apply for them. As this entailed a considerable loss of time and money, His Excellency the Governor-in-Executive Committee decided in December 1919 that for the future a notice should be inserted in the newspapers in the month of January of each year asking those persons wishing plants for Arbor Day, the Bank Holiday in August, to make application during that month, and to deposit three cents for the pot for each plant, this amount to be forfeited in the event of the plants not being taken and to be expended in the purchase of pots.

HERBARIUM.

Owing to the changes that took place in the staff of the Department during the year and to the extra work caused by attacks of the root borer (*Diaprepes abbreviatus*, Linn), and the brown hard back (*Phytalus smithi*, Arrow), it was practically impossible to do much work in the way of collecting plants for the herbarium.

LOCAL AGRICULTURAL SHOW.

This year the Local Agricultural Show for peasant proprietors, children of the elementary schools and others, was held on Wednesday, December 3, at Blowers plantation, St. James, kindly lent for the occasion by Mr. A. Cameron, the Proprietor and Mr. E. A. Atwell, the Attorney. There were 373 prizes offered, amounting to £50. 13s. 6½d, for exhibits of young oxen, milch cows, small stock, vegetables, fruit, Sea Island cotton, budded and grafted citrus and mango plants, etc. Again this year two prizes were offered for hats made from native grown material, and the exhibitors competing were required to complete the brims of the hats in the presence of the Judges, as it was stated the previous year that those persons who sent the hats in for competition did not do the work, but that others did the work and sent the hats to the exhibition in the names of those who received the prizes. In the classes provided for the boys of the elementary schools 108 prizes were offered for plants grown by them in half barrels, tubs, pots or boxes and in school gardens. Seeds of the various vegetables, such as beet, carrots, cabbages, lettuce, tomatoes, etc. cultivated in Barbados were, as usual imported and with the kind assistance of the Committee of Management distributed free of cost to peasants, small proprietors and teachers for children of the elementary schools. The Education Board was good enough to contribute a sum of £3. 10s. 11d. towards the purchase of this seed. Exhibits numbering 355 were sent in from the elementary schools competing, being an increase of forty-one over the number sent in the previous year. Of these 102 were awarded prizes from the following schools, viz., Mount Hillaby Combined, thirty-nine; Southborough Boys', fifteen; Holy Innocents Boys', fifteen; St. Joseph Church Boys', fourteen; Welches Combined, seven; St. George Church Boys', four; Mount Tabor Boys', three; St. Silas Boys', two; St. Saviour's Boys', one; and St. Bernard's Boys', one. As Barbados is mainly an agricultural colony, it is felt that every effort should be made to encourage every one to take an interest in agriculture but especially the children of the elementary

schools, most of whom will, in after life, be agriculturists, so again this year, in addition to offering prizes to the children of the elementary schools for articles grown by them in half barrels, tubs, pots and boxes and for articles grown in school gardens, the Committee of Management offered thirty-two prizes in Class VIII for various agricultural operations, such as making sweet potato and yam banks, digging cane holes, forking and draining land, etc. Four prizes amounting in the aggregate to 17s. 8½d. were offered for collections of pinned insects which attack the economic crops grown in Barbados. This year for the first time prizes in Class IX were offered to girls of the elementary schools for the performance of various agricultural operations, as they were able to perform, such as weeding, digging Indian corn holes, making sweet potato beds, and also for making baskets, etc. In this class the Misses O'Brien offered special prizes for articles of clothing made from flour sacks and it is a pleasure to have to record that a large number were sent in. In Class X prizes were as usual offered to the Head Teachers of those schools that gained the greatest number of prizes for collections of plants growing in half barrels, tubs and boxes; for collections of articles grown in a school garden; for agricultural work performed by the children; for collections of pinned specimens of insects attacking economic crops and for the largest number of boys entered for Agricultural work in Class VIII. For the first time this year five prizes amounting to £5. 16s. 8d. were awarded to the Head Teachers for the best kept school gardens. The winners of the prizes offered for the best collections of plants growing in half barrels, tubs, pots and boxes were: first prize, Mr. E. G. Smithwick, Mount Hilloby Combined; second prize, Mr. J. R. Bailey, Southborough Boys'; third prize, Mr. F. A. Williams, St. George Church Boys'; fourth prize, Mr. L. T. Gay, Welches Combined. The winners of the prizes offered for the best collections of articles grown in school gardens were: first prize, Mr. E. G. Smithwick, Mount Hilloby Combined; second prize, Mr. O. Walcott, St. Joseph Church Boys'; third prize, Mr. P. W. Jones, Holy Innocent's Boys'; fourth prize, Mr. J. K. Bailey, Southborough Boys'. The winners of the prizes offered for agricultural work performed by the children of the elementary schools were: first prize, Mr. L. T. Gay, Welches Combined; second prize, Mr. F. A. Williams, St. George Church Boys'; third prize, Mr. R. A. Dottin, St. Saviour's Boys'; fourth prize, Mr. P. W. Jones, Holy Innocent's Boys'. The winners of the prizes offered for the best collections of pinned insects were: first and second prize, Mr. O. Walcott, St. Joseph Church Boys'; third prize, Mr. E. G. Smithwick, Mount Hilloby Combined; fourth prize, Mr. J. Ward, St. Matthias Boys'. The winners of the prizes offered for the best kept school gardens were: first prize, Mr. E. G. Smithwick, Mount Hilloby Combined; second prize Mr. O. Walcott, St Joseph Church Boys'; third prize, Mr. J. R. Bailey, Southborough Boys'; fourth prize, Mr. P. W. Jones, Holy Innocent's Boys'. This year a special prize of £4. 3s. 4d. was awarded by C. B. Austin, Esq., M. C. P., for the greatest number of boys from any elementary school entered for agricultural work in Class VIII. The winner of this prize was Mr. L. T. Gay of Welches combined, who entered twenty-one boys, each of whom received two shillings, Mr. Gay receiving the balance of the money given. Diplomas of Merit of the Barbados Department of Agriculture were offered to the large cultivators for stools of sugar canes, samples of Sea Island cotton, collections of yams, sweet potatoes, eddoes, Indian corn, Guinea corn, and the best bunches of bananas and plantains. Diplomas of Merit were also offered to the Head Teachers of elementary schools for the best collection of plants growing in half barrels, tubs, pots and boxes; for the best kept school garden and for agricultural work, as well as to the small proprietors for exhibits of special merit.

The Diplomas were awarded as follows:—

LARGE PROPRIETORS.

Chestnut filly	A. P. Baker, Esq. Blowers Plantation.

HEAD TEACHERS OF THE ELEMENTARY SCHOOLS.

Best kept school garden	Mr. E. G. Smithwick, Mount Hilloby Combined.
Agricultural work	Mr. Oliver Walcott, St. Joseph Church Boys'.

SMALL PROPRIETORS.

Ox	Mr. Reuben Thornhill.
Carrots	Mr. E. G. Smithwick, Mount Hilloby Combined.

As Blowers is situated in that part of the island where the rainfall conditions are favourable for the growth of fruit and vegetables, there was a fair number of exhibits of beets, carrots, egg plant fruit, christophines, etc., which were declared to be excellent and came in for a great deal of praise, but still the exhibits were not as numerous as might have been expected from the quantity of seed distributed. The exhibits sent in from the elementary schools were very satisfactory and compared favourably with those of last year, being 355 as against 314 of the previous year, although the number for 1917 was the best on record, being 409. There was a notable improvement this year on the part of the exhibitors in staging the vegetables and fruit which were practically free from insect pests, clean and of good appearance. In the afternoon His Excellency the Governor, Sir Charles O'Brien, K.C.M.G., visited the Show, and after inspecting the exhibits was good enough to distribute the prizes.

After the distribution of the prizes the Director of Agriculture then on behalf of those present thanked His Excellency for being so good as to attend the meeting and for distributing the prizes. He called attention to the exhibits that had been staged in general, remarking that they were excellent, and that he had been practically unable to find any fruit exhibit deserving criticism. On previous occasions, he had found it necessary to complain of the specimens of fruit with scale insects and improperly cut, while in the case of the vegetables they had often been too old for food purposes, but this year he had not found a single vegetable exhibit which was faulty and he thought this very creditable indeed. This year a new departure had been made in the offering of prizes by the Misses O'Brien for articles of clothing made from flour sacks. This competition called forth a large number of exhibits, which were so numerous that Mr. Harold Wright, who was Secretary to the Judges of the clothing, gave four prizes in addition to those offered by the MissesO'Brien. These articles were excellently made and reflected great credit on the Sewing Mistresses of the schools from which they came. He drew attention to the prize of £4. 3s. 4d. which Mr. C. B. Austin had been good enough to give to the teacher who sent in the largest number of boys from any school for competition in agricultural work. Half of this, £2 1s. 8d. was awarded to Mr. L. T. Gay of Welches Combined School and the remainder was divided equally among the twenty-one boys who competed. With regard to the school children's exhibits he said that on the whole they were excellent. They were, he thought, the best that he had seen, both those grown in pots, etc., and those grown in school gardens. This year for the first time prizes were offered to the girls of elementary schools for performance of agricultural work as was suited to their strength. At the request of Mr. Bovell three hearty cheers were given His Excellency, Mr. Austin and Rev. J. R. Nichols respectively.

The Governor in acknowledging the vote of thanks which had been accorded him regretted that Lady O'Brien could not be present, as she had been detained at home on account of one of the Misses O'Brien being unwell. He remarked upon the work done by the Director of Agriculture and his comment on the exhibits of the schools was that they were "splendid." He had noticed that the exhibits were not as numerous as those of the previous year, but that, he supposed, was chiefly due to the drought. He was particularly pleased with the work of the school children and remarked that they were the future agriculturists of the Colony which solely depends on agriculture. He joined Mr. Bovell in thanking Mr. Cameron, Mr. Atwell and Mr. Baker for allowing them to hold the exhibition at Blowers.

Rev. J. R. Nichols then said a few words with reference to the schoolmasters and the faithful way in which the majority of them performed their work. Again this year he was obliged to call attention to the professional idler that preyed upon school gardens. This was unsatisfactory from every point of view, but especially so since it served to dishearten both the schoolmasters and the children and he thought the best way to punish such thieves was to make them repay, where possible, the utmost value of what they had stolen.

In conclusion he called attention to Germany as organizing all her economic forces and pointed out how the children of today should be taught to produce the most they can from the land.

CANADIAN EXHIBITION.

Owing to the unsettled conditions which have prevailed during the year as a result of the war, the Permanent Exhibition Committee decided that it was undesirable to take part in the National Exhibition held annually at Toronto.

INSPECTION AND FUMIGATION OF SEEDS, PLANTS, &c.

For the year ending March 31st, 1920, 301 consignments of plants and seeds other than cotton seed were examined. Of these twenty-seven were either fumigated or disinfected, and 88 consignments which had been imported in contravention of the order promulgated by the Governor-in-Executive Committee were destroyed. During the year 63 consignments of cotton seed amounting to 46,513 bags were fumigated. In addition to the above, four bags of cotton seed for planting purposes were also fumigated at the Department of Agriculture.

INSECT PESTS AND FUNGOID DISEASES, ETC.

As usual during the year special attention was given to the various insect pests and fungoid diseases. Until August 11th, 1919 there was no Assistant Director of Agriculture who had been trained in entomology and mycology, and so the Director had, with the assistance of the then First Field Assistant Mr. M. S. Goodman, who was acting as Assistant Director of Agriculture, to undertake the entomological and mycological duties of the Department, and, as in previous years, considerable attention was paid to the attacks of the root borer and the brown hard-back. As the brown hard-back was found to be spreading rapidly about the island a start was made to work out the life history of this pest. Before, however, very much could be done, Mr. B. A. Bourne, B.Sc., was appointed as Assistant Director of Agriculture, and as he had some special training in working out the life history of a coleopterous pest while at college, the whole of that work was handed over to him. As will be seen from Mr. Bourne's report he has taken a great deal of pains in connection with the matter, and I would like to place on record here my appreciation of the thorough manner in which he carried out that special work entrusted to him. As he has dealt with the subject so fully there is no need for me to say anything further on the matter.

Owing to enquiry being made by a firm in the United States of America as to whether cotton seed from Santo Domingo could be marketed in Barbados, the question of the importation of cotton seed from Santo Domingo and Hayti into the island was considered, and it was decided by His Excellency the Governor-in-Executive Committee that the importation of cotton seed from those two countries should be prohibited.

As the Cotton Diseases Prevention Act 1919 (1919-10) proved to be defective in certain particulars, I suggested, in drawing attention to the matter, that as it might be desirable owing to abnormal climatic conditions in any year to require the destruction of the cotton plants at an earlier or later date than is stated in the Act, that power should be given to the Governor-in-Executive Committee to retard or advance the date on or before which cotton plants are required to be destroyed and also the period during which it is unlawful for cotton to be growing on any land. In due course, an amending Act was passed by the Legislature making lawful, on the recommendation of the Director of Agriculture, for the Governor-in-Executive Committee to advance or retard the "close season."

REPORT OF THE ASSISTANT DIRECTOR OF AGRICULTURE ON THE ENTOMOLOGICAL AND MYCOLOGICAL WORK CARRIED OUT DURING THE SEASON UNDER REVIEW.

Before proceeding to outline the work under the above heading, it may be stated that the writer was appointed to the post of Assistant Director on September 1, 1919. Owing to the fact that the post of Lecturer in Natural and Agricultural Science at Harrison College was still vacant at the opening of the college session in September, and in order to avoid the serious loss which would result to the college through the discontinuance of the teaching of certain Science subjects, the Governor was, on the recommendation of the Director of Agriculture, good enough to grant permission that the writer be allowed to give a total of five hours per week lecturing in Botany and the Principles and Chemistry of Agriculture at Harrison College.

The following are the principal divisions of the work with insect and fungoid pests for the season under review :—

(1) Plant inspection and fumigation.
(2) Upkeep of collections.
(3) Investigation of insect and fungoid attacks reported or observed.
(4) Special investigations of the life history, etc., of *Phytalus smithi*, Arrow (the brown hard-back) under Barbados conditions.

PLANT INSPECTION AND FUMIGATION.

The Orders made by the Governor-in-Executive Committee from time to time providing for the inspection, fumigation, disinfection and where necessary destruction of plants, seeds, etc., brought into the island have been carried out in the usual manner. In five instances, insects have been prevented from being introduced which, as far as could be determined, do not exist in the island. Twenty-seven packages of plants, bulbs, seeds, etc., had to be fumigated or disinfected, and in thirty-eight instances cane cuttings, and other plants growing in soil, from Trinidad, Demerara and other places, had to be destroyed to prevent the possible introduction of the sugar cane froghopper (*Tomaspis varia*, Fabr.)

All cargoes of cotton seed, amounting to 46,513 bags, imported for the extraction of oil were fumigated with sulphur dioxide generated by the Clayton Disinfector mounted on the barge Hygeia. In more than one instance, this seed was brought, in large part, loose in the hold of the vessel and as a result these vessels had to go out in the harbour at a safe distance from the shore and bag up the seed before it was allowed to be fumigated. Since then the Harbour Master has cooperated with the Director of Agriculture in this matter and will not allow vessels to enter the careenage until they certify that all the cotton seed on board the said vessels is in bags. Extended experiments carried out at Pelican Island some years ago have proved this precaution of having the seed bagged before fumigation to be essential to its efficiency.

UPKEEP OF COLLECTIONS.

The collection of insects has been renewed with fresh specimens from time to time and added to as occasion offered itself. Two lots of specimens were forwarded to the Director of the Imperial Bureau of Entomology, London, for identification, and he has been good enough to have the following insects named for us :—

ORDER—HYMENOPTERA (Bees, wasps, etc.)

FAMILY— CHALCIDIDAE (Chalcid "flies").

Euplectrus furnius, Walk. (Sub family Eulophidae)
Bred from larva of *Protoparce cingulata* found parasitised in a field at a certain estate.

ORDER—COLEOPTERA. (Beetles).

FAMILY—TENEBRIONIDAE.

Alphitobius piceus, Oliv.
From cotton seed imported from Venezuela.

FAMILY—CERAMBYCIDAE.

Lagochirus araneiformis, L. (Sub-family Lamiidae).
Taken from exhibits at Local Show at Lancaster, St. James in 1917.

ORDER—DIPTERA.

FAMILY—CHIRONOMIDAE.

Culicoides sp.
Taken sucking human blood, Belleville.
Sarcophaga pavida, Will.
Bred from larva feeding on decaying larva of *Protoparce cingulata*.
Sarcophaga chaetopygialis, Will.
Caught in field at Valley estate which was infested with larvae of *Protoparce cingulata*.

FAMILY—OSCINIDAE.

Oscinis sp.
On plant leaves.

FAMILY—AGROMYZIDAE.

Agromyza sp.
Leaf-miner of cowpea.

ORDER—LEPIDOPTERA.

FAMILY—NOCTUIDAE.

Perigea albigera, Gn.
Bred from larvae attacking leaves of Chrysanthemum.

FAMILY—TINEIDAE.

Plutella maculipennis, Curt. (Sub-family Plutellidae).
Bred from larvae attacking leaves of cabbage.

ORDER—HEMIPTERA.

SUB-ORDER—HOMOPTERA.

FAMILY—JASSIDAE.

Balclutha sp.
Found on *Zea mays*, Linn. (Maize, Indian corn).

In addition to the collection and preparation of entomological specimens, considerable attention has been devoted during the period to the preparation of a permanent collection of fungi as well. The main problem which confronted the writer with regard to the preparation of a permanent collection of fungi was in the working out of a suitable method for preserving the large number of delicate superficial cryptogamic fructifications in their natural position and arrangement, which are commonly encountered. The method given below was devised after considerable experimentation and has been used with considerable success subsequently. It is based on a method prepared by Professor F. L. Stevens, Urbana, Ill, and supplied to the Director of Agriculture.

METHOD USED IN MAKING EXCELLENT PERMANENT MICRO-MOUNTS OF FUNGI.

The method consists of placing a drop or two of a 4% solution of Celloidin (in ether alcohol) on the fungus. As soon as the edges curl, in about five minutes the film is lifted off carefully with forceps to a clean slide. Drops of a mixture of carbolic acid (crystals) and xylol or pure creosote are now added to the film to clear it and as soon as any cloudiness which may be present disappears in about five minutes the excess of clearing fluid is sucked up with filter paper and the film bearing the fungus with all parts in their natural position encased in the celloidin, mounted permanently in Canada Balsam.

The solutions used above are made as follows :—

4% celloidin.

4 grams celloidin (previously washed in distilled water and dried over calcium chloride)

22. 4 cc Alcohol (Absolute)

77. 6 cc Ether (Squibb's kept over calcium oxide for twenty four hours and then re-distilled).

Clearing solution.

Either (1) Carbolic Acid and Xylol

12 cc Carbolic acid (Anhydrous)

36 cc Xylol (Pure).

Or (2) Pure Beech wood creosote.

In the case of fungi whose spores are enclosed in a pycnidium embedded in the tissues of the host such as the Sphaeropsidales or borne in asci enclosed by a perithecium as in the Ascomycetes the usual method of embedding in paraffin and cutting microtomic sections has been practised,

The card catalogue of West Indian insects injurious to plants and animals with remedial measures, as well as fungi and fungicides has been added to in many instances as information in bulletins, pamphlets, etc. became available.

INSECT ATTACKS REPORTED OR OBSERVED.

SUGAR-CANE.

No new insect pests of this crop have been observed during the year although it is to be regretted that some of the old ones have given considerable trouble and occasioned much loss in some instances. The root-borer, *Diaprepes abbreviatus*, Linn. still constitutes a formidable factor in production in many localities, and unless serious co-operative effort is made very shortly this pest may assume the form of an epidemic in some localities. The writer has seen as many as thrity-three of these borer larvae recovered from a single cane hole, and when it is remembered how much damage a single larva can do to a cane stool some idea of the ravages of this pest can be formed. In order to obtain some definite idea as to the potential possibilties of reproduction of the root-borer a number of these were caught hazardly and after dissection the number of developed and immature eggs found in each female counted. The table of the result of this experiment is given below.

TABLE SHOWING NUMBER OF IMMATURE AND MATURE EGGS PRESENT IN DIAPREPES ABBREVIATUS ON DISSECTION.

No. of Beetle.	No. of Eggs.	No. of Beetle.	No. of Eggs.
1	530	7	327
2	321	8	405
3	528	9	519
4	313	10	294
5	377	11	309
6	435	12	354

Average number of eggs found in 12 beetles	393
Maximum	530
Minimum	294

From the above results it is clearly seen how necessary it is for planters to pay special attention to the collection of adults early after their first flight, otherwise each female may, under suitable conditions give rise on the average to some three hundred and ninety three larvae to continue the ravages of the pest.

The brown hard-back, *Phytalus smithi*, Arrow, has continued to appear in such large numbers and to cause so much economic loss, particularly in certain localities, that it has been made the subject of a special report, vide page 18.

The moth borer, *Diatraea saccharalis*, Fabr., has done considerable damage during the period under review, both directly as a stem borer and indirectly by enabling certain well known wound-parasitic fungi to gain an entrance. It is not uncommon to find cuttings selected for planting infested with the larvae of this pest and unless proper attention is paid in the future to the selection of healthy cuttings much unnecessary economic loss to the country must continue. The practice of collecting egg batches and preserving the parasites which emerge from such as have been parasitised to continue their good work, has been carried out in many instances with considerable success, reducing the infestation and loss to a minimum.

The other pests of minor importance, namely, *Pseudococus calceolariae*, *P. sacchari*, the scale, *Aspidiotus sacchari*, and the mite, *Tarsonemus spinipes*, Hirst., etc., have been prevalent only in some isolated instances. In one instance a Pseudoscorpion was found associated with *T. spinipes* and evidently predaceous on this pest.

The "cane fly," *Delphax saccharivora*, has not been observed during the period under review. In some isolated instances the white cottony masses were seen, indicating their existence at one time, but evidently high parasitism by *Anagrus flavescens* had occurred and served to keep them in check.

The corn ear worm, *Laphygma frugiperda*, S. & A., was noted in one instance causing slight damage to cane leaves on an estate in St. Joseph's parish.

COTTON.

The growing crops have been found to be free from any new pest. Leaf blister mite, *Eriophyes gossypii*, Banks, has been observed in a number of instances although the attack did not assume severe proportions at any time. Stem injury due to red maggot, *Porricondyla gossypii*, Coq., has been observed in three or four instances. On one or two occassions known to the writer attacks of cotton caterpillars, *Aletia luridula* and *Alabama argillacea* were quite serious and resulted in a considerable reduction in the crop through the neglect of dusting the plants with Paris green which remedial measure proved entirely successful in checking the pest in several parallel cases. During the period of drought aphidae appeared in large numbers in some localities but were soon held in check mainly by the lace wing fly, *Chrysopa* sp. and the red ladybird beetle, *Cycloneda sanguinea*, L.

The root-borer of the sugar cane, *Diaprepes abbreviatus*, Linn., has been observed to cause the destruction of many cotton plants in fields formerly used for growing sugar cane and infested with the borer. Plants up to several feet in height were observed to be withered and on digging them up the tap root was found to be "wrung" almost to the surface of the soil in most cases, and the borer grub was invariably associated with the tunnel thus made.

MISCELLANEOUS CROPS, TREES, PLANTS, ETC.

Sweet potato (*Ipomea batatis*) :—About the middle of September a serious outbreak of the potato moth *Protoparce cingulata*, Fabr., was reported from one estate. The infestation occurred in a field of an area of about six acres and was so severe that in about a week's time few potato leaves were to be seen. During the period when the larvae were most abundant an attempt was made to determine what parasites existed, if any. Collections of Diptera were made throughout the field with a view of ascertaining whether the parasite *Sturmia distincta*, Wied., was present during the early part of the infestation but an examination of a large number collected failed to reveal the presence of this particular parasite at that time. The Diptera most commonly found in the field during the ravages of the larvae were *Sarcophaga trivittata*, Macq., *Chrysomia macellaria*, F. and *Sarcophaga chaetopygialis*, Will. In one case a decaying larva of *P. cingulata* was found in the field infested with dipterous larvae which were bred to maturity and have been determined as *Sarcophaga pavida*, Will. by Dr. G. A. K. Marshall, of the Imperial Bureau of Entomology. Numerous potato moth larvae were collected in the field and bred out artificially. In one instance parasitism had occurred and nine adult Diptera emerged from the remains of the larva and have been determined by Dr. Marshall as *Sturmia distincta*, Wied.

About two weeks subsequent to the first sign of the outbreak of the pest no larvae were to be seen in the field at all. Numerous pupae were to be found in the ground and in many instances the chewed remains of these were seen associated with the burrows of field mice. Another factor which entered into the control of the pest was the predaceous activity of numerous blackbirds, *Quiscalus fortirostris*, on the young larvae. Two of these birds were shot at about 7.30 a.m. flying from the field and dissection showed one to contain thirteen and the other ten freshly devoured potato moth larvae.

The controlling factors were so efficient after they had gained a footing, namely, the dipterous parasite, *Sturmia distincta*, Wied, the predaceous activities of field mice on the pupae and of blackbirds on the larvae, that within three weeks after the first noticeable outbreak of the pest this latter was almost completely under control.

During the prolonged drought there were also occasional small outbreaks of thrips, *Euthrips* sp., and red spider, *Tetranychus telarius*. Dusting with approximately equal parts of flowers of sulphur and lime was beneficial in many cases and fields recovered greatly from the attack subsequent to a few showers although not treated with flowers of sulphur and lime.

Indian corn (*Zea Mais*) :—Considerable damage was done in many instances by the corn ear worm, *Laphygma frugiperda*, S & A., owing to neglect on the part of many planters. Much of this loss could have been avoided with small expense had the pest been observed at an early stage and suitably combatted. A mixture of lead arsenate and hydrated or air slaked lime in equal parts and applied at the rate of a pen-nib full, well dusted down among the folded leaves of each plant is very effective in controlling this pest.

Cabbage (*Brassica* sp.) :—Numerous attempts on the part of certain individuals to grow this crop on the southern portion of the island, particularly near the sea-coast have resulted in practically an entire loss, due mainly to the ravages of a small microlepidopterous insect which was identified by the writer and later confirmed by the Imperial Bureau of Entomology as being *Plutella maculipennis*, Curt. This insect commonly

known elsewhere as the Diamond-Back moth lays its eggs on the leaves and the smal green larvae occur in large numbers on the dorsal surface of the same, riddling them with holes and ruining them completely. It was recommended that the leaves be sprayed on the dorsal surface with arsenate of lead, three lb. to fifty gallons of water. A sticker should be added to the spray in the form of one pound of ordinary soap to five gallons of the spray in order to make the spray adhere properly.

Shallot (*Allium ascalonicum*): —In some localities this crop was occasionally attacked by *Thrips tabaci*, Lind. but it was soon controlled by spraying with nicotine sulphate. One case was observed in which the larvae of a variety of the corn ear worm, *Laphygma frugiperda*, S. & A., caused some loss by boring into the leaves and feeding internally. Hand-picking proved effectual in controlling this pest, indications of their presence being easily detected by the characteristic withered appearance of the leaves, and the presence of the larvae and excrement both internally and externally.

Egg plant (*Solanum melongena*) :—Certain vegetable growers experienced some trouble with this crop through the ravages of the Eggplant Lace Bug probably *Corythaica monacha*. These bugs were found in hundreds on the dorsal surface of the leaves sucking out the plant juices. Often the attack was so serious as to cause the majority of the leaves to shrivel and fall off. A soap and water spray made by dissolving 8 lb. of fish-oil soap in fifty gallons of water is recommended as a control, care being taken to spray the dorsal surface where the bugs are present.

Pea :—Cowpeas and other varieties of the Leguminosae which were being grown experimentally were attacked by larvae which ate the leaves. Larvae bred to maturity gave adults which agreed with the description of *Fundella pellucens*, L. A leaf-miner of the cow pea, *Vigna catjang*, was fairly common and has been determined as *Agromyza* sp. at the Imperial Bureau of Entomology. An undetermined species of *Microlepidoptera* has also been bred out from larvae attacking pea pods.

Whitewood (*Tecoma leucoxylon*) :—Branches of a tree which was seriously attacked by the larvae of a borer were sent in for examination. Several moths of *Duomitus punctifier*, Hamp. were bred to maturity from the larvae. It was recommended that the killed branches be pruned back to the healthy tissue and the dead portions burned. In cases where branches were not badly infested extraction of the larvae with a slightly hooked steel wire or fumigation of the burrows with carbon bisulphide should be done.

Chrysanthemum :—One amateur florist reported that much damage was being done to the foliage of these plants by the larvae of some insect. Some of these larvae were collected and bred out at the laboratory and the adult moth has been determined as *Perigea albigera*, Gn. by Dr. Marshall, of the Imperial Bureau of Entomology. Hand-picking has proved successful in controlling this pest.

Coccidae and Aleurodidae. A spieces of *Pulvinaria* was collected on a tuber of artichoke (*Helianthus tuberosus*) which, as far as can be determined, has not been previously recorded in Barbados. Specimens of fruit trees and garden plants were received and found infested with the following, from time to time :— *Orthezia praelonga*, Dougl., *Coccus viridis*, Green, *Saissetia nigra*, Nietn, *Coccus mangiferae*, Green, *Vinsonia stellifera*, Westw., *Chionaspis citri*, Comst., *Pseudococcus calceolariae*, Mask., *Aspidiotus sacchari*, Ckll., *Pseudococcus sacchari*, Ckll. and *Aleyrodes goyabae*, Goldi. *Selenaspidus articulatus*, Morg. appeared to be fairly common on *Tamarindus indica*, Linn. but the fungus *Hormodendron* sp. was quite frequently found associated with them and apparently keeping them in check. *Coccus viridis*, Green was usually found in abundance on citrus plants but in some cases heavy parasitism by the fungus *Cephalosporium lecanii* had occurred and was very successful in keeping this pest in check.

The male scales of *Aulacaspis rosae*, Bouché found infesting mango leaves were observed to be parasitized by a small Chalcid. The parasities were bred out successfully and have been determined as *Aspidiotiphagus citrinus*, Craw. at the Imperial Bureau of Entomology. The larvae and pupae of *Aleyrodes goyabae*, Goldi, found on leaves of avocado pear were also being held in check by a minute Chalcid which was determined as *Encarsia* sp. at the Imperial Bureau of Entomology. In both instances of parasitism by Chalcids mentioned above, specimens collected showed these beneficial insects to be almost 100 per cent. efficient.

Among the *Hymenoptera* sent to Dr. Marshall, of the Imperial Bureau of Entomology, have been specimens of Chalcididae bred from an unknown lepidopterous larva found on grass and determined by him as *Euplectrus furnius*, Walk. In an attempt to breed out the leaf miner of *Cordia interrupta* two species of Chalcids were obtained from the mines, specimens of which were forwarded to Dr. Marshall for identification and which have been determined by him as *Apanteles* sp. and *Zagrammosoma* sp.

Lasioderma serricorne, Fab. has been found eating into stored dry ginger causing much loss.

Grains of Indian corn (*Zea Mais*) and also the larvae of *Phytalus smithi*, Arrow which were being fed with the corn under experimental conditions in the Laboratory have been found infested with a species of *Acarina* which has been determined as *Tyroglyphus* sp. at the Imperial Bureau of Entomology.

FUNGOID ATTACKS REPORTED OR OBSERVED.

SUGAR-CANE.

Marasmius sacchari, Wakker. This root fungus has been noted many times during the year and seems to be particularly prevalent in some districts. On the whole ratoon canes appeared to suffer more from the disease than plant canes, yet in some isolated cases even these latter suffered severely. The writer has seen cuttings ready for planting heavily infected with the white mycelial growth characteristic of the superficial appearance of this fungus, and very often the feathery growth of the fungus *Himantia stellifera*, Johnston, was found in addition binding the lower leaf-sheaths of these cuttings to the stalk. Owing to the prolonged drought this year the damage done by this disease when present to ratoon canes was perhaps the most pronounced. The root system was evidently killed back to such an extent during the first year that adverse conditions could not be withstood during the subsequent season and the result was that the ratoons were much stunted and produced few tillers, and in some instances were a total failure. The planting of healthy cuttings, proper tiliage and drainage are essential to the control of this disease and will well repay planters for their efforts along these lines.

Colletotrichum falcatum, Went. This disease commonly known as "Red Rot" has been observed on several occasions particularly in instances where canes had been damaged by the moth borer (*Diatraea saccharalis*, Fabr.)

Thielaviopsis paradoxa (*De Seynes*) J. Hohn. Reports of losses due to this cane cutting disease, commonly known as the Pineapple Disease have not been numerous during the year. In many instances, planters are beginning to realize the benefit from using healthy cuttings for planting and the proper disinfection of the same with Bordeaux mixture prior to their insertion in the soil.

Cercospora vaginae, Kruger. The leaf sheath red spot fungus has been noted in several instances during the year. On estates where no pains are taken for the selection of healthy seed, cuttings for planting purposes are frequently found infected with this fungus disease.

Cephalosporium sacchari, Butl. This fungus was observed in one or two instances associated with red rot due to *Colletotrichum falcatum*, Went. Canes which had been attacked by this disease were observed to be infested with the moth borer, spores evidently having gained entrance through the wound thus made.

Leptosphaeria sacchari, van Breda de Haan. This leaf spotting disease known as Ring Spot was found to be fairly common in some localities. In no case was the attack severe enough to give the canes a decided check, although its presence lowered the vitality of the canes a little by the injury done to the leaf surface.

Sclerotium Rolfsii, Sacc. This fungus causes a red rot of the leaf-sheath. It has only been observed in one instance and is as yet of no economic importance to the cane crop although it occasionally causes serious loss to various vegetable crops.

Cytospora sacchari, Butl. This fungus was observed to cause a dry rot of stalks in one or two instances and was also to be found occasionally on the leaf sheath of certain varieties but was not very prevalent during the period under review.

An attempt was made during the year to make collections of the various fungi found associated with diseased and apparently healthy canes. The following are the commonest which the writer has observed.

Himantia stellifera, Johnston. Very common on base of cane stalks binding the lower leaf-sheaths to the stalk.

Melanconium sacchari, Masse. Common on stalk and base of leaf-sheath of certain varieties such as B.S.F. 12 (34) and others having soft rinds.

Melanconium saccharinum (?) Penz et Sacc. One instance noted. Present on the under surface of leaf, particularly on midrib.

Hormiactella sacchari, Johnston. Common on dead cane leaves.

Trichoderma lignorum (Tode) Harz. Very common on dead and dying cane stalks and leaves. Of frequent occurrence in damp chamber cultures.

Acanthorhynchus vaccinii, Shear. One instance noted on leaf kept in damp chamber for some time.

Chaetomium globosum, Kunze. Common on dead leaves in damp chamber cultures.

Tetraploa aristata, (B & Br) Commonly found on dead cane stalks associated with other fungi.

Stemonitis fusca, Roth. One instance noted on cane leaf.

MISCELLANEOUS CROPS, ETC.

Cotton (*Gossypium* spp.) No instance has been recorded where this crop suffered from any specific fungoid disease. Mildew and leaf-spot both appeared to be common but did not seem to exert any very great influence on the general vigour of the plants.

Pea. In a plot in which Martinique peas were being grown for experimental purposes at Codrington one instance was noted in which almost a full grown plant died suddenly. Death was found to be due to crown rot produced by *Sclerotium Rolfsii*, Sacc., fructifications of this fungus being produced in abundance at the base of the stem and on the upper portions of the root. This variety of pea also seemed very susceptible to "spotting" of the pods. A species of *Alternaria* was found associated with the spots on the pod, and could not be distinguished from *Alternaria brassicae* (Berk) Sacc. *var phaseoli*, Brun. by the available descriptions.

Bean. In an experimental plot in which bush beans were being grown, leaf spot appeared quite common. The fungus *Colletotrichum lindemuthianum* (Sacc & Magnus) was found associated with the disease. This fungus appears to be a stage of *Glomerella rufomaculans* (Berk) S & S, both having been found associated with these diseased spots at different stages. Shear and Wood, in their cultural studies, also showed these two fungi to be related.

Carrot (*Daucus carota*) One specimen was received of a diseased carrot from a small vegetable grower. The plant had showed signs of rotting at the crown, although the leaves themselves appeared to be healthy. When placed in a damp chamber the crown and root portion developed practically a pure culture of a species of *Fusarium*. Both *macroconidia* and *microconidia* were present, although the former appeared to be the more abundant. The plant was carefully removed from the field along with the surrounding soil and burned in order to avoid further infection. The appearance of the disease in this field has not been observed subsequently.

Parsley (Petroselinum spp.) One vegetable gardener reported that several plants had been lost through some disease and sent in a specimen to the laboratory for examination. The withering and scorching of the leaves was the first symptom of the disease. On examination, the upper portion of the root just below the surface of the ground was found to be soft and semidecayed, the tissues of this region showing the presence of the mycelium of a fungus. The leaves were infested with numerous olive-green to brown, globose, ostiolate pycnidia on both surfaces and these were found to contain numerous filiform, straight or much curved, hyaline, multiseptate conidia. The fructifications could not be distinguished from those of *Septoria petroselini*, Desm. by the available literature. The number of plants attacked in this case were not sufficient to warrant the usage of a fungicide. The selection of seed from resistant varieties and a suitable rotation should be practised where possible.

Tomato (*Lysopersicum esculentum*) A specimen of a diseased plant was sent to the Department during the period under review. Disease in this case was due to the leaf mould caused by the fungus *Cladosporium fulvum*, Cke. The fructifications on the underside of the leaves varied from minute spots to large, irregular, greyish patches. The result was that the leaves curled, turned yellow and died. It was recommended that all diseased plants be pulled up and burned and the rest be sprayed with Bordeaux mixture. Overwatering or damp situations should also be avoided.

Artichoke (Helianthus tuberosus) One specimen of a diseased plant was sent to the Department for examination. Death was found to be caused by crown rot due to the fungus *Sclerotium Rolfsii*, Sacc.

Pumpkin (*Cucurbita pepo.*). Complaint was made by a vegetable gardener that he was losing several of his pumpkins by a disease which produced rot of the fruit. Examination showed that fruit were attacked shortly after pollination and often when only a few inches long. A downy mildew was found associated with the disease and could not be distinguished from *Peronoplasmopara cubensis*, Cl. As the decay of the fruit proceeded, several other fungi were to be found, the chief of which were *Cladosporium cucumerinum*, E & A, *Fusarium* sp., *Alternaria* sp. and *Spondylocladium* sp. It was recommended that all diseased fruit be removed and burned as soon as possible and to avoid an excessively moist situation. By selecting plants resistant to the disease the greatest amount of success is likely to be obtained. Spraying cucumber vines affected with the disease with Bordeaux mixture in Porto Rico has given negative results.

Lime (*Citrus medica var acida*). Seedlings were lost among a batch which were being raised for experimental purposes. The plants died when only a few inches high, remained erect and appeared as though they had suffered from severe drought by their dry, shrivelled leaves. Diseased seedlings placed in a damp chamber produced a scanty white byssoid growth of a fungus along the hypocotyl, just below the cotyledons, which bore numerous falcate macroconidia and oval microconidia of a species of *Fusarium*. Sections of the root were cut and examined and the mycelium of the fungus was seen in and among the cells. The mycelium was branched and septate. It was evident that the prevalence of the mycelium in the root tissues, particularly the xylem vessels, had caused the death of the seedlings by these latter becoming plugged up. This disease has not been observed affecting well grown plants and trees and evidently only causes the death of non-resistant seedlings, the loss of a few of these at an early stage being of no economic importance, but rather beneficial in weeding out the less hardy individuals.

Mango. (*Mangifera indica*) Several specimens of diseased leaves and plants have been sent in for determination from time to time. The commonest disease noted was the leaf spot caused by *Gleosporium mangiferae*, Hen. Following the glassy star scale the superficial fungus *Capnodium mangiferum* was found in many instances and appeared to weaken the vitality of trees somewhat by hindering the proper physiological functions of the leaves. In one instance the leaves of a tree were found heavily inested with the fungus *Pestalozzia guepinia*, Desm. This latter tree produced numerous fruit, but seldom did any of these reach maturity, the majority dropping at an early stage. Spraying trees with Bordeaux mixture has given good results and has been found not only to improve the yield but the keeping qualities and appearance of the fruit as well.

Golden apple (*Spondias dulcis*). A die-back of the young branches of this tree was reported in one instance and specimens of diseased twigs and branches were sent to the laboratory for examination. The leaves would turn yellow and then wither up and fall off. Specimens of twigs immediately below the area of the same which

had die-back were placed in a damp chamber. Numerous *acervuli* of a species of *Colletotrichum* developed within a few days. Careful examination of these *acervuli* was made and they were found to be typical of *Colletotrichum falcatum*, Went. Measurement of the falcate spores, borne in great abundance, also showed them to be typical of the above species, being 24x4 microns in every instance observed. Those portions of the stem which had been killed were found in many instances to be infested with the acrobatic ant, *Cremastogaster* sp., evidently feeding on the gum residues of the diseased areas. It was recommended that all diseased twigs be carefully pruned off and burned, the surface exposed by each cut being tarred or painted over to prevent the entrance of fungoid spores. Subsequently the tree should be sprayed with Bordeaux mixture.

Sugar apple. (*Anona squamosa*) In one instance a tree was observed which was reported would not yield any fruit. The twigs and young branches in most cases seemed to be suffering from necrosis. An examination of these twigs and stems in the laboratory showed them to be infested with numerous scattered *pycnidia* of a species of *Rhabdospora*. It was suggested that all the diseased portions be removed and burned, and the tree thoroughly sprayed with Bordeaux mixture.

Breadfruit. (*Artocarpus incisa*) Several instances of the black blight due to *Capnodium* sp., have been observed. In one instance particularly the superficial fungus was causing much harm by impairing the proper physiological functions of the leaves. Spraying with kerosene emulsion to control the scale insects present will soon eliminate this fungus.

Rose. (*Rosa spp.*) The black leaf spot caused by *Dicoccum* (*Marssonia*) *rosae*, Bon. and the white mildew caused by *Sphaerotheca pannosa*, Lev. were very prevalent during the season under review. During the prolonged drought the latter fungus was very severe in many instances and caused considerable defoliation of trees. This fungus is controlled by dusting with flowers of sulphur diluted with about ¼ of its volume of slaked lime, application being made early in the morning when dew is present on the leaves which will enable the material to adhere. The former fungus if present on a few leaves only these latter may be picked off and burned, but if present to a large extent, spraying with Bordeaux mixture gives satisfactory results in preventing its spread to any new foliage which may be put out.

Sweet pea (*Lathyrus odoratus*, L.) A local florist experienced considerable difficulty in growing these plants from seed imported from the U. S. A. The seed in question had a high germination per cent but as soon as the plants reached a height of about five to six inches they died. Diseased plants remained erect but showed signs of wilting. On pulling these plants up, the root system was found to be quite dead. Sections of the root were examined microscopically and revealed the presence of numerous nematodes in the tissues. On placing plants in a damp chamber they developed numerous fructifications of a species of *Hormodendron* on the dorsal surface of the leaves and along the stem, this fungus evidently having gained entrance through the nematode-infested roots.

Specimens of the nematode-infested roots were preserved in alcoholic formalin and forwarded to Dr. N. A. Cobb, Agricultural Technologist, U. S. Department of Agriculture, Bureau of Plant Industry, and he has examined them and found two species of nematodes to be present, viz : *Heterodera radicicola* (Greef) Mül and *Aphelenchus agricola*, de Man :

With regard to *Aphelenchus agricola* Dr. Cobb states that he has frequently observed it in and on the roots of diseased plants and it has been observed on several different occasions in Europe by de Man, Maupas and Steiner, in Holland, Algeria and Switzerland respectively. He knows it to exist in the region of Washington on the roots of peas and sweet potatoes ; from the roots of citrus trees, Corfu, Greece ; from the roots of citrus trees, Valencia, Spain ; from the roots of citrus trees, Brazil ; from the roots of citrus trees, California ; and from the roots of iris from China. He considers, therefore, that it is a cosmopolitan species more or less injurious to plants, although never having had occasion to believe that it is a very serious pest.

That *Heterodera radicicola* (Greef) Mül is the cause of death of the sweet peas, Dr. Cobb is strongly inclined to believe. It is indeed well known in the West Indies and other parts of the world as one of the worst pests which the agriculturist encounters.

Experiments on the prevention of the nematode disease by using soil previously sterilized with boiling water have proved successful. This method is impracticable of course if the plants are grown in the earth under ordinary local conditions, but can be readily applied in the case of medium sized pots and tins which allow of efficient sterilization.

Tamarind (*Tamarindus indica*) An algal disease of the leaves of this tree has been noted during the year. It appears to be identical with *Cephaleuros Mycoidea*, Karst, which is described by Dr. Butler and which causes a serious disease of tea known as "red rust" in India. It does not seem to be a severe parasite of the tamarind, however, and practically disappears during the dry season, but is occasionally found causing the characteristic "red rust" spots on the leaves during the rainy months. No instance of cankered shoots caused by this disease has been observed.

SPECIAL INVESTIGATIONS OF THE LIFE HISTORY, ETC., OF PHYTALUS SMITHI (ARROW) UNDER BARBADOS CONDITIONS.

Among the insect pests attacking the subterranean portions of plants by feeding on their roots, *Phytalus smithi*, Arrow, is no doubt one of the most serious which the agriculturist has to combat. Not being limited to one or two hosts as is the case with some insects but attacking several crops and plants respresenting dissimilar botanical natural orders, this insect is liable to exert very great economic loss unless stern measures are adopted for its repression through an intimate knowledge of its life history and habits. The adult has been compared with specimens from Mauritius by Dr. G. A. K. Marshall, Director of the Imperial Bureau of Entomology, and he considers it to belong to the family *Melolonthidae* and to be identical with the species described from that island as *Phytalus smithi*, Arrow and commonly known as the brown hard-back.

CHARACTER OF INJURY TO SUGAR-CANE.

The ravages of many insects are apparent immediately, even to the untrained observer, but injury due to *Phytalus smithi*, Arrow is the more serious for the reason that the larvae are hidden beneath the soil and are not visible unless a careful search is made for them. In the case of the sugar cane the casual observer can detect no difference between attacked and unattacked fields in the early stages, but later on the stunted condition of the former becomes readily apparent. The presence of the root-feeding larvae is evident on digging up a few stunted stools, for these are found to be practically devoid of roots, or perhaps have only one or two stray ones which have escaped the notice of the very active larvae.

In is evident that such a serious destruction of the root system must occasion much loss not only in tonnage of cane but in pounds of manufactured sugar, etc. The problem becomes even more serious because of the insidious habits of the insect, since the average planter greatly underestimates the full amount of damage done. Only by a careful examination of attacked stools with a view of finding how many larvae are feeding on the roots can any definite idea of the full amount of injury be obtained.

ESTIMATE OF LOSSES.

In the report on *Phytalus smithi* and other beetles injurious to the sugar cane in Mauritius by Mr. D. d'Emmerez De Charmoy, that writer mentions an instance of a field of young virgin canes four months old which was utterly destroyed by this insect, while more advanced virgin canes as well as ratoons suffered to an equal extent when the infection was intense.

About ten years ago, although this insect was known to occur in this island it did not appear in such numbers as to be considered of any special economic importance. However, within the last five or six years their numbers have been steadily increasing, particularly in some localities until at present it is considered one of the most serious pests of the sugar cane in many infected areas.

In the Sugar Cane Report of the Barbados Department of Agriculture for the season 1917-19 an estimate was made therein as to the minimum loss per acre sustained at the Manurial Experiment Plots at Dodds through the ravages of *Phytalus smithi*, Arrow, and the root borer, *Diaprepes abbreviatus*, Linn. The number of larvae of *Phytalus smithi* found in the plots for that year was approximately one third the number of larvae of the root borer and one quarter of the total number of larvae of both insects. A fair estimate can be obtained of the loss then, if we assume that the grubs of *Phytalus smithi* caused one quarter of the total loss due to both insects.

It was pointed out in the report for 1917-19 that the minimum loss per acre at the Manurial Plots was 4·36 tons of cane. The loss due to *Phytalus smithi* then amounted to at least 1·09 tons of cane per acre. Assuming that one third of the total area planted to sugar cane in the island was attacked by *Phytalus smithi*, and to no greater extent than in the case of the Manurial Plots where systematic destruction of beetles and larvae is undertaken annually, then the loss from approximately 11,666 acres or one third of 35,000 acres amounted to 12,715 tons of sugar cane in 1919 having a value at the rate of $8·94 per ton, this being the price obtained for cane sold from the land of the Government Industrial Schools that year, of $113,681·04.

In the Sugar Cane Report of Barbados for this year 1918-20 a similar estimation of the losses due to the attacks of the root-borer and brown hard-back was made. The number of larvae of *Phytalus smithi* found in the same number of plots was only approximately five-eigths what they were for the previous year. Assuming that the total loss for this year was the same as for the previous year, then the loss due to *Phytalus smithi* is at least ·681 tons of cane per acre. The loss from 11,666 acres or one third of 35,000 acres amounts to 7,945 tons of sugar cane in 1920 having a value at the rate of $21·02 per ton, this being the price obtained for cane sold from the land of the Government Industrial Schools this year, of $167,003·00.

These figures are indeed the minimum loss for they are based on results obtained from the manurial plots where effort is made to destroy the beetles and larvae every year, and furthermore, all of these plots were attacked. Had there been unattacked check plots to compare with, it can readily be seen that the loss would have been very much higher. Then again no account is taken of the losses due to injury to corn and other crops and trees which must be considerable but rather difficult to estimate.

DISTRIBUTION.

Most authors who have studied the history of this genus *Phytalus* have considered it to be indigenous to that part of South America lying between Brazil and Mexico. Up to 1913, however, this species was only known to occur in Barbados and Mauritius, the introduction into that latter island, according to De Charmoy evidently having taken place either from South America or Barbados.

FOOD PLANTS.

The adult insect seldom does any appreciable damage to the foliage of leaves and is a light feeder. Almost every green foliage is acceptable although it seems to be particularly fond of the leaves of sugar cane, cassava and rose trees. The leaves of banana are often attacked quite seriously. During the period of maximum flight rose trees are often seriously defoliated.

The larvae are particularly fond of the roots of grasses of various kinds particularly sugar cane, Indian corn, imphee, etc., but if the above are not available they will feed readily on the roots of several kinds of legumes, palms, bananas and rose trees.

DESCRIPTION OF STAGES IN LIFE CYCLE.

The writer has used the descriptions given in De Charmoy's Report from Mauritius of 1912 following them through and making such additions etc. as he found necessary.

THE ADULT.

The adult beetle varies somewhat in size ; the largest observed being 17 mms in length by 8·5 mms in width, while the smallest observed was 13·5 mms by 6·5 mms and the average dimensions of twenty beetles were 15·7 mms by 7 8 mms.

The live insect is of a uniform reddish brown colour about the hue of mahogany. When killed by boiling water and then dried, no appreciable change in colour results. The dorsal surface of the thorax is found to be of a darker shade than the elytra and ventral surfaces of both the thorax and abdomen, the head being even darker than the dorsal surface of the thorax. It is uniform in length though widening slightly posteriorly. The elytra are rounded at their posterior extremity and do not cover the pygidium ; diverging slightly at their tip leaving a narrow angular space between when closed.

The head is rather broader than long and bears a transversal medium furrow. The anterior edge (clypeus) is notched in the middle and strongly recurved forming a concave space bordered by a slight protuberance situated before the transversal furrow ; the posterior part is convex and laterally indented at the base of the eyes. All these parts save the occipital one covered by the prothorax are deeply punctured by irregularly scattered subcircular depressions.

The antennae which project beyond the head are made up of nine joints ; the three last are flattened and of an ovoid hammer-shape, together forming a knob ; the first is as long as the next five together, small at the base it gradually becomes thicker and bears at the outer edge a row of rather long spines, these latter being somewhat shorter at the base than at the apex where they are longest ; the second joint is as long as the third and fourth, notched outerly at the base ; the third and fourth are subequal ; the fifth and sixth thicker ; the last three are hammer-shaped and as long as the fourth, fifth and six together, with ten short hairs at the outer edge and three to five apically.

The labrum (upper lip) is deeply indented forming two vertical conical lobes provided with long hairy spines. The maxillary palpi are four jointed and project beyond the forehead clypeus ; the first joint is small and subovate in shape ; the second is somewhat longer than the third, both being small at the base and becoming thicker apically, in which region four or five spines are borne, those of the third joint being nearly twice as long as those of the second ; the fourth joint is elongated, subconical and as long as the preceding two together.

The labium (inferior lip) is quadrangular and has in the middle of its anterior edge a lunular indentation ; the labial palpi are three jointed and are inserted under the labium ; the third joint is subconical and as long as the first two together. The second joint bears a few long spines apically.

The prothorax is broader than long with its lateral edges slightly angular, and bearing short hairs at intervals ; its posterior and anterior edges bear thin short golden hairs. The scutellum forms an enlarged curvilinear triangle.

The elytra are slightly narrowed at the base and widen gradually posteriorly, their lateral edges bearing a row of short hairs wide apart. The legs are long, slender and spiky ; the tarsi of the fore and middle legs are distinctly longer, while those of the hind legs are only slightly longer than the tibiae.

The tibia of the fore leg is flattened, indented outerly and bears at the supero-inner edge a long stout spine with a few short hairs disseminated along the middle line ; the five tarsal joints are of nearly equal length although the fifth is distinctly the longest, the first is more prickly than the others. The tibiae are slightly larger at the apex ; the two lateral edges are carinated, the outer one with two and the inner one with three short distant spines, under each of which one long hair protrudes, the inferior inner part is bordered with a row of alternating long and short hairs.

The theca of the male genitalia is cupuliform and closed ventrally.

The apices of the tibiae bear on their inner portion two long conical flattened spines reaching to the first half of the second tarsal joint and a row of short conical hairs around the edge. The tarsi are longer than the tibiae, their joints being nearly equal, the last one however, being the longest ; all the joints are hairy underneath and bear a row of rather long hairs at their apices. The tarsal claws are bidentated and of equal length ; the first tooth is narrower at the base and longer than the second which is situated a little before the superior half of the former. The pygidium bears a row of short hairs along its marginal edge and the majority of the minute punctures with which it is beset bear each a single delicate decumbent hair having its origin in the centre of the puncture. All the body is minutely punctured. The puncturations are slightly larger on the head and are not so close together on the elytra and abdominal segments as in this region.

The pro, meso and metasternum are covered with a short yellowish pubescence which is longer and coarser on the mesosternum. The posterior edge of the under surface of the prothorax is densely beset with thin short golden hairs.

THE EGG.

The eggs are white and elliptical in shape. Under normal damp soil conditions they are laid singly in elliptical earthen cells approximately 2·8x2·3 mms. and at a depth of about 5 inches, varying according to the depth at which normal damp conditions in the soil occur. In dry soil they are found somewhat deeper than under normal conditions of moisture but without an earthen cell for protection ; under which conditions they have never been observed by the writer to hatch. They are on the average 2x1·5 mms. when first laid but they gradually swell under normal damp conditions and become more spherical by about the seventh day at which time they measure on the average 2·5x2·1 mms. approximately.

THE LARVA.

The full grown larva measures 30 mms. long and 8 mms. broad at the thorax and five of the intermediary abdominal segments. The head measures 4·5 mms. across. It is white with the head and antennae of a yellowish brown colour ; the legs are faintly yellowish in colour particularly towards their tips ; the anal segment is blackish ; during the pre-nymphal stage it is of a creamy colour and the anal segment then contracted is of the general colour. It is strongly curved but straightens easily when in progression ; the thoracic segments are three in number and the abdominal ones nine. The seven anterior abdominal segments are covered dorsally with numerous spiny hairs which are represented on the other segments by longer and scattered ones.

The anal aperture is transverse and consists of an upper and a lower lip, the inferior of which bears numerous short, very dark brown spines while the superior one has spiny hairs yellowish brown in colour, longer but less numerous. There exist on the lateral preceding segment two tufts of long yellowish brown hairs, the same segment showing at its dorsal part hairs of the same shape and colour but more scattered.

There are nine pairs of stigmata, the first one is situated on the lateral part of the prothorax, the others on the abdominal segments in the shape of a horse-shoe, quite horny and of a yellowish brown colour. There exist on the dorso-lateral part of the prothorax, anteriorly, a pair of yellow obtuse-triangular spots.

The legs are short, the posterior being the longest ; the coxa of the hind leg is as long as the trochanter, the femur and the tibia together ; the one of the intermediary legs is a little longer than the trochanter and the femur together, the one of the foreleg a little shorter.

The tarsi are represented by a terminal conical sharp joint, the femurs and tibiae are covered with strong spiny hairs more numerous and coarser on the inner part. The posterior legs are about 6 mms. in length.

The head is of a bright yellowish brown colour, and is rounded posteriorly ; the antero lateral sides are oblique for joining the anterior edge which is united with the epistoma. On the marginal edge there is a row of 7 to 9 spines and a few others rare and scattered on the cephalic disc. Under the first antennal joint there are 6 or 8 spines of unequal length. The epistoma is twice as long as it is broad, its anterior edge slightly rounded, the anterior half inclined downwards and bears four long silky hairs. The superior lip is fleshy and is covered with numerous strong spines, those situated underneath are more numerous, shorter and thicker ; the anterior part is obtuse-triangular and the posterior strongly oblique. The mandibles are crooked ; very broad at their base they become thinner at their apex and are not provided with teeth ; they are black at their apex and yellowish brown at their base. On the dorsal part are two longitudinal ridges, leaving between them and the marginal edge two corresponding elongated furrows, under the external ridge is a row of 6 or 7 long hairs.

The antennæ are long and slender and project slightly beyond the extremity of the mandibles; they are composed of four articulated joints and a basal short conical one blended with the supero anterior edge of the head.

The second joint is a little longer than the last one, the third the longest of all and as long as the last two together ; the fourth one is longer than the second, its apex is obliquely cut and forms an external expansion ; the fifth is subconical and about the half of the fourth one. The inferior lip (labium) is transverse and bears two slender palpi of two joints; the first joint is somewhat stouter than the second and they are subequal in length. The maxillae are bent, pediform with rounded joints, the basal joint is cylindrical, the terminal one having strong spines on its inner portion, those at the base being thinner

and yellowish brown in colour while those borne apically are blackish and rather stout. The palpi are four jointed, the basal is cylindrical and as long as broad bearing two spines outerly from the middle of the joint which are equal in length to that of the joint itself; the second is longest, the third not as long as the fourth, the fourth being fusiform and not as thick as the third and second and bears a single spine at its external part.

THE PUPA.

The pupa is white in colour and irregular in shape when first formed but in a day or two it assumes a yellowish brown colour and its natural shape. It is somewhat variable in size, the largest observed being 20 mms. long by 8 mms. wide, while the smallest observed was 17 mms. long by 6·5 mms. and the average dimensions of thirteen pupæ selected at random was 18·2mms. by 7·5mms. The head was found to vary in breadth from 3·5 mms. to 4·0 mms. the average of thirteen being 3·8 mms. It is enclosed in an elliptical earthen cell measuring about 20 mms. in length. The elytra are shorter than the membraneous wing case. There are five abdominal segments which are prominent, rounded and protruding, the anterior three bearing each a pair of stigmata laterally, these latter not being horse-shoe shaped as in the larva, but spherical and of a yellowish brown colour. The terminal segment in acute-triangular and forms an oblique angle with the preceding ones and is strongly recurved at its end which is bifid, having the processes diverging from one another at the apex. The characteristics of the ventral surface of the terminal segment are such as to easily distinguish the sex of the adult to be. The male pupa bears under the terminal segment a small elevation which terminates in a distinct rounded, tubercular nodule, while in the case of the female this elevation is flattened and no such nodule exists.

INSECTARY METHODS.

Experiments with the brown hard-back were conducted at the office of the Department of Agriculture at Queen's Park, Bridgetown. Practically the same methods were adopted as the writer had successfully used during the period he had assisted in the working out of the life history of certain species of Lachnosterna at the Insectary of the Dominion Entomological Laboratory at Ottawa, Canada. The writer is much indebted to Dr. Gordon C. Hewitt, the late Dominion Entomologist of Canada, and Mr. Arthur Gibson, the Assistant Dominion Entomologist for the experience gained in experiments of this nature, and under whose direction similar work was carried out.

Five-inch flower pots with large arc light glass chimneys to fit and covered at the top with mosquito net were used for the adults. These pots were filled with rich loamy soil and the adults supplied with fresh cassava leaves, with their petioles immersed in water, for their food.

In the determination of the number of eggs which a single female could lay, the males and females were caught in copula and a single pair introduced into each cage. In case the male died prematurely a fresh one was supplied immediately. The soil was kept moist by placing the pot in a saucer about one inch deep in which a little water was introduced daily or as required and by lightly watering the surface of the soil. The females readily laid eggs in the damp soil which was emptied out and searched carefully for eggs every four or five days. A range of these cages was placed on a table about four feet high and the feet of the latter kept immersed in jars of water with a layer of kerosene oil on the surface.

In the determination of the egg stage about twenty to thirty beetles caught haphazardly were placed in two seven-inch pots rigged out as above and fed on cassava leaves. These pots were examined daily and the eggs laid placed in four or five-inch petri dishes which were filled with rich loamy damp soil and artificial cells made of about five mms. diameter to contain a single egg each. The covers were replaced on the petri dishes which were then kept covered so that no light could reach the eggs. The examination of the eggs was very easy, each being visible through the petri dish cover in its respective cell. This same method of placing eggs in petri dishes was used in the hatching of all eggs for the determination of the larval stage, etc.

The methods used in rearing larvae consisted in some cases in the use of flower pots about five inches in diameter filled with rich loamy soil, the grubs feeding on the roots of corn which was planted in the pots. The objections to the use of the pots was that the earth had to be dumped in order to view the grubs, which meant disturbance and often injury to them. Futhermore, it was useless to try to raise more than two or three grubs in each pot for the grubs readily destroyed each other at all stages by reason of their carnivorous habits, and thus the method meant considerable space for the handling of a large number of pots which required constant attention to keep the soil moist and in a natural condition physically. By far the most convenient method was found in the use of two-inch, round, seamless tin boxes about an inch deep. One grub was kept in each box. These boxes were conveniently kept in piles and tiers and were opened and the contents examined regularly at intervals of several days to a week or more. Pupae were examined every day. Water was never added to the soil in the boxes as this invariably caused excess moisture and often the death of the grubs, but instead fresh sifted soil of the right dampness was used to replace that in boxes when the latter became dry or sour.

Food was supplied by adding a kernel of corn to each box. As soon as a kernel was consumed a fresh one was added. When more than one kernel was added at a time a species of mite, determined at the Imperial Bureau of Entomology as *Tyroglyphus* sp. nearly always appeared in great numbers and appeared to feed on the corn, but would eventually attack the grub and cause it to sicken, finally resulting in its death unless the mites were carefully brushed off with a delicate camel's hair brush and fresh earth supplied. In the absence of corn, grains of imphee (*Andropogon sorghum saccharatus*) may be fed, the grub readily eating the delicate sprouts. No instance of attack by mites has been observed when this latter

grain was used although many grains were supplied at a time, and the writer regards it as the safest food to supply if mites are too persistent when corn is used.

Examination of grubs in tins is effected with practically no chance of injury. Quite often when the cover is removed a portion of the grub's tunnel is visible and the advent of light causes the grub to rush towards the closed extremity of the tunnel below the soil. By carefully uncovering the top earth with a knife blade or flat piece of stick the bottom of the grub's tunnel is easily reached and the grub viewed without any difficulty.

On placing a grub in a tin the latter is filled up to the top with sifted moist soil not being packed in by pressure but allowed to remain loose With a finger a pit is compressed in the soil into which the grub is placed and the cover replaced. It is not advisable to cover the grub with soil.

Other workers on the life history of similar grubs have shown that there was no difference in the time of emergence between adults from grubs in tin boxes and adults from grubs out-doors, provided grubs escaped the attack of mites, fungus or bacterial disease. In this case the time required for grubs to emerge which were confined in tin boxes tallied very closely with the time required for grubs bred in flower pots, showing that soil and other conditions in the smaller tin boxes did not cause abnormality in the time of emergence.

In addition to rearing grubs in pots and tins some were also carried through the larval stage in specially constructed cages having glass sides so that the activities of the larvae could be closely studied. Essentially these cages consisted of a frame made of wood which supported two panes of glass in a vertical position and situated parallel to each other at a distance of about an inch apart. At the bottom of this cage holes were bored to allow for drainage and a layer of small stones was first filled in to the depth of about an inch and one half before filling up the rest with good rich loamy soil previously sifted. The total depth of soil amounted to about twelve inches. On the outside of the panes of glass there were sliding shutters made of wood and working vertically. The tops of the shutters were fitted with horizontal pieces like the top of a "T" in cross section and running the whole length of the glass so as to keep out light from above while the sliding portion kept out light from the sides. The length of the cages was for the most part about fourteen inches. Grains of corn were planted in them and they were watered regularly. By lifting the shutter on one side or the other the grub could be seen in its cell quite readily and photographs made. The rate at which roots were devoured could also be studied, etc.

Temperature apparatus used in the experiments was a recording thermograph.

LIFE HISTORY.

ADULT.

ISSUING AND EMERGENCE.

Immediately on issuing the adult has only the legs, head and thorax brown, the elytra being milky white and soft and the wings extended their full length beneath the elytra and projecting posteriorly. In a few hours the beetle turns tawny yellow in colour until after about twenty-four hours it has turned light reddish brown. In two days the beetle has attained a uniform reddish brown mahogany colour.

The adult remains in its pupal cell for a period known as the pre-emergence period during which time the chitinous parts of the beetle gradually become perfectly hard. In determining the duration of this period as soon as pupae which were kept in tins had hatched and assumed their normal colour in a couple of days they were either put into pots and covered over with soil, having first been placed in an artificially constructed cell of earth or placed in one of the sliding observation cages in an artificial earthen cell as before. By examining the surface of the soil in the pots every day for the emergence hole always left by the adult or by direct examination of the sliding observation cages the exact date of emergence could be determined.

Table I. below shows the results of the experiment carried out to determine the length of this pre-emergence period.

TABLE I.—SHOWING DURATION OF PRE-EMERGENCE PERIOD OF ADULT PHYTALUS SMITHI.

Expt. No.	Date beetles hatched.	Date of emergence.	Pre-emergence period in days.
9-24	April 7	May 24	47
10-1	April 11	April 26	15
11-1	April 16	May 2	16
16-2	May 5	May 25	20
Cd-1	May 9	June 1	22
44-2	May 13	June 13	31
12-1	May 20	June 24	35
43-1	May 24	June 20	27

From the above table it is seen that the average pre-emergence period for eight observations is twenty-seven days with a minimum period of fifteen and a maximum of forty-seven days.

PROTECTIVE HABITS.

Considering the number of adult beetles which emerge yearly very few are ever caught in lighted houses, and apparently these lights have no attraction for them. The adults begin to fly shortly after dusk and lie buried during the day underground at a depth of about two to four inches during the pre-reproductive period and much deeper or about five to eight inches depending on the dampness of the soil, during the reproductive period. If the soil is dry towards the upper layer the beetles will be found to burrow deeper for the deposition of eggs They do not fly very long but soon alight on the nearest shrub to feed or copulate. Copulation may take place on the surface of the ground before flight also. When feeding they hardly move for hours but remain clinging to the leaf, cutting semicircular pieces therefrom. Before daybreak they return to their underground shelter and are never seen by day. If unearthed from the soil during the day they quickly commence burrowing in the soil for shelter. If a bright light is flashed on them while they are engaged in feeding, they remain motionless, but if the branch or leaf on which they are clinging is disturbed even lightly, they readily fall to the earth and may be lost in the undergrowth.

The eggs, larvae and pupae pass their respective stages several inches below the surface of the soil and thus are safe from birds and most predaceous insects.

FERTILIZATION.

The mating of the adults occurs shortly after dusk and may take place either on the surface of the soil or on the foliage on which the beetles alight. They may remain in copula for about an hour if undisturbed, clinging end to end, the male remaining at right angles to her body with his abdomen facing her back. He does not cling to his mate at all but remains almost motionless with his feet dangling free throughout the entire period. If present on a shrub in copula the female will feed quite normally during the entire period of copulation, but the male never feeds during that period.

Table No. II below shows the results of observations under experimental conditions to show the length of the period of copulation. On August 20th, the observations were made and it is seen that from 5 records the average duration is 44 mins. while the maximum is 55 and the minimum 35 mins. Under out-door conditions beetles may be found in copula even between 8 and 9 o'clock, copulation evidently having started later than when confined in a small cage where pairing is sooner accomplished.

TABLE II—SHOWING THE DURATION OF THE PERIOD OF COPULATION OF PHYTALUS SMITHI.

Expt. No.	Time copulation started.	Time copulation ceased.	Period of copulation in minutes.
1	6.40	7.15	35
2	6.45	7.25	40
3	6.45	7.30	45
4	6.45	7.32	47
5	6.50	7.45	55

OVIPOSITION.

Experiments to determine the pre-oviposition period were successfully conducted at the laboratory. A complete record was kept of all pupae with regard to the sex of the adult to be, so that when these latter emerged they could be mated without having to perform a close examination which might result in serious injury. Table III shows the results of the experiments with beetles bred experimently from eggs.

TABLE III—SHOWING THE DURATION OF THE PRE-OVIPOSITION PERIOD OF PHYTALUS SMITHI.

*Expt. No.	Date female emerged.	Date first egg laid.	Pre-oviposition period in days.
13–2 / 9–18	June 19th, 1920.	August 14th, 1920.	56
13–1 / 16–1	June 3rd, 1920.	Died Sep. 2nd, 1920.	No mature eggs yet in abdomen after ninety-one days.
Unknown. / 9–28	July 7th, 1920.	September 9th 1920.	64

*The numbers above line denote males and those below females.

From the above it is seen that the average pre-oviposition period from two

observations is sixty days while the maximum is sixty-four and the minimum is fifty-six days.

The actual period of oviposition is given in Table XI and is seen to vary from twenty-two to 115 days and to have an average duration of sixty-one days.

EGG.

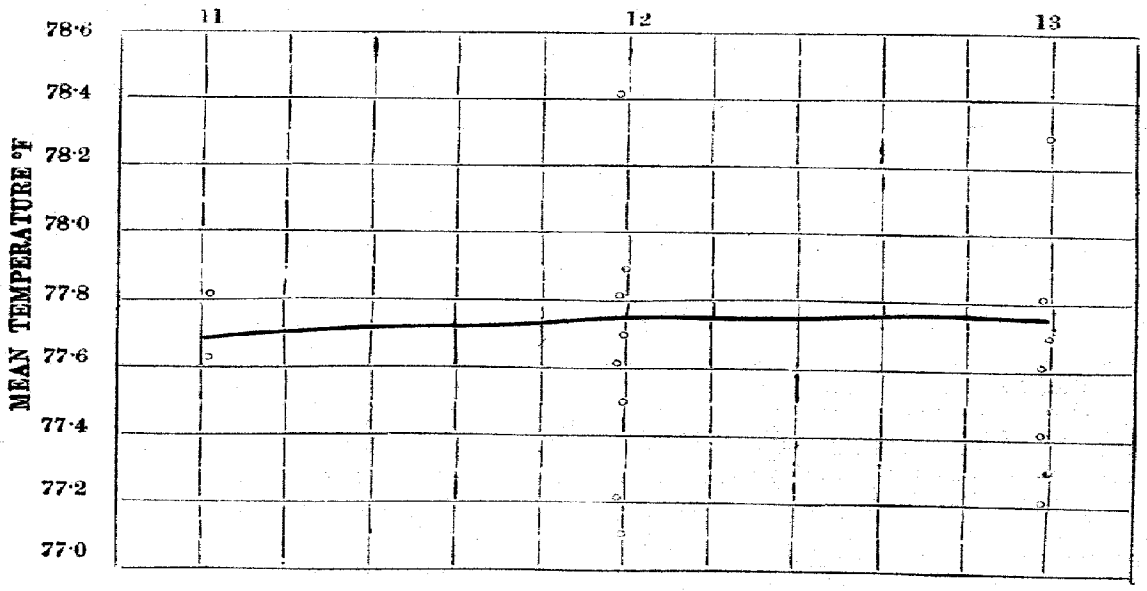
DURATION OF EGG STAGE.

The duration of the egg stage has been found to vary from eleven to thirteen days and to be practically independent of the temperature under our conditions as shown in figure 1. The average of 215 eggs was 12·8 days. The average length of the egg stage at the prevailing temperatures is shown in Table IV below.

TABLE IV.—RELATIONSHIP OF MEAN TEMPERATURE TO THE DEVELOPMENTAL PERIOD OF PHYTALUS SMITHI IN THE EGG STAGE.

Period in days.	Maximum Mean Temperature °F.	Minimum Mean Temperature °F.	Average Mean Temperature °F	No. of Records.
11	77·8	77·6	77·7	2
12	78·4	77·1	77·6	42
13	78·3	77·2	77·6	171

FIGURE 1.—DIAGRAM SHOWING RELATIONSHIP OF MEAN TEMPERATURE TO LENGTH OF EGG STAGE OF PHYTALUS SMITHI, AND INDICATING LINE OF CALCULATED MEANS. THE DOTS REPRESENT PERIOD MEANS OF INDIVIDUALS.



DEVELOPMENT.

When the eggs are first deposited in their cells they are somewhat eliptical in shape but as they absorb moisture and swell they become more spherical. Table V given below shows the rate of development and the approximate time required for them to reach their maximum size.

TABLE V.—SHOWING RATE OF DEVELOPMENT AND THE APPROXIMATE TIME REQUIRED FOR THE EGGS OF PHYTALUS SMITHI TO REACH THEIR MAXIMUM SIZE.

Day.	Average length in mms.	Average breadth in mms.	No. of eggs from which average taken.
First.	2·00 mms.	1·45 mms.	10
Third.	2·11 mms.	1·64 mms.	10
Fifth.	2·47 mms.	2·06 mms.	10
Seventh	2·45 mms.	2·07 mms.	10

As soon as they have reached their maximum size on about the fifth day certain changes are observed in the appearance of their contents. The homogeneous opaque appearance gradually gives rise to one of heterogeneity as certain areas become denser and others more transparent during the embryonic development. Finally about the tenth day the distinct form of the larva curled up within the egg shell can be seen, the remaining space being filled with a watery and almost transparent fluid. At this stage the mandibles of the embryo are plainly visible and are yellowish brown in colour. On exposure to ordinary daylight the embryo can be seen to move slightly within its shell. In two days time or about the twelfth day, the body spines become yellowish brown and are plainly visible through the shell. Not many hours after this the egg will hatch.

HATCHING.

Hatching may occur at any time during the night or day. A record was kept of the percentage of eggs which hatched from fertilized females under laboratory conditions and observations showed that from a total of 245 eggs only thirty failed to hatch. Thus approximately 88 per cent. hatched in spite of the handling to which they were subjected. In many cases a 100 per cent. hatch occurred however.

LARVA.

FOOD HABITS.

The larvae immediately upon hatching are found with their egg-shell adhering either near the tip of the abdomen or about the middle of the dorsal side of the same. In some cases it is found adhering to the head while vigorous efforts are applied with feet and abdomen in an endeavour to remove it as soon as possible. Shortly after the shell has been freed from the larva and as soon as the head and mandibles have hardened somewhat the larva devours the shrivelled shell completely. It is evident that the larva feeds on some decayed organic matter during the first few days, for the anal pouch is observed to fill out somewhat and darken when freshly hatched larvae are placed in rich soil devoid of living or partly decayed roots. In about fifteen days after hatching grubs placed in tins with germinating grains of corn have been observed to eat root hairs quite readily and in the section cage the adventitious roots of sugar-cane were observed to be eaten by a larva only thirty-eight days old. Freshly hatched grubs kept in rich humus soil seldom lived more than three weeks unless given food such as the roots of germinating corn, etc. When fifty days old a grub was seen to clear away the soil from around the root of a sugar-cane plant and then cut off a piece about 4 mms long, and by holding it between its fore-legs proceed to grind the end between its mandibles, pushing it into the mouth all the time. Larvae have been observed to cut off adventitious roots near the suface of the soil and then follow them down into the soil devouring them until the tip was reached. The opposite procedure of devouring adventitious roots from the tip towards the surface has also been observed. During the process of moving from place to place in the soil larvae exist in a somewhat oval cell. They do not leave an open tunnel behind them, but soil removed from the end of the cell in the direction of their travel is packed at the opposite end.

CANNIBALISM.

Larvae confined in cages are cannibalistic at all stages and especially during the smaller stages. In experiments in which eighteen or more newly hatched larvae were left together in six-inch pots planted to Indian corn, only about four or five were found in each after about two weeks. In no instance was it possible to rear more than two or three grubs in a six-inch pot although they were all of the same age. Smaller larvae are usually eaten by larger ones if larvae of different stages are confined together, but full grown ones commonly attack each other.

GROWTH.

The rate of growth is dependent upon many external conditions, the kind and quantity of food being, no doubt, the most important factors in this climate. Larvae feeding under similar conditions show a great variation in the rate of development as may be seen from Table VI.

TABLE VI.—SHOWING THE RATE OF DEVELOPMENT IN LENGTH OF DIFFERENT LARVAE UNDER SIMILAR CONDITIONS.

Age in days.	Average length in millimetres.	Maximum length in millimetres.	Minimum length in millimetres.	No. of observations.
4	7·2	8·0	7·0	5
57	14·6	17·0	12·0	5
93	18·2	20·0	16·0	5
162	27·5	28·0	27·0	2
166	29·3	30·0	28·0	3
179	30·0	30·0	30·0	3

Under favourable conditions the average rate of increase in bodily length calculated from the above table is about ·13 mms. per day. When hatched larvae are from 7 to 8 mms. long and when fully grown about 30 mms.

DURATION OF LARVAL PERIOD.

The larval period is very variable as it is this stage which is prolonged by adverse conditions or lack of food, etc. Table VII shows the duration of the larval stage from observations of twenty larvae bred through to the pre-pupal stage.

TABLE VII—SHOWING DURATION OF LARVAL AND PRE-PUPAL STAGES OF PHYTALUS SMITHI.

Expt. No.	Date egg hatched.	Date of first sign of contraction of anal pouch and preparation of cell.	Larval stage in days.	Date of pupation.	Prepupal stage in days.
10-1	July 18th 1919.	Feb. 16th 1920.	213	Mar. 23rd 1920.	36
10-2	July 18th 1919.	Mar. 20th 1920.	246	Apr. 14th 1920.	25
11-1	July 19th 1919.	Mar. 4th 1920.	229	Mar. 30th 1920.	26
C -2	July 22nd 1919.	Feb. 16th 1920.	209	Apr. 14th 1920.	58
16-1	July 22nd 1919.	Mar. 23rd 1920.	245	Apr. 20th 1920.	28
16-2	July 22nd 1919.	Mar. 23rd 1920.	245	Apr. 19th 1920.	27
12-1	July 22nd 1919.	Mar. 23rd 1920.	245	May 2nd 1920.	40
13-1	July 23rd 1919.	Apr. 12th 1920.	264	May 6th 1920.	24
13-2	July 23rd 1919.	Apr. 12th 1920.	264	May 3rd 1920.	21
31-1	Aug. 18th 1919.	Mar. 23rd 1920.	218	Injured & died.	...
38-1	Aug. 29th 1919.	May 1st 1920.	246	May 30th 1920.	29
43-1	Sept. 9th 1919.	Mar. 24th 1920.	197	May 6th 1920.	43
44-1	Sept. 9th 1919.	Apr. 12th 1920.	216	May 15th 1920.	33
44-2	Sept. 9th. 1919.	Apr. 1st 1920.	205	Apr. 27th 1920.	26
9-24	Sept. 16th 1919.	Feb. 27th 1920.	164	Mar. 22nd 1920.	24
9-18	Sept. 16th 1919.	Apr. 1st 1920.	198	May 5th 1920.	34
9-28	Sept. 16th 1919.	May 1st 1920.	228	May 24th 1920.	23
9-20	Sept. 16th 1919.	May 20th 1920.	247	Injured & died.	...
52-1	Sept. 24th 1919.	May 22nd 1920.	241	June 13th 1920	22
51-1	Sept. 27th 1919.	Apr. 28th 1920.	214	May 29th 1920.	31

From the above table it is seen that the average duration of the larval period taken from twenty observations is 227 days, while the maximum duration is 264 days and the minimum 164 days.

RESISTANCE TO LACK OF FOOD.

Larvae which have reached their maximum size, but which would, under normal conditions of food supply continue to feed for a month or two longer have considerable resistance to the absence of food. An experiment was conducted on a small scale to demonstrate this resistant property and the results are shown in Table VIII.

TABLE VIII.—SHOWING RESISTANCE TO LACK OF FOOD BY FULL GROWN LARVAE OF PHYTALUS SMITHI.

Expt.	Date at which full grown larva put into box with soil but without food.	Date of death.	Length of existence in days without food.
49—1	May 20, 1920	Aug. 4	76
9—36	May 20, 1920	Aug. 4	76
49—2	Apr. 28, 1920	Aug. 22	116
49—3	Apr. 28, 1820	Sep. 1	126

From the above table it is seen that full grown larvae may live for ninety-eight days without food on the average, while a maximum of 126 days or a minimum of seventy-six days may be spent by these larvae without any food.

PUPAL CELLS.

As soon as larvae have ceased to feed, they construct a pupal cell before pupation. The depth at which this cell is constructed depends on the depth at which the soil is reasonably moist and under normal conditions is not less than 6¾ inches below the surface. In this cell which measures about 22 mms. long and is elliptical in shape the prepupal, pupal and pre-emergence stages are passed. The cell is made of agglutinated earth, the inside of which is smooth.

PREPUPA.

As the pupal cell nears completion the larva merges into the prepupa. During the prepupal stage the body contracts longitudinally and the contents of the anal pouch are expelled. The average length of the prepupa from observations just before pupation is 22 mms. with a maximum of 23 mms. and a minimum of 21·5 mms. The prepupa is sluggish and inactive and just before pupation it lies on its back, its legs being motionless until the transformation to the pupa takes place.

DURATION OF PREPUPAL STAGE.

This has been found to be very variable as is seen from Table VII. From eighteen observations the average duration was thirty-one days while the maximum was fifty-eight days and the minimum twenty-one days.

PUPATION.

After lying on its back for about three days with its legs quite motionless the larval skin is cast and the pupa is revealed.

PUPA.

When the pupa is first formed it is white in colour and irregular in shape but in a day or two it assumes its natural shape and a yellowish brown colour. At this stage, the sheaths of the elytra, legs and mouth parts, as well as the spiracles of the second, third and fourth abdominal segments are light brown in colour. The cast skin remains attached to the last segment of the pupa by two separate whitish cords which may eventually become twisted together into a single strand but which are attached separately to the cast skin internally on either side of the thoracic cavity. About six days subsequent to the formation of the pupa the region of the eyes is found to be quite dark in colour. Towards the thirteenth day the sheaths of the elytra, legs and mouth parts become more transparent and the outlines of these parts are clearly visible beneath. On the day before hatching occurs the tarsal claws can be observed to exhibit a flapping motion occasionally on exposure to daylight, as the two halves open to the limit of the enclosing sheath and then close up again tightly.

ACTIVITY.

The pupa is quite active when disturbed or on exposure to daylight. It thrashes about with its abdomen exhibiting a rolling squirming motion.

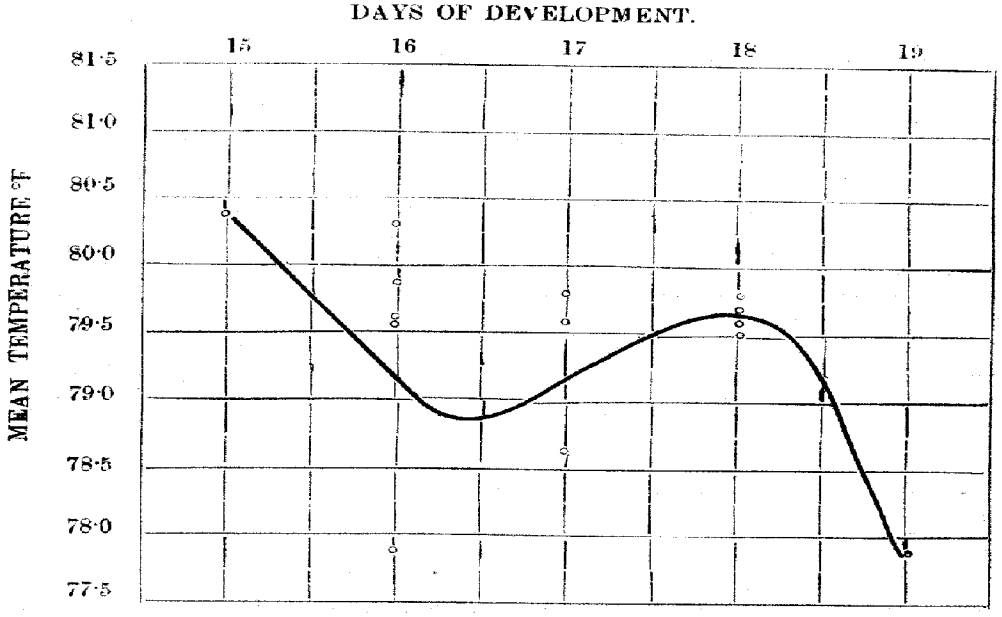
DURATION OF PUPAL PERIOD.

The duration of the pupal period has been found to vary from fifteen to nineteen days as shown in Table IX, and to be influenced to some extent by the temperature under our conditions as shown in figure II. The average of seventeen pupae was found to be 16·8 days.

TABLE IX.—SHOWING RELATIONSHIP OF MEAN TEMPERATURE TO THE DEVELOPMENTAL PERIOD IN THE PUPAL STAGE OF PHYTALUS SMITHI.

Period in days.	Maximum Mean Temperature, °F.	Minimum Mean Temperature, °F.	Average Mean Temperature, °F.	No. of records.
15	80·4	80·4	80·4	2
16	80·8	77·9	79·6	6
17	79·8	78·6	79·5	4
18	79·8	79·5	79·7	4
19	77·9	77·9	77·9	1

FIGURE II.—DIAGRAM SHOWING RELATIONSHIP OF MEAN TEMPERATURE TO LENGTH OF PUPAL PERIOD OF PHYTALUS SMITHI AND INDICATING LINE OF CALCULATED MEANS. THE DOTS REPRESENT PERIOD MEANS OF INDIVIDUALS.



DURATION OF THE LIFE CYCLE.

The length of the life cycle varies considerably due mainly to the great variation in the larval stage. Table X below gives a summary of the life cycle and the average is seen to be 452 days while the maximum is 618 and the minimum 308 days.

TABLE X.—SHOWING THE AVERAGE, MAXIMUM AND MINIMUM DURATION OF THE LIFE CYCLE OF PHYTALUS SMITHI.

Stage.	Period in Days.			No. of records.
	Maximum.	Minimum.	Average.	
Egg incubation	13	11	13	215
Larva (active).	264	164	227	20
Pre-pupa.	58	21	31	18
Pupa.	19	15	17	17
Adult. Pre-emergence. ...	47	15	27	8
Adult. Pre-oviposition. ...	64	56	60	2
Adult. Reproductive period. ...	115	22	61	6
Adult. Post-reproductive period.	38	4	16	7
Total. ...	618	308	452	

SEASONAL ABUNDANCE.

Inasmuch as the life cycle may vary from 308 to 618 days it is evident that there must occur a very great overlapping of broods and to such an extent as to distribute the emergence of adults throughout the entire year. The maximum period of emergence under our conditions is between the months of May and June usually, but there is a considerable emergence of beetles from May to January, from which month there is usually a gradual diminution in their numbers up to the end of February.

POSSIBLE ANNUAL PROGENY OF ONE PAIR.

Because of the great possibilities of reproduction the brown hard-back is able to inflict enormous damage unless control is effected either naturally or artificially. Table XI shows the results of the experiment conducted with a view of finding out the reproductive possibilities of this beetle.

TABLE XI—SHOWING THE OVIPOSITION PERIOD, REPRODUCTIVE POSSIBILITIES AND AVERAGE DAILY REPRODUCTION OF PHYTALUS SMITHI.

Expt. No.	Date laying started.	Date laying ceased.	Oviposition period in days.	Total No. of eggs laid.	Av. rate of reproduction per day.
2	July 4th.	Oct. 27th.	115	210	1·8
4	„ 7th.	Sept. 13th.	68	137	2·0
8	„ 5th	July 30th.	25	21	0·8
9	„ 9th.	Oct. 2nd.	85	190	2·2
10	„ 15th.	Aug. 6th.	22	22	1·0
11	„ 16th.	Sept. 5th.	51	69	1·4
12	„ 23rd.	Aug. 5th.	13 (escaped)	25	1·9

From the above table it is seen that the average number of eggs produced by six beetles was 108 while the maximum was 210 and the minimum twenty-one. These beetles were caught in copula in the field, however, and it is not known whether laying had started before this, so that the experiment can only give a moderately accurate idea as to the possible, rather than the actual, reproduction ; which is no doubt much greater.

The maximum average rate of reproduction from seven observations is seen to be 2·2 and the minimum average 0·8 eggs per day, while the mean average is 1·6 eggs per day.

NATURAL CONTROL.

CLIMATIC CONTROL.

EFFECT OF RAINFALL AND MOISTURE.

No special experiments have been conducted in the field to determine definitely the effect of rainfall on the prevalence of this insect although laboratory experiments have thrown some light on the subject. Furthermore, although the rainfall at Dodds Experiment Station for the past four years has been steadily decreasing, yet the beetles continue to be on the increase in that locality.

An experiment was conducted, using two cages, one containing damp soil and the other air-dried soil. Into each cage about thirty beetles caught at random were introduced and the soil examined every day, the beetles being fed with cassava leaves.

The pot containing the damp soil was found to contain about twenty to thirty eggs daily, while the pot with the dry soil rarely contained more than two or three.

It was found also that eggs which were kept in dry soil shrivelled up and failed to hatch.

Thus we may conclude that under very dry conditions these beetles very seldom lay their eggs and even when they do these will perish. Under field conditions, however, the beetles may overcome this condition of temporary drought to some extent by burrowing deeper into the soil and depositing their eggs under more favourable humid conditions.

A similar experiment to the one mentioned above was conducted, using excessively wet soil instead of air-dried soil and as with excessively dry soil so with excessively wet soil, the beetles refused to lay their eggs. The eggs having been laid under normal damp conditions are not affected by flooding the soil, however, since the egg cell affords ample protection.

EFFECT OF IRRIGATION.

As stated above beetles do not lay their eggs readily in dry soil. It stands to reason, therefore, that having dry and moderately damp soil to select from the beetles will be attracted toward the latter. This would not necessarily result in a higher infection in irrigated fields, however, since the beneficial effect of the green muscardine fungus,

occasioned by the improved humid conditions, would no doubt be considerable. Extended experiments will have to be undertaken before any definite conclusion as to the effect of irrigation can be arrived at.

FUNGUS DISEASE.

Larvae and adults are occasionally found to be infected with the green muscardine fungus, *Metarrhizium anisopliae*, Sorokin, but it did not appear to have been common during the past year. Only one instance of its occurrence in the case of a larva was observed under laboratory conditions by the writer. Where moisture conditions are favourable no doubt this fungus would do much to keep the pest in check.

BACTERIAL DISEASE.

During the studies of the life history, whenever larvae died prematurely under experimental conditions, this not being due to injury through handling, they were dissected and examined carefully with a view of discovering some bacterial disease which may prove useful in future control.

In every case when dissection was made not only were smears made direct from the larvae and stained, but streak cultures were also attempted with a view of cultivating the organism present. The medium used was prepared by making an infusion of the larvae of *Phytalus smithi* in water by boiling for about an hour and then adding 1·5 per cent. agar as a solidifying agent. The medium was then titrated and adjusted to +6° Fuller's Scale before use.

On more than one occasion when grubs died prematurely, before putrefaction set in, smears were made of the watery contents and stained with methylene blue. In every instance the same organism was present in the smear in great abundance and the writer suspected it as being the causal organism of death. Streak cultures on the medium mentioned above proved positive, the growth at room temperature being white to yellowish white and glistening in appearance. Smears made from the cultures showed the same organism as was found in the smear direct from the grub to be present in almost pure culture.

Description of the Organism.

When stained with methylene blue the organism resembles very much the bacterium of plague, viz: *Bacterium pestis*. They vary from 1·6 microns to 2·7 microns long by 0·7 to 1·0 microns wide with rounded ends, occurring singly or in pairs. No spores formed. Non-motile in hanging drop. It stains readily with methylene blue and carbolfuchsine, particularly at the poles which usually show deeply stained granules resembling nuclei.

Experiments with the Bacterial Organism Associated with Diseased Larvae.

Extended experiments have not yet been conducted with pure cultures to prove without doubt the parasitism of the organism but those which have been tried so far, seem to indicate that it is parasitic under certain conditions. In all, five larvae have been inoculated, three with a suspension of an almost pure culture, and two with the watery contents of dead larvae having the organism present in abundance as shown by stained smear. The inoculating material was placed on the mouth parts and anus in each case. Both of those inoculated from dead larvae died, one in four, and the other in twenty-three days. Of the other three larvae inoculated from the culture, two have died, one in eleven and the other in nineteen days. In every case the organism described above was found in the grubs which died. Three grubs were kept as controls under similar conditions during the experiment and none of these died.

PARASITES AND PREDACEOUS ENEMIES.

Much has been said in previous reports concerning the parasites *Tiphia parallela* and *Dielis dorsata*, F. (See Rept. Dept. Ag. 11-2, p. 52 and 12-13, p. 38), the former being considered to be effectively keeping this pest in check several years ago. At the present time this parasite does not seem to be effectively keeping their numbers from increasing in some localities, and although they are doing much good, yet it is quite probable that adverse weather and other conditions, and possibly some unknown parasite are hindering their activity somewhat. The writer is of the opinion that a special insectary, if established for the rearing of large numbers of these parasites for their liberation at a period of the year when larvae are most abundant, viz; between August and January, would do much to check the serious increase in the numbers of the brown hard-back, and thus save much economic loss.

Another predaceous enemy of the brown hard-back which has been discussed in previous reports is that of the common toad *Bufo agua*. Within recent years this veritable friend of the farmer has practically suffered extermination in many localities due mainly to ignorance as to its great usefulness. The writer knows of more than one instance where these useful animals were ruthlessly destroyed through ignorance. This state of warfare against the frog has, in the opinion of the writer, contributed greatly to the increase of the brown hard-back within recent years.

During the work with the life history, nematodes were often found associated with diseased eggs which failed to hatch and also with dead larvae of all stages, dead pupae and even adults. Specimens of the nematodes found associated with diseased eggs and dead larvae were submitted to Dr N. A. Cobb, Agricultural Technologist of the United States Department of Agriculture, who has been so good as to identify several species

for our collection in the past. Dr. Cobb has examined the above mentioned specimens and found two species to be present, viz : *Cephalobus nanus*, de Man, and a *Rhabditis* which he thinks to be *Rhabditis dolichura*, Shneider. There was some doubt about this latter, however, as no males were found in the specimens sent and furthermore these did not arrive in very good condition.

Dr. Cobb has had several instances called to his attention where insect eggs of various kinds were infested with nemas and he has frequently found the *Cephalobus nanus* in and on such eggs, although he does not know positively whether it has the power to penetrate insect eggs. As regards *Rhabditis dolichura* he states that it is a cosmopolitan species found in decaying substances and quite frequently in the excreta of mammals. He has found it in the excreta of dogs, in the nests of white ants, and especially in connection with dead and diseased white ants, and in a culture of mites derived from the roots of bamboo. He considers, therefore, that it is a species which inhabits decaying organic matter of animal orgin and doubts if it has a specific relationship to the eggs of *Phytalus smithi*.

The writer on one occasion found several eggs of *Phytalus smithi* which were being hatched out in a petri dish with soil, infested with the nemas. Some of this infested material was included in that sent to and examined by Dr. Cobb, while the remainder was placed in contact with several healthy eggs which were also being hatched out and which had already reached their maximum size. No instance of infection of these healthy eggs occurred. Further experiments are necessary, however, since eggs which have reached their maximum size are much tougher on their surface than freshly laid ones, and it is not impossible that the nemas may be able to penetrate the latter while the former may be immune because of the toughened, outer surface.

Considerable difficulty was also experienced in rearing eggs and larvae in the laboratory unless strict precautions were taken to exclude a species of red ant. They have been found attacking larvae in cages several inches below the surface of the soil and causing death. Specimens have been forwarded to the Imperial Bureau of Entomology for identification.

REPRESSION.

Collection of Beetles.

Recent experiments have demonstrated the great egg laying possibilities of this beetle, which largely accounts for the great increase in their number within recent years. By a study of the life history it is seen that beetles do not commence laying for some time i.e., fifty-six to sixty-four days after their emergence, so that this gives ample opportunity for their collection before they have had time for reproduction. To give some idea as to the benefit which may be derived from the collection of beetles, the writer needs only to call attention to the number of these collected during the year from March 1919 to February 1920 at the Government Industrial Schools. During the period a total of 291, 919 brown hard-back beetles were collected. From the experiments on the annual progeny of a single pair it was seen that a female may produce on the average 108 eggs. Assuming then that fifty per cent of these beetles were females and that these latter were collected shortly after their emergence, and before they had a chance to lay their eggs, these beetles would have been prevented from producing a total of 15,763, 626 eggs.

To be thoroughly effective of course, the collection of beetles should be co-operatively undertaken. As a means of repression it is indeed much cheaper and more easily carried out than any other method which the planter may adopt at the present time.

Encouragement of Predaceous Enemies.

Every effort should be made to encourage the common toad *Bufo agua* in cane fields. Ponds should be used for the purpose of breeding these in large numbers and distributeing them throughout the fields.

RECOMMENDATIONS.

1. A rigorous co-operative action on the part of planters for the collection of beetles throughout the year.
2. The establishing of a central insectary for the rearing and distribution of the parasite *Tiphia parallela*.
3. The establishing of permanent ponds on estates for the rearing of toads for distribution in the field.
4. The rotation of crops with a view of discouraging the insect in attacked fields. Cotton forms an excellent rotation.
5. The introduction of any new parasites of *Phytalus smithi* which may be discovered in the future in any country where this insect may be found to exist.

B. A. BOURNE,
Assistant Director of Agriculture.

INFORMATION ON VARIOUS AGRICULTURAL MATTERS SUPPLIED TO THE PRESS.

Through the courtesy of the Editors of some of the local newspapers, who so far have been always willing to render any assistance they can in these matters, the following subjects were brought to the notice of agriculturists, viz :—

On June 2, asking them to publish extracts from Queensland Agricultural Journal with reference to the value of silos and ensilage.

On July 8, informing persons that His Excellency the Governor had appointed August 4 to be observed as Arbor Day, and inviting applications for young trees grown at the Nurseries of the Department of Agriculture, for planting on that day.

On August 13, forwarding letter from British Cotton Growing Association *re* shortage in Sea Island cotton crop grown in United States of America.

On August 28, forwarding letter from British Cotton Growing Association giving an approximate valuation of West Indian Sea Island cotton in Liverpool.

On October 20, calling attention to a circular from the Right Honourable the Secretary of State for the Colonies relative to the necessity of developing the economic resources of the colony.

On November 22, calling attention to the Peasants' Local Agricultural Exhibition to be held at Blowers, St. James on Wednesday, December 3.

On February 2, 1920, informing the public that the Director of Agriculture was willing to import onion seed from Teneriffe for those persons desirous of obtaining it for planting purposes.

SUGAR AND MOLASSES CROPS.

According to the Customs Returns, the exported sugar and molasses crops of 1919 were 39,252 tons of vacuum pan crysrals, 11,560 tons of muscovado sugar and 8,569,830 wine gallons of molasses, equal at 110 gallons per puncheon, to 77,908 puncheons of molasses of all grades of the total value of £883,597 made up as follows :—

White Crystal sugar	53	tons	valued at	£	1,867
Yellow " "	125	"	"		3,766
Dark " "	39,074	"	"		937,783
Muscovado "	11,560	"	"		288,999
	50,812			£	1,232,415
Fancy Molasses	7,149,958	gals.	at	£	744,617
Choice "	1,299,599	"	"	£	129,960
Vacuum Pan "	120,273	"	"		9,020
	8,569,830			£	883,597

Fancy molasses is concentrated cane juice from which most of the impurities have been removed, and owing to the impossibility in the ordinary muscovado sugar factories of concentrating each tayche or panful of Fancy molasses to the same density, it is difficult to say how many gallons of this molasses are equivalent to a ton of muscovado sugar. From data obtained from various sources it would appear that 380 wine gallons of Fancy molasses at 41° Baumé are equivalent to one ton (2240 lb.) of centrifugal muscovado sugar and 115 wine gallons of Choice molasses. At this rate the Fancy molasses manufactured in 1919 is equivalent to 18,816 tons of sugar. The total sugar crop, therefore, if no Fancy molasses had been made, would have been 69,628 tons, i.e., 12,437 tons more than the previous year.

COTTON CROPS.

For the "Cotton Year" i.e., from October 1, 1918 to September 30, 1919 there were exported from 1,445 acres 223 bales of lint, weighing 114,444 lb. of the value of £22,888. There were also exported 9 bales and 9 bags of linters weighing 6,866 lb. of the estimated value of £177 1. 8. In addition there were 281,556 lb. of seed of the estimated value of £2,148 all of which was, with the exception of that used for planting purposes, manufactured locally into oil and undecorticated cotton seed meal. It may be mentioned that for the previous year there were 1,337 acres of cotton which yielded 373 bales of lint, weighing 192,541 lb. of the estimated value of £28,943. The yield of lint per acre for the season 1918–19 was 79 lb. as compared with 144 lb. for 1917–18.

METEOROLOGY.

The following are summaries of the observations recorded at the Government Meteorological Station for the year 1919, the details of which are given in Appendix 1.

Barometric Pressure. During 1919 the mean pressure, corrected for temperature and gravity and reduced to sea-level, was at 9 a.m. 29·967 inches and at 3 p.m. 29·903 inches ; the highest recorded being 30·112 inches on August 19, and the lowest 29·783 inches on November 13. In 1911 for the first time the barometric pressure was corrected for gravity. For the ten years 1909–1918 the average barometric pressure was at 9 a.m.,

29·937 inches and at 3 p.m., 29·872 inches. The highest pressure at 9 a.m. during the ten years was on February 5, 1917, when it was 30·098 inches, and the lowest at 3 p.m. on April 14, 1915, when it was 29·669.

Temperature. The mean maximum temperature for the year 1919 was 85·7° F. and the mean minimum 72·6° F. The maximum extreme for the year, which was 91·1° F. was registered on August 24, and the minimum extreme which was 63·0° F. was registered on January 25. The mean average temperature was 79·2° F.; the highest monthly range for the year was 23·1° F., the lowest was 16·3° F., and the mean monthly range 18·8° F. For the ten years 1909-18 the average maximum temperature was 84·3° F., and the average minimum 74·5° F. The average maximum extreme during the ten years was 87·0° F., and the average minimum extreme 68·0° F.; the average mean temperature was 79·4° F., and the average range 19·0° F. During the ten years the maximum extreme was 90·1° F. on September 28, 1912, and the minimum extreme 61·0° F. on February 20, 1911.

Tension of Vapour and Relative Humidity. The mean tension of vapour for the year 1919 was at 9 a.m. ·713 and at 3 p.m. ·692. For the ten years 1909-1918 the average tension of vapour was at 9 a.m. ·715 and at 3 p.m. ·704. The mean relative humidity for the year 1919 was at 9 a.m. 66 and at 3 p.m. 63. For the ten years 1909-1918 the average relative humidity was at 9 a.m. 68 and at 3 p.m. 65.

Wind. The mean velocity of the wind during 1919 was 11·7 miles per hour, the maximum being 20·3 miles per hour on June 3 and the minimum 4·0 miles per hour on October 4. The average velocity for the ten years ended 1918 was 11·6 miles per hour.

Rainfall. The rainfall measured at the Government Meteorological Station during 1919 amounted to 42·35 inches. This fell on 175 days, the greatest fall being 8·17 inches on August 25th, and the lowest ·01 of an inch on May 6th, July 9th and 30th, October 18th, and 23rd, November 21st and December 26th. For the ten years 1909-1918 the average rainfall was 47·58 inches and the average number of days on which rain fell was 175.

Rainfall of the Island. The total mean rainfall for the year 1919 from 99 stations was 51·30 inches which fell on 154 days and was 10·83 inches below the average for the sixty years ended December 31st, 1918 which was 62·13 inches. The details with respect to the number of days on which rain fell at each of the stations during each month of the year, the total rainfall for each month, and in a number of instances, the height of the rain gauge above sea-level are given in Appendix II.

JOHN R. BOVELL,
Director of Agriculture.

APPENDIX–I.

METEOROLOGICAL REPORT FOR 1919.

DEPARTMENT OF AGRICULTURE, BARBADOS.

HEIGHT ABOVE SEA LEVEL 181 FEET.

Months.	Barometric pressure reduced to sea level, 32° Fahrenheit and corrected for gravity.					Temperatures.									Tension of vapour.			Relative Humidity.			Wind.	Rainfall.	Number of days on which rain fell.
	9 a.m.	3 p.m.	Mean.	Highest.	Lowest.	Maximum Mean.	Minimum Mean.	Maximum Extreme.	Minimum Extreme.	Maximum blackened bulb 4 ft. from ground in vacuo.	Mean for month.	Range for month.	Dew point 9 a.m.	Dew point 3 p.m.	9 a.m.	3 p.m.	Mean.	9 a.m.	3 p.m.	Mean.	Velocity miles per hour.		
January	29·981	29·898	29·940	30·041	29·808	83·2	68·9	84·5	63·0	152·6	76·1	21·5	67·2	66·1	·666	·645	·656	68	65	67	11·0	1·45	15
February.	30·015	29·941	29·978	30·057	29·872	84·4	69·7	86·7	65·5	150·6	77·1	21·2	66·9	65·9	·661	·641	·651	65	61	63	10·4	1·31	8
March.	30·001	29·925	29·963	30·054	29·870	85·6	70·0	87·5	64·4	151·0	77·8	23·1	65·6	64·1	·636	·602	·619	60	55	57	12·1	·65	6
April.	29·956	29·885	29·921	30·043	29·813	87·9	73·4	89·3	69·4	153·4	80·7	19·9	67·6	66·9	·676	·659	·668	58	56	57	11·8	·68	4
May.	29·962	29·905	29·934	30·021	29·854	87·4	74·5	88·9	71·8	150·0	81·0	17·1	68·7	67·7	·706	·681	·694	63	61	62	15·1	1·91	15
June.	29·992	29·937	29·965	30·049	29·885	87·4	74·7	88·7	71·5	150·4	81·1	17·2	68·6	68·0	·702	·684	·693	62	58	60	15·8	1·78	12
July.	29·989	29·943	29·966	30·095	29·892	86·9	74·2	88·4	72·0	153·6	80·6	16·4	69·8	69·1	·734	·715	·725	66	63	64	13·1	3·08	19
August.	29·190	29·932	29·961	30·112	29·877	85·6	74·7	91·1	71·3	152·6	80·2	19·8	71·4	70·8	·773	·758	·766	71	69	70	12·6	16·01	25
September.	29·932	29·873	29·903	29·992	29·807	85·7	73·8	87·3	71·0	152·7	79·8	16·3	71·5	70·7	·775	·754	·765	69	69	69	9·3	5·54	17
October.	29·935	29·863	29·899	30·004	29·787	86·3	72·8	87·7	69·9	151·7	79·5	17·8	71·0	70·4	·760	·744	·752	68	65	66	8·7	2·53	20
November.	29·909	29·832	29·871	29·981	29·783	85·2	73·3	86·8	70·4	153·7	79·3	16·4	71·8	70·7	·779	·753	·766	72	69	70	9·1	3·75	15
December.	29·941	29·899	29·920	30·075	29·830	83·0	71·0	84·2	65·6	150·4	77·0	18·6	68·0	67·2	·690	·668	·679	68	64	66	11·6	3·66	19
	359·603	358·833	359·221	360·522	358·078	1028·6	871·0	1051·1	825·8	1822·7	950·3	225·3	828·1	817·6	·8558	·8304	·8431	790	755	771	140·6	42·35	175
	29·967	29·903	29·935	30·044	29·840	85·7	72·6	87·6	68·8	151·9	79·2	18·8	69·0	68·1	·713	·692	·703	66	63	64	11·7	42·35	175

BARBADOS RAINFALL

FROM

JANUARY TO DECEMBER 1919.

APPEN

BARBADOS RAINFALL FROM

Name of Station.	Elevation.	January.		February.		March.		April.		May.		June.	
	Feet.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
I. District "A."													
ST. MICHAEL. *Lowlands.*													
Strathmore ...	..	8	1·91	5	1·35	2	·20	2	·54	6	2·00	8	·98
Lower Estate ...	237	14	1·80	7	1·75	7	·68	4	·33	14	2·48	10	1·65
Clapham ...	216	7	1·27	3	·60	...	Nil.	3	·45	2	·70	4	·60
Government House ..	90	7	1·40	7	1·37	6	·37	5	·74	11	2·50	11	1·42
District "A." Police Stn.	97	16	1·81	10	1·61	4	·50	2	·21	13	2·69	8	1·17
Central Police Station...	...	10	2·61	7	1·14	6	·63	2	·28	10	2·05	8	1·50
Bush Hall ...	110	7	1·65	4	1·25	1	·20	2	·35	6	2·36	5	1·83
Waterford ...	...	12	2·10	7	1·43	4	·39	4	·18	12	1·85	10	1·51
Windsor Cot ...	...	15	1·65	10	1·22	7	·48	6	·62	17	2·55	10	1·33
Warrens ...	...	14	2·41	6	1·56	3	·81	3	·59	9	1·72	7	1·82
Neils ...	...	9	2·19	6	1·50	2	·42	3	·24	14	2·07	6	1·16
Cane Wood ...	...	8	1·07	9	1·37	4	·61	2	·21	11	1·04	10	1·47
Codrington House ...	...	15	1·45	8	1·31	6	·65	4	·68	15	1·91	12	1·78
Goodland ...	...	11	1·80	8	1·33	7	·57	1	·20	11	2·71	9	1·23
Penlee ...	...	9	1·97	5	·88	3	·23	3	·74	8	1·43	8	·80
		162	27·09	102	19·67	62	6·74	46	6·36	159	30·06	126	20·25
		10·80	1·81	6·80	1·31	4·13	·45	3·07	·42	10·60	2·00	8·40	1·35
II. District "B."													
CHRIST CHURCH. *Lowlands.*													
Woodbourne ...	150	15	2·24	8	2·73	2	·62	2	·35	11	2·21	4	·81
Haunays ...	...	10	1·94	7	3·15	5	·60	2	·45	10	1·74	8	·74
Coverley ...	254	8	1·62	4	1·70	3	·47	2	·68	7	1·14	7	·86
Searles ...	283	19	1·94	9	3·11	8	·55	4	·96	15	2·28	8	1·21
Lower Greys ...	...	9	2·54	6	2·28	5	·72	2	·43	10	2·17	7	1·28
Newton ...	...	8	1·80	7	2·71	7	·91	1	·42	11	2·19	7	1·16
Maxwells ...	20	12	1·89	6	1·11	4	·52	3	·77	9	2·26	11	·95
Bentley ...	169	5	2·33	9	3·09	8	·77	4	·33	14	2·08	11	1·31
Rosebank ...	...	13	2·36	7	1·12	5	·50	7	·86	10	1·39	9	1·21
Isleworth (Hastings) ...	...	12	1·58	8	·83	4	·24	2	·56	10	1·20	9	·75
Yorkshire ...	...	13	2·59	12	3·07	3	·62	11	1·04	12	2·38	11	1·17
Frere Pilgrim ...	...	12	2·47	8	2·12	7	·85	3	·81	12	3·03	12	1·32
Graeme Hall ...	...	4	1·52	3	·90	1	·07	1	·32	7	1·52	4	·70
		140	26·82	94	27·92	62	7·44	44	7·98	138	25·59	108	13·42
		10·77	2·06	7·23	2·15	4·77	·57	3·38	·61	10·61	1·97	8·31	1·03

DIX II

JANUARY TO DECEMBER 1919.

July.		August.		September.		October.		November.		December.		Totals.	
Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
12	3·66	18	14·95	11	6·29	15	5·01	14	5·31	8	2·17	109	44·37
14	4·82	17	16·19	13	5·25	15	5·15	13	6·46	8	4·18	136	50·24
8	2·68	13	13·11	11	6·29	8	3·24	9	4·06	11	·68	79	33·68
16	3·58	23	18·80	17	5·95	18	5·55	17	5·97	17	3·74	155	51·39
17	3·54	24	13·69	18	4·82	17	3·86	16	4·93	14	3·82	159	42·15
9	2·82	23	15·89	17	5·10	18	4·52	16	4·68	14	3·10	140	44·32
8	3·28	15	18·38	10	5·17	9	2·54	9	3·75	7	2·83	83	43·59
13	2·74	21	15·04	15	4·06	15	3·01	12	3·41	14	3·01	139	38·73
16	3·19	25	16·59	17	4·90	18	5·15	16	4·61	15	3 23	172	45·52
10	3·49	24	16·18	18	5·98	17	4·14	15	5·75	15	4 47	141	48·92
17	3·58	17	13·32	10	4·12	11	3·59	12	4·53	8	2·76	115	39·48
10	3·02	21	13·84	11	4·09	13	3·49	13	4·54	12	3·71	124	38·46
19	3·08	25	16·01	17	5·54	20	2·53	15	3·75	19	3·66	175	42·35
12	3·13	25	16·19	10	4·17	14	3·65	15	4·82	14	2·44	137	42·24
15	4·04	26	14·94	14	6·07	14	3·47	13	4·74	10	1·62	128	40·93
196	50·15	317	233·12	209	77·80	222	58·90	205	71·31	186	44·92	1992	646·37
13·07	3·34	21·13	15·54	13·93	5·19	14·80	3·93	13·67	4·75	12·40	2·99	132·80	43·09
10	3·11	21	11·03	18	5·88	14	5·77	17	5·75	9	2·80	131	43·30
12	3·10	21	9·69	16	5·57	15	6·04	14	4·06	10	3·07	130	40·15
10	3·95	18	11·12	10	6·05	12	4·98	14	5·56	7	2·74	102	40·87
14	4·14	26	10·72	18	6·00	20	5·69	19	4·95	17	3·25	177	44·80
12	3·47	23	10·40	15	3·97	15	4·47	15	4·87	10	3·28	129	39·83
12	4·45	28	10·11	15	5·96	14	4·51	16	6·38	8	2·98	129	43·58
17	4·27	24	11·60	17	4·90	16	4·58	17	7·25	8	1·50	144	41·60
13	3·53	23	10·26	18	4·92	17	5·34	20	4·46	13	3·26	155	41·78
15	3·77	21	15·52	15	5·54	16	3·92	15	5·05	6	1· 6	139	42·40
16	3·09	23	13·12	16	4·51	17	3·76	17	4·27	11	1·51	145	35·42
13	3·64	23	11·31	16	5·88	14	6·22	15	4·85	15	3·44	158	46·21
13	3·63	25	12·91	15	5·15	16	5·44	18	5·59	13	3·64	154	46·96
9	3·29	18	11·86	12	4·36	10	4·23	12	5·33	6	1·51	87	35·11
166	47·44	289	149·15	201	68·69	196	64·95	209	68·37	133	34·24	1780	542·01
12·77	3·65	22·23	11·47	15·46	5·28	15·08	5·00	16·08	5·26	10·23	2·63	136·92	41·69

Name of Station.	Elevation.	January.		February.		March.		April.		May.		June.	
	Feet.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
ST. GEORGE. *Highlands.*													
Ashbury ...	...	13	2·63	12	2·62	9	1·32	6	1·11	16	2·47	9	1·51
Cottage ...	720	18	3·02	10	2·92	11	1·34	7	·88	15	2·74	15	3·14
		31	5·65	22	5·54	20	2·66	13	1·99	31	5·21	24	4·65
		15·50	2·88	11·00	2·77	10·00	1·33	6·50	1·00	15·50	2·61	12·00	2·33
ST. GEORGE. *Lowlands.*													
Salters ...	...	15	2·11	11	2·53	2	·52	2	·25	15	2·42	10	1·80
Byde Mill ...	...	16	2·45	9	1·94	9	·94	3	·49	17	1·98	14	2·04
Brighton ...	...	12	2·41	6	2·17	5	·54	2	·15	11	1·35	8	1·72
District "B." Police Stn.	...	15	2·69	10	2·24	8	·67	7	·61	19	2·61	15	1·36
		58	9·66	36	8·88	24	2·67	14	1·50	62	8·36	47	6·92
		14·50	4·42	9·00	2·22	6·00	·67	3·50	·38	15·50	2·09	11·75	1·73
III. District "C."													
ST. PHILIP. *Highlands.*													
District "C." Police Stn.	505	13	1·94	10	1·06	8	·76	3	·30	16	1·81	12	1·47
Hill View ...	507	11	2·38	7	1·43	6	·98	4	·60	10	1·80	9	2·10
		24	4·32	17	2·49	14	1·74	7	·90	26	3·61	21	3·57
		12·00	2·16	8·50	1·25	7·00	·87	3·50	·45	13·00	1·81	10·50	1·79
ST. PHILIP. *Lowlands.*													
Oughterson ...	291	5	1·40	3	·88	5	1·06	2	1·27	15	2·21	10	1·74
Govt. Industrial School	210	13	2·08	13	1·56	10	·98	4	·33	18	1·81	10	1·56
Sunbury ...	160	9	2·16	8	1·64	8	·71	2	·16	12	1·92	7	1·18
Hampton ...	103	12	2·32	8	2·64	5	·47	3	·37	12	2·41	9	1·07
Carrington ...	110	10	2·40	8	2·91	8	1·16	2	·32	15	2·59	9	1·25
Chapel ...	228	13	2·74	8	1·45	11	·96	3	·25	18	1·48	12	1·42
Edgecumbe ...	207	9	1·97	8	2·98	6	·70	6	·42	15	2·26	10	1·63
Summervale ...	...	14	1·95	12	1·20	8	·91	5	·53	19	1·91	13	1·69
Stirling ...	...	10	2·34	9	2·22	3	·69	1	·14	10	2·32	8	·95
Senhouse Grove ...	...	11	2·35	7	2·63	2	·84	1	·20	8	2·58	5	·89
Bayleys ...	128	9	1·62	6	1·02	3	·62	1	·30	6	·97	4	1·20
Ruby ...	...	10	2·71	10	1·89	3	·63	3	·37	9	1·78	8	1·74
		125	26·04	100	23·02	72	9·73	33	4·66	157	24·24	105	16·32
		10·42	2·17	8·33	1·92	6·00	·81	2·75	·39	13·08	2·02	8·75	1·36

JANUARY TO DECEMBER 1919.

July.		August.		September.		October.		November.		December.		Totals.	
Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
17	4·47	24	15·04	16	4·96	17	5·80	14	5·20	14	6·53	167	53·66
19	5·74	24	16·87	19	3·92	19	7·37	20	6·56	19	6·70	196	61·20
36	10·21	48	31·91	35	8·88	36	13·17	34	11·76	33	13·23	363	114·86
18·00	5·11	24·00	15·96	17·50	4·44	18·00	6·59	17·00	5·88	16·50	6·62	181·50	57·43
15	3·98	20	13·97	16	4·22	16	5·31	17	5·57	14	3·63	153	46·31
18	4·48	24	11·53	23	4·85	13	5·48	19	5·38	15	2·79	180	44·35
13	4·28	18	13·29	14	3·50	15	4·94	15	4·79	5	2·49	124	41·63
16	3·92	25	12·01	18	5·28	19	4·22	19	4·97	18	4·55	189	45·13
62	16·66	87	50·80	71	17·85	63	19·95	70	20·71	52	13·46	643	177·42
15·50	4·17	21·75	12·70	17·75	4·46	15·75	4·99	17·50	5·18	13·00	3·37	161·50	44·36
16	3·20	22	11·86	20	3·93	14	6·89	18	7·42	16	3·83	168	44·47
14	3·54	21	11·72	19	3·83	14	7·35	17	5·96	11	3·05	143	44·74
30	6·74	43	23·58	39	7·76	28	14·24	35	13·38	27	6·88	311	89·21
15·00	3·37	21·50	11·79	19·50	3·88	14·00	7·12	17·50	6·69	13·50	3·44	155·50	44·61
14	3·48	21	11·91	17	3·54	14	7·28	13	6·71	12	3·04	131	44·52
15	3·65	26	11·07	20	3·50	15	7·80	18	5·40	20	3·11	182	43·45
13	3·49	22	10·46	20	4·64	15	5·95	16	4·78	15	2·71	147	39·80
13	3·80	22	9·58	16	5·71	15	6·35	15	5·50	11	3·04	141	43·26
13	4·47	21	11·50	17	5·98	15	6·13	17	5·99	11	3·39	146	48·09
13	3·95	20	9·25	17	3·17	13	7·24	19	5·39	11	2·49	158	39·79
10	3·95	22	11·31	17	5·02	17	5·37	19	4·30	13	3·22	152	43·13
14	3·41	25	11·57	21	3·42	15	7·40	18	6·53	18	3·36	182	43·88
8	3·79	21	9·68	14	3·63	12	7·22	14	5·64	6	2·69	116	41·31
10	3·64	19	10·21	16	5·18	11	7·27	12	5·23	8	2·48	110	43·50
11	3·47	18	11·93	11	3·09	14	7·05	10	6·36	11	3·11	104	40·74
11	4·34	23	10·66	5	2·40	14	10·07	14	4·99	11	3·51	121	45·12
145	45·44	260	129·73	191	49·28	170	85·13	185	66·82	147	36·18	1690	516·59
12·08	3·79	21·67	10·81	15·92	4·11	14·17	7·09	15·42	5·57	12·25	3·02	140·83	43·05

Name of Station.	Elevation.	January.		February.		March.		April.		May.		June.	
	Feet.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
ST. JOHN. *Highlands.*													
Cliff	534	11	2·20	6	1·81	4	·84	7	·71	12	2·31	9	1·45
Ashford	606	14	2·07	12	1·86	6	·82	9	·88	4	2·56	12	1·29
Pool	716	11	2·31	8	1·85	5	·76	8	1·18	12	2·20	13	1·59
Henley	553	16	2·78	9	1·76	8	·98	5	·49	17	2·56	15	1·85
Wakefield ...	707	14	2·81	9	2·10	5	1·63	4	1·00	13	2·31	11	2·01
Malvern ...	900	9	2·77	8	2·34	5	1·04	7	·96	8	1·95	12	2·24
Kendal	544	16	2·93	8	1·44	4	·89	6	·73	15	2·86	13	1·99
Claybury	750	10	2·87	5	1·92	4	1·44	3	·49	13	2·80	9	1·78
Clifton Hall ...	...	9	1·99	8	1·91	3	·79	7	·96	12	1·95	10	1·78
Lemon Arbor ...	720	9	2·26	7	1·90	3	·92	4	1·28	9	2·37	10	1·62
		119	24·99	80	18·89	47	10·11	60	8·63	115	23·87	114	17·26
		11·90	2·50	8·00	1·89	4·70	1·01	6·00	·86	11·50	2·39	11·49	1·76
ST. JOHN. *Lowlands.*													
Codrington College ...	...	11	1·81	7	1·74	4	·85	8	·75	11	1·70	6	1·28
Newcastle ...	238	11	2·37	6	1·26	8	1·03	8	·64	16	1·78	14	1·74
		22	4·18	13	3·00	12	1·88	16	1·39	27	3·48	20	3·02
		11·00	2·09	6·50	1·50	6·00	·94	8·00	·70	13·50	1·74	10·00	1·51
IV. District "D." ST. THOMAS. *Highlands.*													
Mount Wilton ...	987	16	4·56	8	2·48	5	1·41	6	1·32	14	3·91	9	2·08
Lion Castle ...	900	23	3·48	13	2·43	11	1·70	7	1·04	20	3·65	19	2·62
District "D." Police Stn.	678	22	2·88	11	2·07	10	1·01	6	·76	21	2·38	19	2·69
Farmers	903	13	4·03	7	2·06	6	1·47	9	1·38	12	2·22	11	2·26
Canefield	1024	7	4·41	3	1·82	2	1·34	5	1·69	15	2·99	11	2·05
Bloomsbury	...	15	3·26	9	2·58	9	1·66	10	1·37	23	3·58	20	2·23
Vaucluse	...	16	2·28	7	2·10	5	1·58	4	·76	8	1·76	6	·75
Highland	...	14	3·68	8	2·79	9	1·83	8	1·26	19	4·27	18	2·41
		126	28·58	66	18·33	57	12·00	55	9·58	132	24·71	113	17·08
		15·75	3·57	8·25	2·29	7·13	1·50	6·88	1·20	16·50	3·09	14·13	2·14
ST. THOMAS. *Lowlands.*													
Fisher Pond ...	725	13	2·82	6	2·27	6	1·09	6	1·17	16	2·38	15	1·65
Olive Branch ...	680	17	2·45	8	2·15	7	·97	6	·58	10	1·62	9	·84
Hopewell ...	534	20	2·76	10	2·35	10	1·43	10	·97	18	2·34	17	1·88
Bennetts	350	17	2·37	9	2·27	12	1·33	8	1·09	17	2·21	20	1·94
Clifton	...	7	2·18	8	2·53	3	1·07	3	·59	10	2·62	9	1·78
Cane Garden ...	360	17	1·96	8	1·82	9	1·15	5	·58	13	1·67	14	1·47
Applewhaites ...	...	19	2·77	9	1·99	11	1·41	6	·97	17	3·22	14	2·22
		110	17·31	58	15·38	58	8·45	44	5·95	101	16·06	98	11·78
		15·71	2·47	8·29	2·20	8·29	1·21	629	·85	14·43	2·29	14·00	1·68

JANUARY TO DECEMBER 1919.

July.		August.		September.		October.		November.		December.		Totals.	
Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
14	4·28	20	12·22	17	5·15	15	7·33	14	6·36	16	6·02	145	50·68
16	4·44	25	13·68	17	5·88	18	6·24	21	6·23	18	5·56	172	51·51
17	4·51	23	13·64	16	5·37	14	6·58	16	6·89	15	6·22	158	53·01
17	4·24	25	12·74	22	5·18	18	6·88	19	5·44	18	5·63	189	50·58
18	4·62	23	12·60	19	7·09	15	5·75	16	7·00	16	5·69	163	54·91
15	4·39	26	16·36	15	6·56	13	6·45	14	7·40	17	7·34	149	59·77
15	4·35	25	13·01	18	5·39	17	7·53	19	6·32	18	6·51	174	53·98
14	4·87	19	15·44	9	6·17	9	5·20	13	6·54	15	6·26	123	55·78
15	3·94	22	13·20	14	6·01	10	4·78	16	8·82	16	5·19	142	50·82
15	4·57	22	15·44	14	6·11	15	5·20	18	6·27	17	6·64	143	54·55
156	44·21	230	138·86	161	58·88	144	61·94	166	66·68	166	61·36	1558	535·54
15·60	4·42	23·00	13·84	16·10	5·89	14·40	6·19	16·60	6·67	16·60	6·14	155·80	53·55
16	4·28	20	12·61	14	5·48	12	5·77	7	2·18	17	4·81	133	43·26
13	3·45	26	14·21	18	5·74	13	4·64	19	6·85	18	6·01	170	49·72
29	7·73	46	26·82	32	11·22	25	10·41	26	9·03	35	10·82	303	92·98
14·50	3·87	23·00	13·41	16·00	5·61	12·50	5·21	13·00	4·52	17·50	5·41	151·50	46·49
11	4·81	24	21·23	13	5·63	11	5·47	19	8·94	20	8·61	156	70·55
22	6·09	29	19·52	21	6·17	16	6·07	26	7·33	24	7·91	231	68·01
19	4·09	26	20·68	19	5·65	17	6·34	19	6·93	24	7·36	213	62·79
12	4·25	22	18·89	12	5·39	17	6·81	17	5·62	13	7·05	151	61·43
12	4·89	27	19·18	22	5·35	16	5·53	24	6·62	21	8·75	165	64·62
19	5·18	25	20·23	17	5·83	13	6·20	21	9·02	21	9·69	202	70·82
14	3·29	26	14·94	15	4·49	12	4·91	14	4·71	13	4·79	140	46·36
17	5·42	25	19·70	19	6·08	16	5·75	21	7·83	22	8·44	196	69·46
126	38·02	204	154·47	138	44·59	118	47·08	161	57·00	158	62·60	1454	514·04
15·75	4·75	25·50	19·31	17·25	5·57	14·75	5·89	20·13	7·13	19·75	7·83	181·75	64·26
14	3·83	25	15·78	16	4·67	14	4·78	18	7·83	17	7·06	166	55·33
19	2·86	27	13·91	15	2·89	8	3·92	15	6·09	17	6·52	158	44·80
20	4·62	29	16·26	21	5·03	20	6·04	23	6·74	24	6·66	222	57·08
17	4·36	25	16·72	16	7·03	16	5·27	13	5·53	19	5·54	189	55·66
9	4·10	21	17·50	18	4·81	12	4·72	18	7·48	18	6·72	136	56·10
14	3·52	22	14·75	14	4·49	18	4·79	14	4·93	15	4·10	163	45·23
19	4·97	28	16·61	20	4·61	20	6·38	22	6·53	20	5·58	205	57·26
112	28·26	177	111·53	120	33·53	108	35·90	123	45·13	130	42·18	1239	371·46
16·00	4·04	25·29	15·93	17·41	4·79	15·43	5·13	17·57	6·45	18·57	6·03	177·00	53·07

Name of Station.	Elevation. Feet.	January. Days.	January. Inches.	February. Days.	February. Inches.	March. Days.	March. Inches.	April. Days.	April. Inches.	May. Days.	May. Inches.	June. Days.	June. Inches.
ST. JAMES *Highlands.*													
Apes Hill ...	...	9	3·25	7	1·89	6	1·16	7	1·28	11	2·32	10	2·98
ST. JAMES. *Lowlands.*													
Holetown Police Stn. ...	...	19	2·19	8	·99	8	·76	6	·63	13	1·94	15	2·54
Trents ...	...	9	2·02	4	·91	1	·48	3	·77	8	2·30	11	2·16
Westmoreland ...	...	11	2·50	7	1·37	4	1·06	4	·81	11	1·72	9	2·23
Lancaster ...	413	17	3·88	11	2·15	8	1·43	8	·99	15	2·57	16	2·43
Husbands ...	...	9	1·93	6	1·39	4	·42	1	·07	6	1·29	8	·98
Oxnards ...	...	15	1·53	6	1·51	6	·63	2	·27	13	1·37	10	1·46
		80	14·05	42	8·32	31	4·78	24	3·54	66	11·19	69	11·80
		13·33	2·34	7·00	1·39	5·17	·80	4·00	·59	11·00	1·87	11·50	1·97
V. District "E." ST. PETER. *Highlands.*													
Nicholas Abbey ...	824	11	3·02	5	1·50	5	1·08	5	2·05	8	1·99	9	1·63
Mangrove ...	...	10	2·45	8	2·12	6	1·00	7	1·46	12	2·16	12	3·28
Castle ...	700	13	3·13	6	1·52	7	1·06	4	1·56	12	2·38	9	1·54
Rock Hall ...	...	16	3·33	11	2·36	9	1·36	7	1·97	13	2·67	14	3·88
		50	11·93	30	7·50	27	4·50	23	7·04	45	9·20	44	10·33
		12·50	2·98	7·50	1·88	6·75	1·13	5·75	1·76	11·25	2·30	11·00	2·58
ST. PETER. *Lowlands.*													
District "E" Police Stn.	...	21	2·69	8	1·25	7	·88	6	1·47	14	2·37	18	3·63
Heywoods ...	50	8	1·90	6	·72	4	·62	4	1·04	7	1·64	14	1·83
Alleynedale ...	...	19	2·47	9	1·35	8	·74	11	1·29	15	2·01	16	2·02
The Rectory ...	...	14	2·77	9	2·06	8	1·34	7	1·75	7	2·18	18	2·93
		62	9·83	32	5·38	27	3·58	28	5·55	43	8·20	66	9·41
		15·50	2·46	8·00	1·35	6·75	·90	7·00	1·39	10·75	2·05	16·50	2·35
ST. LUCY. *Lowlands.*													
Pickerings ...	71	13	2·64	7	·72	3	·49	6	·76	12	2·20	6	1·08
Cove ...	...	9	1·90	4	·94	3	·64	3	·34	11	2·41	3	·96
		22	4·54	11	1·66	6	1·13	9	1·10	23	4·61	9	2·04
		11·00	2·27	5·50	·83	3·00	·57	4·50	·55	11·50	2·31	4·50	1·02

JANUARY TO DECEMBER 1919.

July.		August.		September.		October.		November.		December.		Totals.	
Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
13	5·41	21	18·74	11	4·98	15	5·85	18	5·68	15	7·01	146	60·55
16	4·71	24	13·00	18	7·29	16	5·86	15	4·84	20	4·37	178	49·12
14	4·26	21	14·91	10	8·28	14	6·96	17	4·92	18	4·21	130	52·18
11	3·89	20	15·05	16	8·84	11	6·19	11	5·13	15	4·87	130	53·57
17	4·42	23	18·45	15	10·06	18	7·07	21	5·50	22	6·42	191	65·37
9	2·11	16	13·26	11	9·58	11	2·60	12	3·43	13	4·04	106	41·10
16	2·63	23	13·36	17	11·84	15	3·21	11	3·68	13	3·38	147	44·87
83	21·93	127	88·03	87	55·89	85	31·89	87	27·50	101	27·29	882	306·2 1
13·83	3·66	21·17	14·67	14·50	9·32	14·17	5·32	14·50	4·58	16·83	4·55	147·00	51·04
8	5·16	22	13·84	16	3·56	13	4·10	16	6·53	16	7·98	134	52·44
11	4·22	23	17·49	11	6·04	15	6·69	20	6·17	14	7·05	149	60·13
12	5·45	22	12·91	14	4·19	14	4·94	19	7·25	14	6·53	146	52·19
13	5·40	24	19·28	12	6·80	17	8·17	17	8·15	14	8·15	167	71·52
44	20·23	91	63·55	53	20·59	59	23·90	72	28·10	58	29·71	596	236·58
11·00	5·06	22·75	15·89	13·25	5·15	14·75	5·98	18·00	7·03	14·50	7·43	149·00	59·15
19	4·78	26	14·80	17	4·41	14	5·58	23	7·75	19	7·98	192	56·59
13	3·83	23	14·21	9	3·12	7	5·58	16	7·88	12	6·36	123	48·73
16	4·51	29	13·84	18	4·19	13	4·87	22	5·08	16	7·01	192	49·38
15	4·49	22	14·52	15	4·82	11	6·70	18	7·78	12	7·99	155	59·33
63	17·61	100	57·37	59	16·54	45	22·73	79	28·49	59	29·34	663	214·03
15·75	4·40	25·00	14·34	14·75	4·14	11·25	5·68	19·75	7·12	14·75	7·34	165·75	53·51
12	5·41	25	11·63	11	3·46	11	5·16	15	3·82	17	6·85	138	46·62
14	5·28	27	12·99	9	3·50	11	3·90	18	8·60	13	7·44	125	49·69
26	11·3	52	24·02	20	6·96	22	9·06	33	15·42	30	14·29	263	96·22
13·00	5·70	26·00	12·01	10·00	3·48	11·09	4·53	16·50	7·71	15·00	7·15	131·50	48·11

Name of Station.	Elevation.	January.		February.		March.		April.		May.		June.	
	Feet.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
VI. District "F."													
ST. JOSEPH. *Highlands.*													
Blackmans ...	910	12	2·49	9	2·25	6	·99	8	1·13	12	2·79	9	1·49
Andrews... ...	780	16	3·00	11	2·85	8	1·81	8	·89	13	2·59	13	2·04
District "F" Police Stn.	966	18	2·35	11	1·39	6	1·00	8	·95	14	1·02	15	2·39
Seniors	...	12	2·66	8	1·79	6	1·21	8	1·17	10	1·96	9	3·32
		58	10·50	39	8·28	26	5·01	32	4·14	49	8·36	46	9·24
		14·50	2·63	9·75	2·07	6·50	1·25	8·00	1·04	12·25	2·09	11·50	2·31
ST. JOSEPH. *Lowlands.*		Did not receive any returns.											
ST. ANDREW. *Highlands.*		Did not receive any returns.											
ST. ANDREW. *Lowlands.*													
Bruce Vale		9	1·99	7	1·77	7	1·86	12	1·95	7	1·70	10	3·52
Baxters House		14	1·92	9	1·33	4	·78	8	1·21	11	1·32	12	3·04
Walkers		11	2·26	8	1·42	7	·85	7	1·11	6	1·29	10	1·33
		34	6·17	24	4·52	18	3·49	27	4·27	24	4·31	32	7·89
		11·33	2·06	8·00	1·51	6·00	1·16	9·00	1·42	8·00	1·44	1·07	2·63

JANUARY TO DECEMBER 1919.

July.		August.		September.		October.		November.		December.		Totals.	
Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
12	4·18	22	17·00	14	4·58	10	4·95	17	5·92	20	6·71	151	54·48
18	5·36	26	17·79	16	5·65	11	4·65	17	6·53	16	6·69	178	59·85
14	4·10	24	12·74	17	4·13	15	3·54	19	4·22	16	5·50	177	43·33
9	5·27	13	14·43	8	6·19	17	6·16	18	5·61	19	6·94	137	56·71
53	18·91	85	61·96	55	20·55	53	19·30	71	22·28	71	25·84	638	214·37
13·25	4·73	21·25	15·49	13·75	5·14	13·25	4·83	17·75	5·57	17·75	6·46	159·50	53·59
10	5·28	22	15·63	13	5·99	17	6·16	18	5·61	19	6·94	151	58·40
13	5·12	22	15·22	13	5·21	15	5·19	17	6·82	16	6·93	154	54·09
13	4·28	22	15·94	13	5·31	13	4·89	13	6·61	10	6·03	133	51·32
36	14·68	66	46·79	39	16·51	45	16·24	48	19·04	45	19·90	438	163·81
12·00	4·89	22·00	15·60	13·00	5·50	15·00	5·41	16·00	6·35	15·00	6·63	146·00	54·60

SUMMARY OF BARBADOS RAINFALL FROM

Name of Station.	No. of Stations.	January.		February.		March.		April.		May.		June.	
		Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
I. District "A."													
ST. MICHAEL. *Lowlands.*	15	10·80	1·81	6·80	1·31	4·13	·45	3·07	·42	10·60	2·00	8·40	1·35
II. District "B."													
CHRIST CHURCH. *Lowlands.*	13	10·77	2·06	7·23	2·15	4·77	·57	3·38	·61	10·61	1·97	8·31	1·03
ST. GEORGE. *Highlands.*	2	15·50	2·88	11·00	2·77	10·00	1·33	6·50	1·00	15·50	2·61	12·00	2·33
ST. GEORGE. *Lowlands.*	4	14·50	4·42	9·00	2·22	6·00	·67	3·50	·38	15·50	2·89	11·75	1·73
III. District "C."													
ST. PHILIP. *Highlands.*	2	12·00	2·16	8·50	1·25	7·00	·87	3·50	·45	13·00	1·81	10·50	1·79
ST. PHILIP. *Lowlands.*	12	10·42	2·17	8·33	1·92	6·00	·81	2·75	·39	13·08	2·02	8·75	1·36
ST. JOHN. *Highlands.*	10	11·90	2·50	8·00	1·89	4·70	1·01	6·00	·86	11·50	2·39	11·40	1·76
ST. JOHN. *Lowlands.*	2	11·00	2·09	6·50	1·50	6·00	·94	8·00	·70	13·50	1·74	10·00	1·51
IV. District "D."													
ST. THOMAS. *Highlands.*	8	15·75	3·57	8·25	2·28	7·13	1·50	6·88	1·20	16·50	3·09	14·13	2·14
ST. THOMAS. *Lowlands.*	7	15·71	2·47	8·29	2·20	8·29	1·21	6·29	·85	14·43	2·29	14·00	1·68
ST. JAMES *Highlands.*	1	9·00	3·25	7·00	1·89	6·00	1·16	7·00	1·28	11·00	2·32	10·00	2·98
ST. JAMES. *Lowlands.*	6	13·33	2·34	7·00	1·39	5·17	·80	4·00	·59	11·00	1·87	11·50	1·97
V. District "E."													
ST. PETER. *Highlands.*	4	12·50	2·98	7·50	1·88	6·75	1·13	5·75	1·76	11·25	2·30	11·00	2·58
ST. PETER. *Lowlands.*	4	15·50	2·46	8·00	1·35	6·75	·90	7·00	1·39	10·75	2·05	16·50	2·35
ST. LUCY. *Lowlands.*	2	11·00	2·27	5·50	·83	3·00	·57	4·50	·55	11·50	2·31	4·50	1·02
VI. District "F."													
ST. JOSEPH. *Highlands.*	4	14·50	2·63	9·75	2·07	6·50	1·25	8·00	1·04	12·25	2·09	11·50	2·31
ST. JOSEPH. *Lowlands.*	...	Did not receive any returns.											
ST. ANDREW. *Highlands.*	...	Did not receive any returns.											
ST. ANDREW. *Lowlands.*	3	11·33	2·06	8·00	1·51	6·00	1·16	9·00	1·42	8·00	1·44	1·07	2·63
	99	215·51	44·12	134·65	30·42	104·19	16·33	95·12	14·89	209·97	36·39	175·31	32·52
		12·68	2·60	7·92	1·79	6·13	·96	5·60	·88	12·35	2·14	10·31	1·91

JANUARY TO DECEMBER 1919.

July.		August.		September.		October.		November.		December.		Totals.	
Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
13·07	3·34	21·13	15·54	13·93	5·19	14·80	3·93	13·67	4·75	12·40	2·99	132·80	43·09
12·77	3·65	22·23	11·47	15·46	5·28	15·08	5·00	16·08	5·26	10·23	2·63	136·92	41·69
18·00	5·11	24·00	15·96	17·50	4·44	18·00	6·59	17·00	5·88	16·50	6·62	181·50	57·43
15·50	4·17	21·75	12·70	17·75	4·46	15·75	4·99	17·50	5·18	13·00	3·37	161·50	44·36
15·00	3·37	21·50	11·79	19·50	3·88	14·00	7·12	17·50	6·69	13·50	3·44	155·50	44·61
12·08	3·79	21·67	10·81	15·92	4·11	14·17	7·09	15·42	5·57	12·25	3·02	140·83	43·05
15·60	4·42	23·00	13·84	16·10	5·89	14·40	6·19	16·60	6·67	16·60	6·14	155·80	53·55
14·50	3·87	23·00	13·41	16·00	5·61	12·50	5·21	13·00	4·52	17·50	5·41	151·50	46·49
15·75	4·75	25·50	19·31	17·25	5·57	14·75	5·89	20·13	7·13	19·75	7·83	181·75	64·26
16·00	4·04	25·29	15·93	17·41	4·79	15·43	5·13	17·57	6·45	18·57	6·03	177·00	53·07
13·00	5·41	24·00	18·74	11·00	4·98	15·00	5·85	18·00	5·68	15·00	7·01	146·00	60·55
13·83	3·66	21·17	14·67	14·50	9·32	14·17	5·32	14·50	4·58	16·83	4·55	147·00	51·04
11·00	5·06	22·75	15·89	13·25	5·15	14·75	5·98	18·00	7·03	14·50	7·43	149·00	59·15
15·75	4·40	25·00	14·34	14·75	4·14	11·25	5·68	19·75	7·12	14·75	7·34	165·75	53·51
13·00	5·70	26·00	12·01	10·00	3·48	11·00	4·53	16·50	7·71	15·00	7·15	131·50	48·11
13·25	4·73	21·25	15·49	13·75	5·14	13·25	4·83	17·75	5·57	17·75	6·46	159·50	53·59
12·00	4·89	22·00	15·60	13·00	5·50	15·00	5·41	16·00	6·35	15·00	6·63	146·00	54·60
240·10	74·36	391·24	247·50	257·07	86·93	243·30	94·74	284·97	102·14	259·13	94·05	2619·85	872·15
14·12	4·37	23·01	14·56	15·12	5·11	14·31	5·57	16·76	6·01	15·24	5·53	154·11	51·30