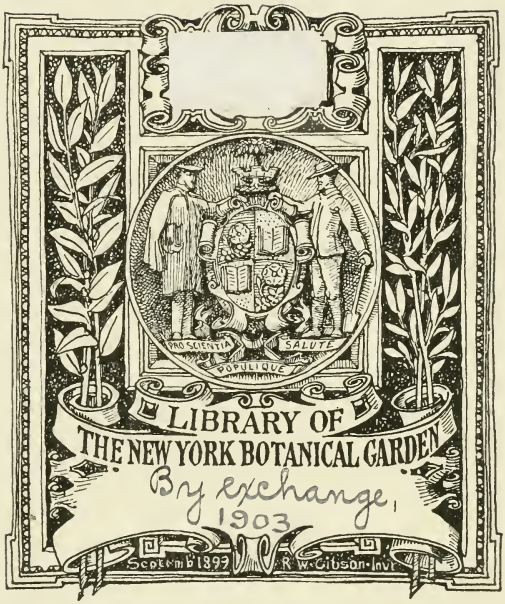

By exchange,
1903

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

EDITED BY

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

Director of Public Gardens and Plantations.

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HOPE GARDENS, JAMAICA:

1903.

Vol. I. JANUARY, 1903. Part 1.

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CONTENTS:

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KINGSTON, JAMAICA :

HOPE GARDENS.

1903.

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JAMAICA.

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Vol. I. JANUARY, 1903. Part 1.

THE BANANA SOILS OF JAMAICA.—II.*

By H. H. Cousins, M.A., F.C.S., Government Analytical and Agricultural Chemist.

The first report on the results obtained at the Government Laboratory on the banana soils of Jamaica appeared in the Bulletin for October 1901. Since that time, a good many representative banana soils have been analyzed and in 6 cases manurial experiments have been carried out, from which the first season's results have now been obtained. During the present season, nine series of manurial experiments on bananas have been started, the results of which should serve as a valuable commentary on the deductions based on the soil-analyses.

Following the plan adopted in the previous paper of considering the soils according to the parishes, the results of analysis are here given in this form.

I. ST. MARY.

This, the chief banana parish of the Island, shall head the list.

Manurial experiments have been carried out on three distinct types of soil in this parish, and arrangements are now complete for 6 distinct series of these experiments on the crop of 1903.

A.—Quebec Park—Hon. R. P. Simmonds. A piece of level land apparently rather below par, judging from the grade of fruit produced —7 and 8 hands—was selected.

The piece known as Duthie's Level is almost surrounded with water-courses and is liable on occasion to be flooded.

The analysis is as follows :—

SOIL ANALYSIS.

Reference Number 55. Source Details—Experimental Plots.—Duthie's Level, Quebec Park Depth of Sample—9 inches.

	Physical Analysis.			Per Cent.	
	Stones	...		Nil	Fine Earth.
	Gravel	...		0.88	
	Sand	...		1.18	
	Fine Sand	...		23.33	
	Silt	.		61.11	
Agricultural Clay	Fine Silt	...	6.09	6.09	
	Clay	...		Traces	
	Combined water, Organic matter.	...		7 41	
	Total			100.00	
				Per Cent.	
Retentive Power for water		...		60.0	

* Continued from Bulletin of the Botanical Department, Jamaica, Oct., 1901, Vol. viii., page 145.

Chemical Analysis.

Soil passed through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter ...	66.51
Soluble in Hydrochloric Acid	33.49
Potash ...	0.957
Lime ...	1.360
Phosphoric Acid	0.080
Carbonic Acid as Carbonate of Lime	1.155
Combined Water and organic matter	9.530
Humus (soluble in Ammonia)	2.019
Nitrogen ...	0.204
Hygroscopic Moisture ...	8.00

Fertility Analysis.

	Per Cent.
Available Potash ...	0.017
Available Phosphoric Acid...	0.022

Observations.

This soil consists almost entirely of fine sand and silt. It drains readily and yet has a high absorptive power for water. The humus, nitrogen and potash are all above the normal. There is no lack of. carbonate of lime The reserve of phosphoric acid is not very high On the other hand, the available potash and phosphoric acid are so high that I do not anticipate that commercial fertilizers will prove remunerative on this soil. In my opinion the grade of fruit obtainable from this land is limited by the seasons and the cultural management. The maintenance of the humus is, of course, an important matter for the future; otherwise commercial fertilisers should not be necessary for a long time to come.

Manurial Experiments.

Nine plots of variable size, distance of plants 10 x 10 feet.

Plot.	Treatment.	No. of Plants.	Cwts. per Acre.		
			Mixed Phosphate.*	Sulphate of Ammonia.	Sulph. of Potash.
1	No Manure ...	35	...	...	...
2	Complete Manure ..	58	5	1½	½
3	No Nitrogen ...	77	5	...	½
4	Double Nitrogen ...	93	5	3	½
5	No Phosphate ...	117	...	1½	½
6	Double Phosphate ...	152	10	1½	½
7	Treble Phosphate ...	109	15	1½	½
8	No Potash ...	105	5	1½	...
9	No Manure ...	113	...	...	...

* Superphosphate 3 parts, Steamed Bone Flour 2 parts.

Applied August 1901, Treatment repeated Autumn of 1902.

"The manured plots of bananas have grown well, but show very little difference in the plants, except slightly better in the "treble

phosphate" plot. The fruit already produced is the same as the piece usually grows, viz.: large 7 and 8 hands."

Report from Hon. R. P. Simmonds.

The manurial results, so far, correspond with the deductions from the analysis, viz.: that nitrogen, phosphate and potash are already present in adequate amount in this soil. A second year's trial is now on hand, and if no appreciable results are then obtained, I propose to try experiments on different modes of cultivation.

B.—Llanrumney.– Messrs. Kerr & Co. per Mr. L. B. Melville.

A level piece ef land closely similar to the Quebec land in character was selected for the experiments. The bananas were established somewhat irregularly, and some were lifted and the plantation straightened up, previous to the application of the manures.

MANURIAL EXPERIMENTS.

6 plots of ¼ acre = 100 plants each.

No.	Description	Cwts. per Acre.		
		Mixed Phosphate.	S. of Ammonia.	S. of Potash.
1	No Manure ...	...	...	...
2	Complete Manure ...	5	1½	1
3	No Nitrogen ..	5	...	1
4	Double Nitrogen ...	5	3	1
5	No Phosphate ...	...	1½	1
6	Double Manure ...	5	3	1

Manures applied Sept., 1901, repeated for 1902-3.

RESULTS.

May to August, 1902.

—	Bunches.				
	1st.	¾	½	¼	Total 1st Bunches per acre.
Plot 1. No Manure ...	3	6	4	0	38
Plot 2, Complete Manure ...	3	5	6	0	39
Plot 2· No Nstrogen ...	3	7	2	0	37
Plot 4, Double Nitrogen ...	6	3	5	0	43
Plot 5. No Phosphate ...	1	2	2	0	14
Plot 6. Double Manure ...	3	2	4	0	26

These results are negative. The experiment is being repeated and records made of the results. The analysis is as follows:—

SOIL ANALYSIS.

Reference Number—53.
Source Details—Experimental Plots, Llanrumney.
Depth of Sample—9 inches.

Physical Analysis.

				Per Cent.	
	Stones	...		Nil	
	Gravel	...		0.31	Fine Earth.
	Sand	...		0.89	
	Fine Sand	...		22.74	
	Silt	...		67.39	
Agricultural Clay	Fine Silt	...	2.53	2.53	
	Clay	...		Traces	
	Combined water, Organic matter	...		6.14	
	Total			100.00	
				Per Cent.	
Retentive Power for water		...		58.0	

Chemical Analysis.

(Soil pass through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter	...	43.141
Soluble in Hydrochloric Acid		56.859
Potash	...	0.607
Lime	...	18.402
Phosphoric Acid		0.120
Carbonic Acid as Carbonate of Lime		31.629
Combined Water and organic matter		17.650
Humus (soluble in Ammonia)		2.369
Nitrogen	...	0.198
Hygroscopic Moisture		6.539

Fertility Analysis.

		Per Cent.
Available Potash	...	0.0060*
Available Phosphoric Acid	...	0.0238*

* Provisional number.

Observations.

This soil is closely similar to the Quebec soil in mechanical structure. It differ in possessing a large proportion of carbonate of lime. All the factors determined are normal for a soil of good fertility. The 'available' potash is being re-determined. The available phosphoric acid is equal to that of the Quebec soil and indicates a sufficiency of this ingredient for all practical needs.

Clearly a soil in need of good management on general agricultural lines rather than starving from lack of plant-food. Fertilisers are not expected to prove remunerative under present conditions.

C. Koningsberg. Hon. Dr. Pringle, C.M.G.

To test the value of analysis as a guide to manuring, it was decided to carry out an experiment on a soil which was analysed for Dr. Pringle in 1901. The figures and an extract from the report are given.

The soil having been found deficient in phosphoric acid and carbonate of lime basic slag was diagnosed as the best phosphate for a clay soil of this nature. Drainage by contour trenches has been found to work wonders on this land, and the proprietor has achieved gratifying results by an extension of this system on these impervious upland fields.

SOIL ANALYSIS.

Reference Number—5.
Source Details—Banana land of poor quality from a part of Koningsberg. Hon. Dr. Pringle.
Depth of Sample—9 inches.

Physical Analysis.

				Per cent.	
	Stones	...		—	
	Gravel	...		0.26	Fine Earth.
	Sand	...		0.94	
	Fine Sand	...		22.07	
	Silt	...		22 87	
Agricultural Clay.	Fine Silt	...	41.56	24.11	
	Clay	...		17.45	
	Combined water, Organic matter.	..		12.30	
	Total			100.00	
				Per Cent.	
Retentive Power for water		...		63.00	

Chemical Analysis.

(Soil passed through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter	...	54.22
Soluble in Hydrochloric Acid		45.88
Potash		0.291
Lime		0.244
Phosphoric Acid		0.025
Carbonate Abid as Carbonate of Lime		0.120
Combined Water and organic matter		12.300
Humus (soluble in Ammonia)		3.150
Nitrogen		0.211
Hygroscopie Moisture		9.660

Fertility Analysis.

		Per Cent.
Available Potash	..	0.033
Available Phosphoric Acid	...	0.015

Observations.

The carbonate of lime is low, the total phosphoric acid is very low although an extraordinary proportion is in an available state. The reserve of phosphoric acid is so low that I consider this soil should receive regular applications of 5 to 7 cwt. per acre of basic slag.

This soil is naturally inferior to the soils from Quebec Park and Burlington where bananas are doing well.

Manurial Experiments.

8 Plots, each ¼ acre.

Plot.	Description.	Cwt. per Acre.		
		Basic Slag.	Nitrate of Soda.	Muriate of Potash.
1	No Manure ...	—	—	—
2	Complete Manure ...	6	1	1
3	No Nitrogen ...	6	—	1
4	Double Nitrogen ...	6	2	1
5	No Phosphate ...	—	1	1
6	Double Phosphate ...	12	1	1
7	No Potash ...	6	1	—
8	Mixed Phosphate* ...	5	1	1

*3 parts superphosphate. 2 parts steamed Bone flour.

The only nine hand bunches were on plot 4 "double nitrogen." The majority of plots gave 7 hands. The neighbouring lands only 5 hands. The absence of potash, and substitution of mixed phosphate for slag on plots 7 and 8 reduced the grade 25 per cent.

It is deduced from this experiment that

6 cwt. slag
2 cwt. Nitrate of Soda (in two doses)
1 cwt. Potash per acre

should prove a remunerative dressing on this land.

D. Buck Piece, Orange Hill
E. Lambie Piece, Orange Hill.
F. Newrey

are three soils recently analysed for Dr. Pringle and the manurial experiments suggested have been started. It is hoped that these experiments will lead to a definite conclusion as to the possibility or otherwise of using chemical manures to a profit on the St. Mary lands which have been so long in cultivation as to show signs of exhaustion.

SOIL ANALYSIS.

Reference Number—50.
Source Details—Buck Piece, Orange Hill. Hon. Dr. Pringle.
Depth of Sample—9 inches.

	Physical Analysis.		Per Cent.	
	Stones	...	Nil	
	Gravel	..	Nil	Fine Earth
	Sand	..	0.28	Fine Earth
	Fine Sand	...	30.22	Fine Earth
	Silt	...	59.21	Fine Earth
Agricultural Clay	Fine Silt	...	1.43 (1.43)	Fine Earth
	Clay	...	Traces	Fine Earth
	Combined water, Organic matter.	...	8.86	Fine Earth
	Total		100.00	
			Per Cent.	
Retentive Power for water		...	56.0	

Chemical Analysis.

(Soil passed through 3 m.m. Seive dried at 100°C.)

Insoluble Matter	...	60.077
Soluble in Hydrochloric Acid		39.923
	Potash ...	0.686
	Lime ...	4.332
	Phosphoric Acid	0.053
	Carbonic Acid as Carbonate of Lime	10.681
Combined Water and organic matter		26.148
	Humus (soluble in Ammonia)	1.486
	Nitrogen ...	0.103
	Hygroscopic Moisture	9.730

Fertility Analysis.

Available Potash	...	0.003
Available Phosphoric Acid		0.007

Observations.

The mechanical composition shows the close similarity between this soil and the other two of the series, and the same relationship to tillage and drainage will be apparent The proportion of carbonate of lime is quite marked in this case. This soil shows signs of exhaustion. Both the total and available potash and phosphoric acid are below par. The humus and nitrogen are also low for a banana soil. Every effort should be made to increase the humus by such methods as are possible in the routine of cultivation I anticipate that the following manure would improve the grade of fruit :—

4 cwt. Superphosphate
1½ cwt. Sulphate of Potosh
1½ cwt. Sulphate of Ammonia
} per acre.

SOIL ANALYSIS.

Reference Number—49
Source Details—Lambie Piece, Orange Hill, St Mary. Banana Land. Hon. Dr. Pringle, C M.G.
Depth of Sample—9 inches.

Physical Analysis.

				Per Cent.	
	Stones	...		Nil	
	Gravel	...		Nil	Fine Earth.
	Sand	...		0.12	Fine Earth.
	Fine Sand	...		15.59	Fine Earth.
	Silt	...		68.42	Fine Earth.
Agricultural Clay	Fine Silt	...	1.57	1.57	Fine Earth.
Agricultural Clay	Clay	...	1.57	Traces	Fine Earth.
	Moisture	...		14.30	Fine Earth.
	Total			100.00	
				Per Cent.	
Retentive Power for water		...		58.00	

Chemical Analysis.

(Soil passed through 3 m. m. Sieve dried to 100° C.)

Insoluble Matter ...	63 250
Soluble in Hydrochloric Acid	36.750
Potash ...	0 830
Lime ...	3.748
Phosphoric Acid	0.158
Carbonic Acid as Carbonate of Lime	5.846
Humus (Soluble in Ammonia)	2.283
Nitrogen ...	0.138
Hygroscopic Moisture	16.680

Fertility Analysis.

	Per Cent.
Available Potash ...	9.0058
Available Phosphoric Acid	0.0046

Observations.

This soil is closely similar to 'Newrey' and 'Buck Piece,' O. Hill, in mechanical composition and the same remarks apply in each case as to cultivation and drainage. The total potash and phosphoric acid are normal, the available supply, however, being decidedly below par. Some degree of exhaustion is clearly indicated. The humus and nitrogen are markedly higher than in the other two cases and are normal for a banana soil. I regard the maintenance and increase of the standard of these constituents as vital to the banana producing value of these lands. This soil contains a marked proportion of carbonate of lime. I recommend a trial of

5 cwt. Superphosphate
1 cwt. Sulphate of Ammonia } per acre.
1 cwt. Sulphate of Potash

as likely to give an increase in the grade of bunch.

SOIL ANALYSIS.

Reference Number—48.
Source Details—Newrey Piece, Newrey. Hon. Dr. Pringle.
Depth of Sample—9 inches.

Physical Analysis.

				Per Cent.	
	Stones	...		Nil	
	Gravel	...		0.22	Fine Earth
	Sand	...		1.38	
	Fine Sand	...		23 83	
	Silt	...		63.79	
Agricultural Clay	Fine Silt	...	0.48	0.48	
	Clay	...		Traces	
	Moisture	...		10.33	
	Total	...		100.00	
				Per Cent.	
Retentive power for water		...		61.0	

Chemical Analysis.

(Soil passed through 3 m. m. Sieve dried at 100° C.)

Insoluble matter	...	64.030
Soluble in Hydrochloric Acid	...	25.970
Potash	...	0.960
Lime	...	1.191
Phosphoric Acid	...	0.085
Carbonic Acid as Carbonate of Lime		0.316
Combined Water and organic matter		10.193
Humus (soluble in Ammonia)		1.146
Nitrogen		0.089
Hygroscopic Moisture	...	11.510

Fertility Analysis.

		Per Cent.
Available Potash	...	0.004
Available Phosphoric Acid	...	0.013

Observations.

This soil is composed almost entirely of particles of medium fineness, gravel and clay being practically absent, Its mechanical composition is highly favoursble for cultivation and provides admirable conditions for the root development of the banana. While retentive of moisture the soil drains easily and would re-act readily to a system of drainage trenches. The total potash is normal, but the 'available' decidedly below par and indicates the desirability of the use of potash manure. The phosphoric acid reserve is low for a banana soil, but the available supply is normal. The humus and nitrogen are both decidedly low and every effort should be made to increase these. I conclude that Pen manure and green dressings would be of decided benefit. I think it likely that the Banana Trash ashes from the Railway Depot, containing 6.86 per cent. of Potash, would be beneficial on this soil. I would suggest as a general fertilizer—

3 cwt. Superphosphate
2 cwt. Sulphate of Ammonia } per acre.
1 cwt. Sulphate of Potash

II. ST. CATHERINE.

Experiments on banana soils in the irrigation area of St. Catherine have i dicated that these soils are possessed of very high natural fertility and that the use of fertilisers is quite uncalled for.

A.—*Rodens.* Mr. R. Hay.

A piece of land was selected on this property which appeared to be balow par and likely to respond to the application of fertilisers.

The analysis of the soil gave the following results :—

SOIL ANALYSIS.

Reference Number—51.

Source Details—Rodens Pen, St. Catherine.

Depth of Sample—9 inches.

Physical Analysis.

				Per Cent.	
	Stones	..		Nil	
	Gravel	...		1.65	Fine Earth
	Sand	...		8.67	
	Fine Sand	...		40 44	
	Silt	...		43.77	
Agricultural Clay	Fine Silt	...	1.81	1.19	
	Clay			0.62	
	Combined water, Orgrnic matter.	...		3.66	
	Total	...		100.00	
				Per Cent.	
Retentive power for water		...		50.0	

Chemical Analysis

(Soil passed through 3 m.m. Sieve dried at 100° C.)

Insolable Matter	...	71.059
Soluble in Hydrochloric Acid		28.941
Potash	..	0.445
Lime	...	1.573
Phosphoric Acid	...	0.194
Carbonic Acid as Carbonate of Lime		0.438
Combined Water and organic matter		7.090
Humus (soluble in Ammonia)		1.604
Nitrogen	...	0.152
Hygroscopic Moisture		3.800

Fertility Analysis.

		Per Cent.
Available Potash	...	0.011
Available Phosphoric Acid	..	0.072

Observations.

This soil consists principally of fine, sandy particles, and has excellent properties for the cultivation of bananas, being free-draining and yet retaining a considerable amount of moisture. The humus is the only factor that might be considered at all low. All the other constituents determined indicate a state of present and reserve fertility of a very high standard. The maintenance of the humus and skilled management of water and cultural operations should suffice to produce bananas from this soil for a series of years without recourse to chemical fertilisers. The available and total phosphoric acid are noteworthy. There is an adequate proportion of carbonate of lime.

MANURIAL EXPERIMENTS.

8 plots, each ⅓ acre.

Plot.	Description.	Cwt. per Acre.		
		Superphosphate.	Sulphate of Ammonia.	Sulphate of Potash.
1	No Manure ...	—	—	—
2	Complete Manure ...	5	2	1
3	No Nitrogen ...	5	—	1
4	Double Nitrogen ...	5	4	1
5	No Phosphate ...	—	2	1
6	Double Phosphate ...	10	2	1
7	No Potash ...	5	2	—
8	Double Complete Manure ...	10	4	2

Manures applied end of August, 1901.

At first, marked effects were observable on the young plants, but as the season progressed they all fruited alike and Mr. Hay reports that it was quite impossible to find any effects whatsoever upon the fruit from any of the manures, all the plots being alike. The experiment is being repeated on the ratoons for the present season. These results, so far, are in complete agreement with the deductions from the analytical data.

B.—Laurencefield—Hon. J. Allwood, per Mr. Arnold Clodd.

A piece of banana land was selected on this property for a manurial experiment and analysis. The analysis revealed a very high standard of fertility and it was not surprising that the fertilisers failed to produce results.

Eight plots of ¼ acre each were treated as at Rodens, except that mixed phosphate, consisting of 3 parts of superphosphate incorporated with 2 parts of steamed Bone Flour, was employed as a source of phosphoric acid.

A second series of experiments on a piece of land in an apparently poorer state is being carried out on the present seasons crop.

Appended is the analysis of the soil.

SOIL ANALYSIS.

Reference Number—54. Source Details—Laurencefield, St. Catherine. Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	2.75	Fine Earth.
	Sand	...	11.27	
	Fine Sand	...	40.79	
	Silt	...	39.34	
Agricultural Clay	Fine Silt	...	3.55 { 3.06	
	Clay	...	0.49	
	Combined water } Organic matter }	...	2.30	
	Total		100.00	
			Per Cent.	
Retentive Power for water		...	46.0	

Chemical Analysis.

(Soil passed through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter ...	78.540
Soluble in Hydrochloric Acid	21.460
Potash ...	0.392
Lime ..	1.022
Phosphoric Acid	0.218
Carbonic Acid as Carbonate of Lime	0.174
Combined Water and organic matter	5.520
Humus (soluble in Ammonia)	3.610
Nitrogen ...	0.162
Hygroscopic Moisture	2.350

Fertility Analysis.

	Per Cent.
Available Potash ..	0.053
Available Phosphoric Acid	0.064

Observations.

This soil corresponds closely to the soil from Rodens in mechanical composition. The fertility is beyond question. The available potash and phosphoric acid are 6 times the normal. It is hardly like y that even extravagant dressings of chemical fertilisers should produce any marked results on this soil. The carbonate of lime might be higher. A dressing of marl will probably be desirable in a year or two. The humus is high enough for present purposes.

III.—ST. ANN.

Huntly, Brown's Town. Mr. H. Q. Levy.

A well managed piece of newly planted banana plantation was here used for manurial experiments.—7 Plots of ¼ acre each were treated as follows :—

Plot.	Description.	Cwts. per Acre.		
		Mixed Phosphate.	Sulph. Ammonia.	Sulph. Potash.
1	No Manure ...	...	...	...
2	Complete Manure ...	5	1½	½
3	No Nitrogen ...	5	...	½
4	Double Nitrogen ..	5	3	½
5	No Phosphate ...	...	1½	½
6	Double Phosphate ...	10	1½	½
7	Double Complete ...	10	3	1
8	No Potash ...	5	1½	...

The results were uniformly bad. No marketable crops were obtained during the year, The bananas, apparently, failed completely. Mr. Levy being of opinion that a heavier dressing was required, the experiment has been repeated this season, using 6 cwt. of phosphates, 3 cwt. of S. of ammonia and 2 cwt. S. of potash per acre as the normal manure for plot 2.

My own opinion is that the manures were not concerned in the results obtained, but that the failure to grow bananas is due to other causes than a deficiency of plant food

The coming season's results should serve to decide whether fertilizers alone can mend matters.

The analysis is as follows :—

SOIL ANALYSIS.

Reference Number—59. Source Details—Huntly. Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	2.74	Fine Earth.
	Sand	...	4.05	
	Fihe Sand	...	30.62	
	Silt	...	55.59	
Agricultural Clay	Fine Silt	...	1.64 { 0.81	
	Clay		0.83	
	Moisture	...	5.36	
	Total		100.00	
			Per Cent.	
Retentive Power for water		...	56.0	

Chemical Analysis.

(Soil passsd through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter ...	18.170
Soluble in Hydrochloric Acid	81.830
Potash ...	0 172
Lime ...	0.254
Phosphoric Acid	0.393
Carbonic Acid as Carbonate of Lime	0.454
Combined Water and organic matter	25.340
Humus (soluble in Ammonia)	3.625
Nitrogen ...	0.130
Hygroscopic Moisture	5.660

Fertility Analysis.

	Per Cent.
Available Potash ...	0.011
Available Phosphoric Acid	0.007

Observations.

This is a specimen of the red soils derived from the limestone found in this district and bears out the fact that such soils are singularly destitute of carbonate of lime. In this case the amount is probably adequate for cultural needs.

The total phosphoric acid is high, the available being below par. The potash is not high. The humus and nitrogen appear to be normal for a good soil. It would seem that this soil should respond to a phosphatic manure, either Basic Slag or preferably a mixture of superphosphate and steamed bone flour. The soil is light and free-draining. It is possible that the large amount of ferric iron in the soil may affect not only the nutrition of plants but also the results of the manures applied.

IV. ST. THOMAS-IN-THE-EAST.

The following analyses of soils from St. Thomas upon which bananas are grown are here presented. As will be seen, these soils are light medium loams of high fertility. The potash appears deficient in one case otherwise each of these soils is beyond reproach in all the elements of fertility. With a liberal rainfall no irrigation is necessary. Hurricanes, which are peculiarly destructive in this part of the island, have played sad havoc in past seasons, but during the past year the banana growers of St. Thomas have obtained splendid results.

—		Soils.								Sub soils.					
Reg. No.	...	16	17	18	19	20	21	22	23	22A	22B	22C	23A	23B	23C
Depth of Sample	...	9″	9″	9″	9″	9″	9″	9″	9″	9″-24″	24″-36″	36″-48″	9″-24″	24″-36″	36°-48″
Mechanical Analysis. Gravel	...	1.39	2.92	0.69	1.16	0.94	0.17	3.40	0.67	0.40	0.62	0 20	0.41	0.32	0.15
Sand	...	4.74	7.94	3.81	8.22	15 45	1.99	5.52	13.31	9 06	4.73	2.49	1 50	2.12	1.75
Fine Sand	...	26.91	29.16	29.33	26.83	30.30	39.67	30.68	25.38	30.41	34.71	41.11	32.26	35.43	31 03
Silt	...	51.46	45 00	45.83	48.36	38.74	46.38	47.35	45.44	42.57	45.63	44.71	49.92	48.74	54.42
Fine Silt	...	7.24	6 15	10.29	6.73	7.16	6.02	5.13	7.35	9.75	7.12	6.23	7.56	6.19	5.49
Clay	...	1.81	1.55	1.30	1.26	1.19	traces	0.51	1.37	2.85	2.64	0.92	2.52	1.86	1.78
Moisture	...	6.45	7 28	8.75	7.44	6.22	6.15	7.41	6.48	4 96	4 55	4.34	5.83	5.34	5.38
Retentive Power for water	...	54.5	52.0	53.0	52.0	56.0	51.0	55.0	—						
Chemical Analysis. Insoluble Matter	...	62.440	62.310	60.450	61.500	63.170	63 720	61.500	52.090						
Potash	...	0.853	0.352	0 395	0 783	0.359	0 240	0.458	0.507						
Lime	...	2.560	3.960	2.631	2.800	3 640	2.670	2.950	10 670						
Phosphoric Acid	...	0.246	0.168	0.199	0 201	0.158	0.139	0.204	0.214						
Carbonate of Lime	...	1.560	2.910	2.470	0.290	4.170	1.990	1.830	14.150						
Humus (soluble)	...	1.810	2.020	1.750	1 670	1.670	1.360	1.860	1.750						
Nitrogen	...	0.172	0.143	0.172	0.196	0.186	0.152	0.170	0.168						
Fertility Analysis Available Potash	...	0.013	0.010	0.005	0.012	0.008	0.011	0.009	—						
Fertility Analysis Available Phosphoric Acid	..	0.044	0.025	0.025	0.023	0.030	0.015	0.029	—						

V. VERE.

When the irrigation canal system is established in Vere, it may prove desirable for some of the estates to grow bananas as well as cane. The analysis of the soil from Hillside estate, here given, is indicative of the type of soil in this district which is suitable for the purpose, provided the irrigation is well managed All grades of soil from this light, fine silt to stiff clay are found in Vere and the lighter soils will undoubtedly be found the best adopted for banana cultivation with irrigation. The soils hitherto analysed from this district (14 samples of soils and 12 subsoils) indicate a remarkably high standard of fertility. We do not expect to get marked results from fertilisers on these soils.

SOIL ANALYSIS.

Reference Number—62
Source Details—Hillside Estate, Vere.
Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	1.12	Fine Earth.
	Sand	...	0.50	
	Fine Sand	...	32.32	
	Silt	...	54.72	
Agrciultural Clay	Fine Silt	...	5.98 { 4.57	
	Clay	...	1.41	
	Moisture	...	5.36	
	Total		100.00	
			Per Cent.	
Retentive Power for water		...	54.0	

Chemical Analysis.

(Soil passed through 3 m. m. Sieve dried at 100° C.)

Insoluble Matter	...	68.931
Soluble in Hydrochloric Acid		31.069
Potash	...	0.573
Lime	...	0.951
Phosphoric Acid		0.168
Carbonic Acid as Carbonate of Lime		0.296
Combined Water and organic matter		9.950
Humus (soluble in Ammonia)		2.810
Nitrogen	...	0.155
Hygroscopic Moisture		5.66

Fertility Analysis.

		Per Cent.
Available Potash	...	0.021
Available Phosphoric Acid		0.044

Observations.

This is a light soil consisting chiefly of fine sand and silt. Its fertility is unimpeachable. This is a soil of very high quality. Irrigation, well managed, should enable this soil to produce very large crops for a series of years without manure. The carbonate of lime is low and as a good grade of marl is obtainable in the locality, it would be desirable to spread some from time to time, otherwise this soil is above reproach.

Conclusion.

From the analysis of over 30 banana soils representing the chief banana lands of the island, it has been ascertained that Jamaica possesses very large areas of land of such exceptional fertility and adaptability that this cultivation is assured for many years to come, without any need for discounting profits by importing fertilisers from abroad.

The manurial experiments have, so far, borne out the analytical data, and the conclusions drawn therefrom in a striking manner. Apart from the professional interest that attaches to the successful use of manures in experiments, it is certainly most gratifying to have demonstrated the fact that, for the most part, the banana industry of the Island is still far from depending on imported aids to fertility.

In so far as soil conditions alone, apart from climate, water supply and cultural management, are concerned, these results fortify the conclusion that by analysis it is now possible to give a practical opinion upon a soil for banana cultivation. I desire to record my indebtedness to Messrs. H. S. Hammond and E. J. Wortley of the Government Laboratory for their assistance in carrying out the laborious operations involved in obtaining these results.

KOLA NUTS.

In answer to enquiries on the subject of Kola Nuts, and the prospects for this product, the following letters have been received:—

Messrs. Gillespie Bros. & Co., London, to the Director Public Gardens and Plantations, Jamaica.

With reference to the low range of prices now current for this article, we have made enquiries from what we believe to be well informed sources, and we understand that the chief cause of the decline is the fact that France (formerly a large buyer here) now imports direct from Africa in big parcels. In the second place many of the advertising manufacturers (cocoa, drinks, &c) both here and in the U.S.A. are not pushing the article as they were a few years ago: and it does not seem that Kola has 'caught on' in either country to the same extent as in France. Our Brokers think there will always be a moderate demand at about 2d to 3d., but former prices are a thing of the past.

Messrs. Gillespie Bros. & Co., New York, to Director, Public Gardens.

There is a regular demand for the dried in small quantities at from 4 cents to 6 cents per lb. The green should not be shipped, and the dried not in lots of more than from 1 to 2 tons; because for some years Africa and the other West Indies have been sending all that was required in this market. As a matter of fact the knowledge that unlimited supplies are procurable has had the effect to cheapen the article, and there is no likelihood of a return to the profitable rates of four or five years ago. There is no duty on the article in the United States.

Messrs. E. A. DePass & Co., London, to Director, Public Gardens.

The demand for Kola Nuts in London is a fair one, and the present value is about 3½d to 4d. per lb. for good sound nuts, but the great majority of those received from Jamaica are mouldy and in that condition are almost valueless. It is true that some years ago, Kola

fetched a considerably higher price, but since then the supplies have materially increased. The principal points however to impress upon shippers from Jamaica is that nuts should be prepared in such a way that they may arrive here absolutely sound.

Mr. J. R. Jackson reports as follows in a late number of the "Agricultural News":—

Of Kola Nuts at the first sale six barrels fresh Grenada sold at 1½d. per lb, 'fair, washed' West Indian realizing 3¾d., and at the second sale 21 barrels of West Indian were disposed of at 3¼d. to 3½d. for good quality, and 1½d. for 'wormy'

ELEMENTARY NOTES ON JAMAICA PLANTS, VI.

8—Grasses.

By the Editor.

Guinea Grass.

Cut across a stem of Guinea Grass. Note where it is cut that the outline is rounded. The stems of all grasses, when cut through, have

a more or less rounded outline, whereas many sedges,—grass-like plants growing on swampy sour soil, have a triangular section.

The leaf is composed of two parts, the lower part forming a sheath round the stem or culm; the upper part the blade, is very long and narrow, with veins running parallel to one another. The margins of the leaf-blade have a saw-like edge with minute sharp teeth pointing upwards; the surfaces also are rough with points all going in the some direction. Between the blade and the sheath, on the inside, is a projecting rim which exists more or less in all grasses; it is called the ligule, and its probable use is to assist the sheath in protecting the tender stem. When the ligule is hairy, as it is here, it more easily prevents rain from soaking down between the sheath and the culm. The sheath is hairy, and it is split, one edge overlapping the other.

Cut across where the young leaves are wrapped round and it will be seen that one half the blade is rolled round the culm, and that the other half encircles it again. This method of folding of the young leaf is spoken of as *convolute*.

Pull off the leaves with their sheaths, and notice that at intervals along the culm there are thicker portions,—the nodes (which are hairy), dividing the culm into joints or internodes.

Notice how this grass grows in tufts. Dig up a tuft, wash away the soil, and see how the buds sprout from below the base and then grow upwards. This shows how the tufts are formed, and how it is possible for it to spring up amongst bush.

The roots are thin, fibrous, and branching, spreading in every direction all round.

Cut off the flowering part, any loose branching inflorescence of this kind is called a panicle. The panicle in Guinea Grass is large, with the lower branches whorled.

Break off a spikelet, one of the seed-like bodies, like fig. C. 1. in Plate 8, and dissect it under a lens with needles. Note the stalk of

the spikelet, that it is rounded and has no angles—"filiform" At the base cut off the short chaffy husk a, and then cut off b (See figs. in C.), these are technically called glumes. Then come two flowers, cut off the lower one, and open it: the large husk is the third glume, and the smaller which fits tightly like a lid, over the flower in the glume is called a palea. There are three stamens only, sometimes none. The flower at the top of the spikelet has also a glume and palea, both with fine lines marked across them; this flower has both stamens and pistil and is called the fertile flower, as it yields the seed. Note that it is rounded on one side, flat on the other, and that the styles are distinct with plumose stigmas.

At the base of the ovary are two small bodies called "lodicules". When the flower is ready to open, these lodicules swell ap and force open the glume and palea (C. 9, 10). Then the stalks or "filaments' of the stamens grow very rapidly, carrying the anthers out beyond the glumes into the air. While the anthers were still concealed within the glumes, no pollen was discharged, but as soon as they are placed outside the glumes by the growth of the filaments, each lobe of the anther begins to split along a line running down it, and discharge the pollen. The anther is balanced at one point at the end of the filament (*versatile*), so that it turns easily at every breath of wind which carries off the pollen, and scatters it on the stigmas of other flowers on the panicle.

Guinea Grass is one of our very tall grasses, often reaching from 6' to 10 feet high.

Its botanical name is Panicum maximum.

Bahama Grass.

The stem of Bahama Grass is prostrate, creeping, with upright, leafy flowering branches, 4 to 8 or 10 inches high. The roots spring from the nodes of the creeping stem.

The blade of the leaf is short, flat, narrow, rough on both surfaces, and the margin. In the young leaf it may be noticed that the two halves of the blade are folded flat against one another (conduplicate). The ligule is very short, but has long bristly hairs. The sheath is split.

The spikelets (fig. B. 1) have no stalks as they have in Guinea Grass, but are arranged in two rows along one side of a common flower-stalk. There are generally four of these stalks radiating from the top of an upright stem.

When the two lower empty glumes are removed from the base, a small bristle will be observed, which looks like the stalk for another flower which has not developed. The third glume and its palea enclose a fertile flower with three stamens, and an ovary with two distinct styles and plumose stigmas. The figure B. 9 shows the two lodicules opposite to the palea. In figure B. 4 the flower is older than the rest, and the stalks or filaments of the stamens have lengthened so that the anthers are now hanging quite outside the flower, and the pollen will be dusted by the wind over the stigmas of other flowers near by.

Sugar Cane.

The spikelet of the Sugar Cane (fig. A.) appears at first sight to be composed of one empty glume (A. 4), then a flowering glume (A. 5)

and a palea (A. 6) enclosing a perfect flower (A. 7) with three lodicules (A. 9). But botanists who have paid special attention to the immense family of Grasses, and have compared the spikelet with those of nearly allied species, consider that there are 3 glumes, and that what looks like a third lodicule is really a very small palea.

A number of bristles spring from below the base of the spikelet.

The spikelets are arranged, two together, alternately on opposite sides of the flower stalk (rachis), one of them with a stalk, the other sessile.

The inflorescence is a large spreading panicle with the branches more or less whorled.

The culm is erect, but sometimes falls over, and then roots at every node There is one bud at every node, and the roots spring out all round it. This is one method of propagation under natural conditions.

The sheaths of the leaves are often covered in the young state with stinging hairs. The ligules are very short, edged with very short hairs. The blades are narrowed at the base, pointed at the apex rough.

Explanation of Plate.

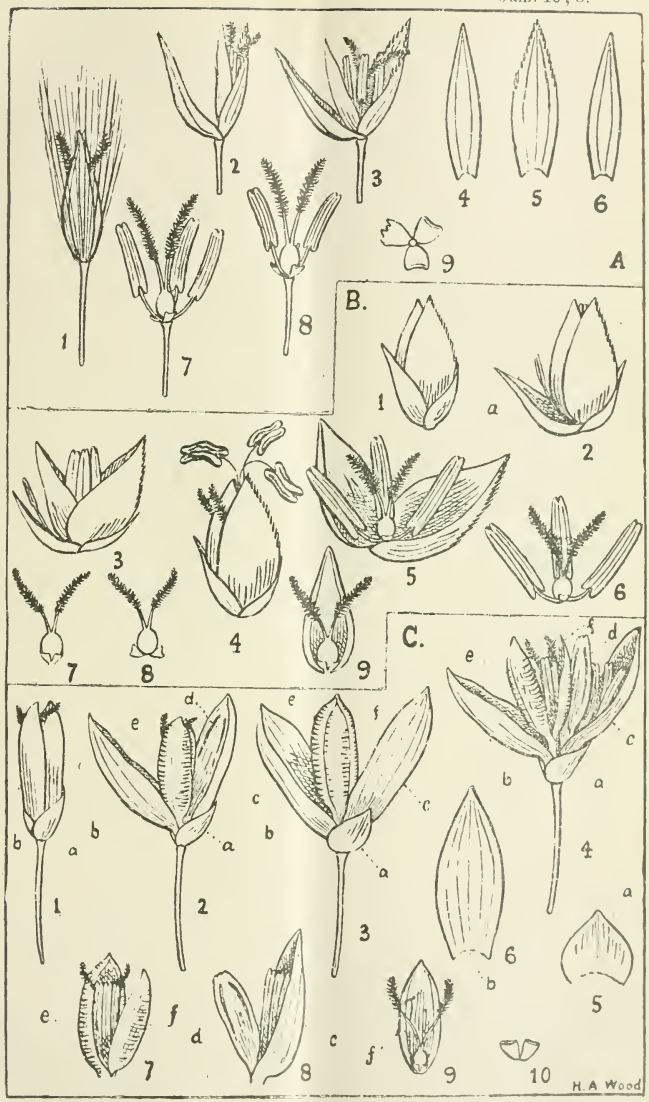
A. Flowers of Sugar Cane.
Fig. 1. Spikelet.
Fig. 2. Do. with glumes partly spread.
Fig. 3. Do. do. widely spread.
Fig. 4. First glume.
Fig. 5. Second glume.
Fig. 6, Third glume.
Fig. 7. Pistil and stamens.
Fig. 8. Do. with one stamen removed, showing lodicules.
Fig. 9. Lodicules and palea.
B. Flowers of Bahama Grass.
Fig. 1. Spikelet.
Fig. 2. Glumes partly spread. showing rachilla *a*.
Fig. 3. Third glume and palea spread, showing anthers.
Fig. 4. Spikelet with pollen discharged from the anthers.
Fig. 5. Spikelet opened.
Fig. 6. Pistil and stamens.
Figs. 7, 8. Pistil with lodicules.
Fig. 9. Position of lodicules with reference to palea.
C. Flowers of Guinea Grass.
Fig. 1. Spikelet.
Figs. 2, 3, 4. Do. opened; *a*. first glume, *b*. second glume, *c*. third glume and *d*. palea of staminate flower, *e*. glume and *f*. palea of terminal perfect flower.
Fig. 5. First glume.
Fig. 6. Second do.
Fig. 7. Terminal flower.
Fig. 8. Staminate flower.
Fig. 9. Pistil, lodicules and palea.
Fig. 10. Lodicules.

DEPARTMENT OF AGRICULTURE.

Report of Meeting of Board, held on 16th December.

Board of Agriculture.

The usual monthly meeting of the Board of Agriculture was held at Head Quarter House on Tuesday, 16th December, when there were present: The Hon. the Colonial Secretary (Chairman), the Hon. the



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GRASSES.

Director of Public Gardens, the Government Chemist, His Grace the Archbishop and the Hon. H. Cork.

The minutes of the last meeting were read and confirmed.

Mr. Fawcett mentioned that he had received a supply of cotton seed from the U. States Department of Agriculture which had been forwarded to Mr. Palache to be planted at the Prison Farm, and also that the expert of the Montpelier Cigar Factory had inspected the tobacco grown and cured at Hope, and had expressed the opinion that the quality could not be better.

Letters were read and discussed on the subject ef growing cotton and the Board concluded that it would be advisable to arrange for an experiment in planting on a moderate scale, before planters were advised to go into the cultivation.

A report was read from Mr. Cradwick on the disease among cocoanuts in which he suggested that arrangements should be made for him to devote a month to studying the disease in all parts of the Island. The Board was however, of opinion that it was not desirable to detach Mr. Cradwick in any way from his present work, and considered that the object might be met by Mr. Cradwick arranging to carry on experiments at Bowden and other selected spots. It was also decided to publish an account of the disease, proposed method of treatment, &c., with a view to obtaining further information from planters.

A recommendation was made to the Board that efforts should be made to stop the damage done to cocoa pods by Woodpeckers, by withdrawing protection from these birds. The members decided against interfering in this matter. It was agreed to make arrangements to admit of Mr. T. J. Harris travelling in the country parts with a view to acquainting himself with the methods of planters and settlers.

A letter was read from Mr. Fursdon apologising for his absence and also requesting the Board to consider the danger of the importation of Foot and Mouth disease. The Board agreed to recommend the Government to impose an absolute quarantine on all cattle from the United States.

Mr. Fawcett stated that the issue of the Bulletin of the Botanical Department would cease with the present number, and a Bulletin of the Department of Agriculture would be commenced in January. It was agreed to increase its size to 24 pages.

PANAMA HATS.

In the Bulletin for October, 1902,* an account was given of the native industry that has lately become of importance, namely, making "Ippi-appa" hats from the native plant.

As there was some doubt whether the process used here for curing the straw was identical with that in Ecuador and Colombia, information was sought from H. B. M. Representatives in Bogota and Guayaquil.

Our thanks are due to them and also to those at Panama and Colon for the courteous and ready manner in which they have afforded most valuable information and assistance.

It will be noticed that lemon juice is used in the manufacture, and probably this helps to make the straw whiter.

* Bulletin of the Botanical Department, Jamaica, Vol. IX., page 145.

H. B. M. Ambassador at Bogota, to Director Public Gardens and Plantations, Jamaica.

British Legation,
Bogota, October 30, 1902.

Sir,

In answer to your enquiries regarding the hat industry, I must refer you to His Majesty's Representative in Peru whose jurisdiction extends to Ecuador, for information regarding the manufacture of "Panama hats" in the latter Republic.

These hats are also made in Colombia, and I enclose a memorandum with some details which may serve your purpose, but I regret I am unable, owing to the unsettled state of the country, to procure the samples of straw you want. Not that I think they would help you as from the process mentioned in the memorandum of its preparation the straw would deteriorate on the way to Kingston.

I would suggest, if this hat industry is to be introduced into Jamaica, the best plan would be to import an expert "boiler" and "hatters" to properly teach the art.

I am,
Sir,
Your obedient Servant,
C. MALLETT.

Information relating to the "Panamà hat" industry in Colombia.

Panamá hats are made in Colombia in the departments of Santander (near Bucuramanga) Antioquia (near Aguadas, Southern Cauca and Southern Tolima (Suaza district).

A traveller will take from ten days to three weeks to get from Bogota to any of these places: it all depends on the state of the roads and the time of the year. During the rainy season, some of the roads become almost intransitable.

To day, an average Suaza hat cost *there* about $120. A fine one $300 to $400—a very fine one $600 to $800. Prices change weekly according to the demand there may be. During the last eighteen months steady weekly rise has taken place.

The Suaza hat is considered here very superior to the Ecuador hats.

The common fan-shaped palm, called by the natives "palmiche" is the one used in the manufacture of these hats.

Young shoots, very uniform as to size are cut from the plant and boiled to a certain stage. Thus they become a uniform light yellow colour. When the proper boiling point has been reached they are hung up to dry and all leaves quickly separated. This is done inside the house, where there is a draught but *no sunlight.* When the leaves are nearly dry, they are split with a little Y shaped wooden tool so that every good leaf is exactly the same size as another. Left alone then to dry, as above, the leaves curl in at the edges and then are ready for manufacture. The "straw" is carefully wrapped in clean clothes, as the light and the dry atmosphere spoils them.

In the Suaza district hats are made on solid wooden blocks, two to four persons (usually women) sitting opposite each other steadily at work. An average hat is thus made between four women in a week's time. A fine hat will take from three to six weeks' time. When

finished, the straw is carefully pared with a penknife, then with a small hand-mase battered all over. After this, it must be well washed with common yellow soap and lime juice, and left to dry out of the sunlight

The climate influences greatly the manufacture of these hats. A good hatter cannot make a good hat during the dry summer weather or during the rainy season. Probably for this reason hats in certain villages of the Suaza district are very superior to those made only a few miles away.

To become a good hatter requires a very long training; for this reason the female children are set to work at very early age—usually about ten years old—and require constant practice. Hatters work every day steadily through all day taking hurried meals and often continue work by candle light so as to have the hat ready by market day. An hour, or two, wasted means to them the loss of the market day and consequently the loss of ready money for their household purposes. They are thus obliged to work without losing, or wasting any time. While at work, the women sing, or chat freely with any visitor, but continue their work without interruption.

The process of boiling the culls appears to be an art in itself as only few people are able to turn out good straw The boilers of straw sell it at so much the pound according to the quality of the straw and the ruling price of hats.

The paper dollar is worth about one-half-penny.

H. B M. Consul, Guayaquil to Director Public Gardens and Plantations, Jamaica.

British Consulate, Guayaquil,
November 18th, 1902.

Dear Sir,

I have your letter of 15th ult. but have been delayed in answering it before, by domestic affliction.

Having now learned the Ecuadorian plan of preparing the toquilla hat straw, I beg to describe it as follows:—

The young leaves are cut off, about two or three inches of stem below the bottom of the leaf, whilst the green leaf is still folded up in pleats, though almost or just ready to open.

Then three or more of the outer pleats of which the leaf is composed are torn off from the *outer* sides, (both sides) as these are at once too tough to form proper straw, and too green to whiten. In the same manner, two or three of the pleats *in the centre* are taken away, as are too fragile or tender to form good straw.

Then the *two* edges of the remaining pleats are removed six or eight at a time, by slitting them with a needle. or better still a bradawl, on either side from about 6 or 8 inches from the top, upwards:—the centre part of the pleat is then caught hold of, and torn downwards *to the stem*, but never separating it from such stem. When this has been done with *all* the pleats. The outside edges or fringes so separated, are cut off and the remaining pleats, with the stem, are wound up as in a ring, so as to fit into a pot of boiling water. They are plunged into this,—and

as they are cold the temperature of the water is at once reduced. They can be left *in the water* (but must be entirely covered by it) until this again boils,—or even a little longer.—They are then taken out, well shaken to get all water possible out of them, and hung up on a string to dry. This must be done in the open air, and in the shade, —never in the sun. After drying thus for say one day, they can be put in the sun to bleach more To get them still whiter, the juice of several lemons may be mixed with the water in which they are boiled. In the course of the drying of the straw, it curls up naturally, so that a flat straw of ½ inch wide, becomes rounded and less than 1/16 inch.

I am sending to you to-day by bearer—

1. One leaf, just in state for gathering.

2. One leaf, (which had been rather over-ripe for gathering) with the exterior pleats and the centre ones removed.

3. One leaf, as per No. 2, but with the edges or fringes of the pleats separated, but hanging down, tied up, so as to show you what has to be separated in this manner.

4. One "Ocho de paja" prepared as above described in my presence, dried &c It is not so white as it should be, because the leaf experimented upon was rather over-ripe, and no lemon juice was used, I also send you a few more plants which I hope may grow with you.

I may further mention that for using the straw, the two fringes or outside edges of each straw, are again torn off. About three inches from top, and two inches from bottom of straw are cut off, and the remainder is the part used for making the hats.

I trust the above explanation may be found sufficiently clear, and extensive for your requirements There are no expenses.

I have not yet obtained the sample of hats, in course of preparation.

Plants and samples go through the British Consul, Panama. Would you like seeds of the C. palmata?

Faithfully yours,

ALFRED CARTWRIGHT.

H.B.M. Consul, Guayaquil, to Director, Public Gardens and Plantations, Jamaica.

Guayaquil, Decr. 3rd, 1902.

Dear Sir,

I have lately received some seed cones of Carludovica palmata for Bermudas, and thought you also might like some, so I send you a part of them.

I am also forwarding a package of the young leaves just in the proper state for preparing the straw, and which should arrive in good state for you to practise the lesson I recently sent as to the modus operandi in the preparation of it. I have not yet received the hat in course of manufacture.

Faithfully yours,

ALFRED CARTWRIGHT.

[Issued Jan. 22nd, 1903.]

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BULLETIN

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EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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JAMAICA

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. I. FEBRUARY, 1903. Part 2.

HEALTH AND DISEASE IN PLANTS.*

By Prof. F. S. Earle.

A plant is in health when all its organs or parts are doing their proper work, and the processes of growth and reproduction are going forward in the natural and regular manner A diseased condition results when for any reason an organ fails to thus perform its usual normal function. The causes that induce disease are very numerous and are often obscure. For convenience diseases may be grouped under three headings: (1) environmental, (2) functional and (3) parasitic.

Under environmental diseases are classed those disturbances of normal growth caused by uncongenial surroundings, such as unfavourable soil conditions, too much or too little water, the absence or over-abundance of some of the food elements or unsuitable soil temperatures; unfavourable atmospheric conditions caused by the pollution of the air with smoke or gases; or unfavourable position as to sunlight. Such unfavourable surroundings often cause a slow and feeble, though perfectly normal, growth that should not be confused with disease. It is starvation or semi-starvation and not sickness. The so-called "scalding" of plants after unusually heavy and protracted rains, the "tip burn" of lettuce and potatoes due to exposure to bright sunshine and dry winds after periods of wet cloudy weather, and the chlorosis or yellowing of the foliage of fruit trees on alkali soils in the West may be mentioned as examples of this class of diseases.

Functional diseases are due to abnormal activities within the plant itself. These may be the excessive or insufficient formation of enzymes or acids or other secretions, or the disturbance of nutritive or other chemical processes. The dreaded peach yellows and the now destructive disease known as "little peach" probably both belong here, though their true nature is not yet fully understood. The "mosaic disease" of tobacco, and the "yellow disease" of the china aster are examples of the abnormal production of an enzyme or ferment. Diseases of this class are usually very obscure, and few of them are as yet fully understood. In the case of the "yellow disease" of the aster the trouble is caused by the failure of the leaf to secrete sufficient diastase, the enzyme or ferment that converts starch into soluble sugars. Starch is being constantly formed in green leaves when they are exposed to sunlight, but it is only after being

* Lecture given in the Autumn Course at the Museum, New York Botanical Garden, Sept. 11, 1902. From *Journal of The New York Botanical Garden, Nov. 1902,*

acted on by diastase, and thus rendered soluble, that it can be taken up by the sap and used as food in the building up of new tissues. The failure to secrete sufficient diastase thus causes a condition quite comparable to that of severe indigestion in man or the higher animals.

By far the greater number of plant diseases are caused by the action of parasites. The number of kinds of parasites that infest plants is very great. Probably no plant of economic importance is free from them, and the more widely cultivated crops have to contend with a formidable number of parasitic foes. These may be either animal or vegetable, and they belong to widely differing groups. In the vegetable kingdom plant parasites are found among the slime moulds, the bacteria, the green algae, the fungi, and a few even among the flowering plants. In the animal kingdom they are less widely scattered, being found only among the nematode worms the mites and the insects. It is in the great group of chlorophylless plants called fungi that we find by far the greatest number of plant parasites. The diseases known as smuts, rusts, mildews, leaf-spots and moulds are all caused by fungus parasites, while many of the blights, rots, and wilts are also due to them.

All parts of the plant are liable to be invaded by parasites. Roots, stems, leaves, flowers and fruits each have their special enemies. The surface only may be the point of attack, or the parasite may burrow deeply in the tissues. The nature of the injury caused will depend on the habit and structure of the host plant, on the point of attack, and on the character of the parasite. In some cases it may be little more than the loss of a certain amount of food material, the host and the parasite being so adjusted to each other that the latter lives with a minimum of inconvenience to the former. Plants of wheat or oats infested by smut show very little inconvenience from the presence of the mycelium of the former in their tissues. It is only at maturity when, instead of ripened grain, we find the black powdered masses of fungus spores that the extent of the injury is suspected. Such cases, however, are rare. There are usually secondary complications that do for more harm than the mere loss of food. Thus the coating of the surface of leaves by external growths of mildews and sooty moulds shuts off the light from the chlorophyl bodies, partially preventing photosynthesis, the process of starch formation. The presence of internal parasites often excites a morbid growth of the plant tissues causing galls, knots or other deformities, or they may cause an excessive formation of gums or resins. In other cases the parasites may multiply so greatly in the tissues as to plug the ducts in the vascular bundles, shutting off the ascending sap and thus causing the sudden wilting and death of the entire top. The rotting of the roots may cause a similar wilting. A bacterial parasite causes the fermenting of the sap in the soft cambium layer of pear and apple trees causing the sudden death of considerable branches.

Different fungi have acquired the power of parasitism in different degrees. The true parasites like the rusts and smuts have the power of taking their nourishment directly from the living protoplasm of their hosts. In most cases they do not kill the tissues in which they are embedded though they may interfere seriously with their normal functions. Other fungi that normally live on decaying vegetable matter have developed the power under certain conditions of penetrating tissues that are still living, These are called facultative parasites. They are not able as a rule to take nourishment directly from the living protoplasm as do the true parasites, but they push their hyphae into or between the living cells of the host, and by the secretion of poisonous acids and enzymes kill them and render

their contents soluble, thus causing the actual destruction of the living tissue. Many of the species of fungi that are normally strictly saprophytic at times develop this power of killing and disintegrating living tissues. Most of the timber rots so destructive to forest trees and to structural timbers, belong among these facultative parasites.

It is only after the cause of a disease is thoroughly understood that we can begin intelligently to seek a remedy. The annual losses from plant diseases are so great as to be beyond computation, but it is safe to say that they reach many millions of dollars for the State of New York alone. Unfortunately. too, all of these losses come from what should be the farmer's profits, for it costs the same to prepare the land, plant and harvest the grain crop when the yield is half smut as it does when it is all clean sound grain. The question of the prevention of plant diseases is thus one of very great practical importance. Vegetable pathology is one of the newest of the biological sciences. What we know of it has practically all been learned during the past thirty years. I remember that when in College during the seventies the only known remedies for plant diseases were that sulphur sprinkled on rose bushes and grape vines would to some extent, prevent mildew, and that soaking seed oats in a weak solution of copper sulphate would prevent smut in the following crop. At least there was a popular impression that these were facts, but no conclusive experiments in regard to them had been recorded. Now the list of preventable or partially preventable diseases is a very long one. The number of remedial measures used is also considerable.

With the environmental diseases the obvious remedy is to correct the unfavourable conditions. If the ground is too wet, drain it. If too dry, irrigate it, or cultivate so as to conserve moisture. If poor in plant food, fertilize it. Or if a certain crop is not suited to the prevailing conditions grow some other crop that will find them congenial. These I say are obvious methods for preventing troubles of this kind and yet the problem is by no means a simple one. In only too many cases we are unable to predict without actual trial whether or not a given crop will thrive under new and untried surroundings.

Our knowledge of the functional diseases is not yet sufficient to permit the suggestion of remedies. They must still, for the most part, be classed as incurable. We may know, as in the case of the aster "yellow disease," that an insufficient secretion of diastase prevents the assimilation of the starch grains but what cause prevents this normal secretion is as yet unguessed and consequently is unpreventable. No group of diseases is more urgently in need of further investigation than these.

It is in the controlling and preventing of parasitic diseases that modern progress has been most marked. Remedial measures that may be employed against them can best be considered under the headings, hygiene, topical applications, and heredity.

Under hygiene are included cultural methods that aid the plant in resisting disease; the establishment of crop rotations so that plants liable to the same diseases shall not follow each other in the same field; the prevention of contagion by the destruction of diseased plants or parts of plants, and methods of pruning and training whether for removing diseased portions, as is often practised with pear blight and plum black knot, or for regulating exposure to sun and rain as in some methods of training grape vines. A good example of the effect of cultural methods in controlling a disease is furnished by the so-called "black rust" of cotton, which often causes serious losses on light sandy lands. Experi-

ments have conclusively shown that this disease can be prevented by incorporating vegetable matter in the soil and applying potash fertilizers. This so increases the vigour of the plant that the facultative parasites causing the disease are unable to gain a foothold. On the other hand, the injury to pear trees from blight can be much lessened by preventing a too vigorous growth and securing the early ripening of the wood. This can best be secured by witholding cultivation and nitrogenous manures. In this case the disease germs only flourish in the soft rapidly growing cambium and the hardening of the wood stops the spread of the disease.

Topical applications may be made to the seed before planting, to the growing plant in the form of fungicidal sprays, or in some cases to the soil. Treatment of the seed is useful only in those cases where the source of contagion is from spores that adhere to the seeds and are planted with them. Thus in harvesting and threshing oats the spores from smutted heads become dusted over the sound grains. It is almost or quite impossible to find seed for planting that is not more or less infested in this manner. If such seed is soaked in hot water of the right temperature or in certain fungicidal solutions, as formalin or copper sulphate, the smut spores will be killed without injuring the vitality of the grain; and the crop from this treated seed will be practically free from smut. Potato scab is a disease that is usually disseminated by the planting of diseased tubers for seed. Where once introduced in the soil it lives from year to year, so that seed treatment is not always effective; but, if planted on clean land, even badly scabbed seed potatoes will yield a clean crop if soaked in a weak solution of corrosive sublimate.

The discovery that certain diseases can be prevented by sprinkling plants with a solution of copper sulphate mixed with milk of lime marked an important epoch in the treatment of plant diseases. This mixture, known as Bordeaux mixture from the town in France near which its use was accidentally discovered, is now the standard remedy for a large class of diseases. In the case of many orchard and garden crops, spraying with Bordeaux mixture is as much a recognized part of proper culture as is the tilling of the soil. As first used the mixture was simply spattered over the leaves by means of a whisk broom, This method was unsatisfactory, as it was slow and did not secure a sufficiently even distribution of the liquid. Thanks to American ingenuity and particularly to the efforts of the late C. V. Riley, then chief entomologist, and of B. F. Galloway, now chief of the Bureau of Plant Industry of the United States Department of Agriculture. suitable pumps and spraying nozzles were devised, by means of which plants can be quickly and evenly covered with this or other liquids in the form of a fine mist-like spray. Other compounds of copper have also been found to have strong fungicidal properties, but none are so generally useful as the Bordeaux mixture. When properly made and applied, it does not injure the foliage except of a few particularly delicate plants and as it is not easily washed off by rains its effects are more lasting than with other fungicides. It is now the standard remedy for potato blight grape rot and mildew, apple scab, peach leaf curl, and a long list of similar diseases. It should always be remembered however that, except in the case of a few external parasites, spraying is a preventive measure and not a cure. Sprays cannot reach internal parasites when once established, but by coating the surface they prevent the germination of spores that find a lodgement there and thus prevent infection. The importance of early spraying before a disease makes its appearance, and of thorough work in reaching all exposed parts of the plant will be apparent from these facts.

The beneficial results from spraying have, in many cases, been so great that, for a time, pathologists were inclined to think it a cure for all kinds of diseases. It is now clearly realized that, notwithstanding its great usefulness, it has its limitations, that there are many diseases it cannot reach and many others where it should not be relied on alone, but should be used in connection with other remedial measures.

Soil treatment can be employed in comparatively few cases. Injections of carbon disulphide are sometimes used for certain animal root parasites. Spraying the ground along the row is recommended for the sclerotium wilt, a disease attacking garden vegetables in the Southern States. Sterilizing the soil in green-houses, by heating it with live steam from perforated pipes, is now practiced with great success in preventing injury from nematodes and from various soil-inhabiting fungi.

The great importance of heredity as a factor in controlling plant diseases is only now beginning to be fully recognised. Individual plants, like individual men, vary in their ability to resist disease. Even in plants of the same cultural variety, this difference in resisting power is often quite marked. It has long been observed that some varieties are more resistant than others. It is now found that, like other qualities, this power of resistance is inheritable, and that by carefully breeding from the most resistant individuals, it is often possible to establish resistant strains or varieties. This point was clearly brought out at the recent Plant Breeders Conference in this city. The case of resistant strains of cotton, described by Mr. Orton, of the Department of Agriculture, was particularly interesting. In a very few years he has been able to select strains of cotton, practically immune to the wilt, a disease that has devastated large areas in the Southern States. Spraying to prevent disease is at best an expensive and exacting operation, and cultivators will welcome the day, if it shall ever come, when the breeding and selection of resistant varieties shall make it no longer necessary.

REPORT ON A TRIP TO JAMAICA.*

BY

PROF. F. S. EARLE.

Dr. N. L. Britton, Director-in-Chief, New York Botanical Garden :

Sir,

In accordance with your directions I sailed for Jamaica on October 16th reaching there on October 20th, and remaining until November 26th. The trip was undertaken on the invitation of the Hon. Wm. Fawcett, Director of the Jamaica Public Gardens, for the purpose of investigating certain diseases of logwood, cocoanuts and other economic plants. My instructions were also to secure living specimens of tree ferns for the Conservatories, and to collect fungi and other cryptogams for the herbarium. Thanks to the hearty co-operation of the Jamaica Government and of the United Fruit Co , and to the invaluable aid given by Mr. Fawcett and his associates, Mr. Wm. Harris and Mr. Wm. Cradwick the objects of the expedition were successfully accomplished. Forty-five specimens of tree ferns representing fourteen or fifteen species were secured and forwarded

* By permission from the "Journal of the New York Botanical Garden," Jan.1903.

to the Garden. Six hundred and thirty herbarium specimens were taken of which nearly five hundred are fungi, the remainder being lichens and mosses with a few fresh water algae. These will be studied and lists prepared as soon as other duties will permit. The following plant diseases were observed. In a number of cases cultures were secured of the organisms found in the diseased tissues and a more extended account will be prepared when laboratory studies and inoculation experiments with these organisms have been completed.

Logwood Root Rot; On some estates, especially toward the western end of the island, logwood trees are dying in considerable numbers.

The diseased trees usually occur in groups, the infection spreading slowly but in constantly widening circle. An examination of dying trees shows the roots to be badly rotted. Their surface tissues are invaded by a white fungus mycelium that is usually more abundantly developed in the region between the bark and the wood. The disease seems to first attack the small rootlets gradually spreading to the larger roots and the crown when the tree dies. In many cases seeming healthy trees near the border of infested areas were found to have the roots on the side next the dying trees badly diseased, while on the other side they were still perfectly healthy. The fungus seems to be the mycelium of some of the Hymenomycetes. Numerous species of Polyporaceae and Thelephoraceae were taken on logwood stumps and logs, but in no case could their connection with this root rot be satisfactorily proven. Whatever the nature of the fungus, leaving stumps of trees that have died from this disease in the neighbourhood of living trees is clearly dangerous. Dying trees should be dug and the roots burned as soon as the disease can be detected. Where it is confined to certain shall definite areas as is often the case, it would be advisable to dig a trench three feet deep just outside of the diseased area in order to prevent its spread underground to the roots of healthy trees. On a few of the estates examined the disease was so widely scattered that this method of treatment would not be practicable. Here it would seem best to clear the infested tract entirely of logwood, marketing such as was sufficiently mature, and allowing the land to grow up in pimento and limes, or reserving it for pasturage or cultivation. It should be mentioned in this connection that pimento trees are said to die from a similar root rot in some parts of the island. If this should prove to be identical with the logwood root rot, pimento would not be available as an alternative crop.

This root rot seems to spread slowly. One old logwood chipper assured me that trees had been dying for thirty five years on a spot that he pointed out. This area does not now include over three or four acres. This would indicate that by vigorous measures it could be controlled. The disease was found on various kinds of soils and under moisture conditions varying from dry rocky hill sides to the margin of swamps. In some cases the diseased areas were on spots where the soil was rich and deep and the moisture and drainage condition perfect. It was not observed on the heavy clay lands toward the eastern end of the island but whether this was due to the absence of infection or to the character of the soil could not be determined.

"Bastard" Logwood: The logwood dye of commerce is extracted from the heart wood of mature trees of *Haematoxylon Campechianum.* In Jamaica occasional trees are found in which little or no haematoxylin is found. In its place is a substance yielding a dull yellowish green dye. Such sticks are rejected by logwood buyers for they not only yield none of the desired colouring material, but if mixed with the normal wood in any quantity, do harm by spoiling the tint of the extract. Complaints have

been reaching the Botanical Department of Jamaica, from certain quarters for some time, that the amount of this so called bastard wood was increasing. The cause of this lack of haematoxylin in certain trees was one of the problems I was requested to investigate and considerable time was given to it. The facts ascertained are as follows : * 1st, logwood is a variable plant showing marked differences in form, colour, and texture of leaf, time of blooming, form and extent of the ribs on the trunk, colour of bark and of especially in the colour and dye-producing quality of the heart wood. Four well marked varieties are said to be recognized in Honduras and three are usually recognized in Jamaica, but there are many other intermediate forms. 2nd. Bastard wood is not the result of disease or of any lack of vigour. The trees producing it are perfectly healthy and normal. 3rd. It is not the result of soil or climatic conditions since bastard and normal trees are found growing side by side under absolutely identical conditions. 4th. It is not the result of immaturity. Aged trees may produce bastard wood while in normal trees the heart wood as soon as formed contains a good percentage of haematoxylin. These facts seems to point to heredity as the probable cause of the trouble. That is that certain trees produce only bastard wood because they grew from the seed of a bastard tree; or in other words that bastard logwood represents a variety of Haematoxylon campechianum that normally produces little or no haematoxylin, just as one Honduras variety has smaller, shorter, thinner and lighter coloured leaves. Experiments now in progress at Hope Gardens, Jamaica, and at the New York Botanical Garden with seedlings from the seed of bastard and of normal trees should in time settle this question conclusively. In any event it seems a matter of minor practical importance since apparently not over one or two trees in a thousand are of the bastard variety. No data was obtained to show whether or not the trouble was increasing as claimed by some An increase could be readily accounted for by the fact that on many estates a tree that is chipped into and found to be bastard has been allowed to stand and produce continued crops of seed while the normal trees have been cut down on reaching maturity. A wise policy would insure the prompt destruction of such trees whenever detected as they have no value except for firewood, and should not be allowed to produce seed. It is unfortunate that there seems to be no constant difference in leaf or trunk by which these bastard trees can be distinguished, that would allow of their still earlier destruction.

Coco-nut Bud Disease :—Outbreaks of a serious disease of coco-nut trees have occurred in Jamaica at various times. Some years ago the groves in the neighborhood of Montego Bay† were badly injured by it and the industry was completely destroyed on the Grand Cayman‡ Island, probably by the same trouble. At present it is attracting but little attention although numerous cases of it exist widely scattered over the western end of the Island, a few being observed as far to the eastward as Port Antonio. It was not observed to the east of a line between Port Antonio and Kingston. One of the first symptoms of the disease is the dropping of the immature nuts. In some cases the lower clusters hang on and reach maturity but usually all fall off. The leaves droop a little, and become somewhat yellow. Often those that are just unfolding are seen to be distorted and blackened on the edges. The young flower buds still enveloped in the spathe, rot, and finally the central leaf-bud rots and the entire

* I am under obligation to Dr. Emil Bucher, Superintendent of the West India Chemical Works for much information in regard to Logwood.

† See Bulletin of the Botanical Department, Jamaica, Sept., 1891. p. 2

‡ See Bulletin of the Botanical Department, Jamaica, Feb., 1889, p. 3.

top falls away. Such trees are often pointed out by the planters as having been struck by lightning. Others attribute the death of the tree to a large borer said to work from the trunk up into the bud. In the numerous cases examined death was not due to either of these causes. The head of the tree was in all cases invaded by what seems to be a bacterial rot. The organism developes in the sweet slimy coating found on all the young protected organs. It eats into the sheathing bases of the petioles and attacks the flowering sheaths. As the spathe grows, the surface becomes cracked and the disease reaches the soft flower buds through these cracks. Finally it reaches the "cabbage" or central growing point which it soon reduces to a stinking rotten mass. The top now falls away sometimes leaving a circle of the lower leaves that had matured before the tree was attacked. These persist for a time but of course finally die also as the tree has no power of branching or of producing a new growing point. The means by which the contagion is conveyed from tree to tree could not be determined nor could any estimate be formed of the time elapsing between infection and the death of the tree. Numerous cultures were secured and the study of the disease will be continued.

At Port Antonio the petioles and midribs of the leaves of some of the diseased trees were found to be invaded by a parasite that caused the browning and death of the tissues. This petiole disease was found on some trees that did not as yet show signs of the bud trouble, Whether or not the two troubles are caused by the same organism can only be determined by the further study of the cultures that were secured.

From our present imperfect knowledge of this disease it is impossible to suggest a remedy. Remedial measures or rather successful preventive measures would probably depend on the method by which the disease is conveyed from tree to tree. This can only be determined by careful and prolonged field study. The importance of the industry involved would fully justify the expenditure and effort necessary to obtain a complete understanding of this disease. The necessity for the destruction of the contagion by the prompt cutting and burning of all infected trees is shown by the marked tendency of the disease to spread from each centre of infection.

It is claimed by some planters that a certain green skinned variety of cocoanut is less liable to this disease than the reddish and yellowish kinds. The facts observed seemed to support this view. If it is confirmed by further obesrvations it will be a factor of the greatest importance as it would make possible the selecting of a resistant race of cocoanuts.

Coco-nut Wasting Disease :—In the Eastern part of the Island between Morant Bay and Manchioneal, a disease occurs that can best be described by the above name. The nuts slowly fall. The lower leaves droop and fall prematurely, while the new leaves that are produced become successively smaller and less vigorous. In the final stage the leaves are reduced to less than half the normal size and the few that remain stand erect as a thin wisp at the apex of the bare stem which is seen to be abruptly tapered almost to a point. At length the tree dies, but the course of the disease is always slow, and affected trees may live for months or perhaps years. In the trees examined a white scale insect was always found at the base of the petioles and on the fruiting peduncles. The slow loss of vitality shown by these trees is a result that could be expected from the presence of this class of insects in sufficient quantity but they did not seem numerous enough to fully account for the serious effect on the tree. In all the cases examined there was also a slow rotting of the sheathing bases of the petioles and of the fruiting sheaths. The scale insects were

also observed on some trees that did not as yet show recognizable symptoms of the disease Whether such symptoms would ultimately develop can only be determined by observations continued through a considerable period. Mr. Wm. Cradwick of the Jamaica Agricultural Department has undertaken to make farther field studies and as specimens of the scale and cultures from the diseased tissues have been secured it is hoped we may ultimately gain a better understanding of this interesting but obscure trouble.

If, as it seems probable, the scale is the first inciting cause of the disease it should be possible to devise some remedial treatment. Owing to the height of the trees and the method of growth, the scales being largely sheltered by the fibrous sheathing bases of the leaves, the successful application of insecticides would be difficult but not necessarily impossible. Mr. Cradwick will undertake some experiments on this line.

An interesting experiment has been tried on one of the plantations of the United Fruit Co., in firing the dead leaves and fibres hanging on the diseased trees. The flame kills all the fruits and open flowers and most of the expanded leaves but the apical bud is not injured and new leaves and flowers are soon developed. This seems like heroic treatment, but two trees were pointed out that had been fired six months ago when they were in advanced stages of the disease; now they seem entirely recovered and are putting on a new crop of fruit This firing of the trees has also been suggested as a remedy for the bud disease. The chances for success would seem to be much less in that case for the disease so soon becomes deeply seated.

Coco-nut Trunk Borer : A few trees were observed where areas on the trunk two or three feet or more in extent had been bored full of small holes no larger than a knitting needle. Minute white larvæ were found at the bottom of some of these burrows but none were taken in condition for identification. A rotting of the trunk soon follows these borings and if the insect was abundant it would cause considerable loss. It was only observed in the grove and there only in a few trees.

Coco-nut Trunk Rot : A few cases were observed when some slight injury allowed the entrance of a rot that destroyed the entire centre of the trunk. In one case an outer rind of less than half an inch of healthy wood remained, a rotten liquid running out when this was cut through. Strangely enough the top of this tree still seemed healthy and vigorous, but the rot in the centre of the trunk had reached to within a few inches of the base of the bud. Such cases seem to be very rare but they shew the importance of avoiding unnecessary wounds of the trunk.

Banana Leaf Blight: On one locality at Stony Hill, north of Kingston a serious banana disease was observed. It causes the browning of the vascular bundles in the veins and midrib of the leaves. This is soon followed by the blackening of the entire leaf blade and eventually by the rotting of the leaf and petiole. It does not seem able to extend from the petiole into the tissue of the stem. The terminal bud is not attacked but continues to push out fresh leaves. These soon become infected in turn so that usually not more than three or four of the younger leaves are free from the disease. Infected plants are much stunted in growth and do not bear fruit. In the small field where it was first observed fully three-fourths of the plants were infected. The contagion was in this case probably introduced with the suckers that were used for planting as these were said to have been taken from some neglected patches in the neighbourhood, and a visit to these showed that they were also infected.

The disease evidently spreads slowly as it had not crossed a wide hedge row separating this infested field from one adjoining. It may never prove troublesome, but the advisability of immediataly destroying all diseased plants was strongly urged. If so destructive a disease should by any chance become widely scattered the result would be truly disastrous.

Apparently it is due to a bacterial parasite. Cultures were obtained and it is hoped to study the disease further. No evidence was secured as to the means by which it is conveyed to the fresh leaves or from plant to plant. So far as known it is confined to this one locality which is at an elevation of some 1,200 feet and on red land. Such locations are not considered to be adapted to bananas, yet all uninfested plants were growing and fruiting satisfactorily.

Orange Root Grub: Orange growers, especially in the neighbourhood of of Bog Walk, are much troubled by a grub that gnaws the bark of the roots. Often the injury is sufficient to cause the death of the trees. Where the trees do not die, the growth ceases, the leaves turn yellow and the crop fails. The grub is a footless larva probably that of *Praepodes vittata*, one of the Curculionidae. (See Journal of Jamaica Agricultural Society, January 1898, p. 11.) From what I am told of the habits of this insect it can best be destroyed when in the adult stage. The beetles are said to gather in great numbers on the orange trees eating the foliage. If such is the case, they could be destroyed by arseniacal sprays. They are said to be clumsy flyers, and to have the habit common to many of the Curculionidae of falling to the ground when jarred or disturbed. This should make it possible to catch them by jarring on to sheets as is done with the peach curculio. The larvae could doubtless be killed in the ground by injections of carbon di-sulphide, but whether this could be done without injury to the tree and at an expense that would make it practicable, can only be determined by carefully conducted experiments in the field. Whether tobacco or other substances worked into the soil about the tree would prevent the depositing of eggs, is perhaps worth trying. The insect is thought to be a general feeder, and is not confined to the orange, though it seems to be particularly partial to all citrus fruits. Some growers claim that they have suffered more when practising clean cultivation than when weeds and bush are allowed to grow for part of the year the roots of which may serve to divide the attention of the grub.

In this connection it may be noted that orange scale insects are not likely to prove seriously troublesome for in the moisture regions at least they are quickly destroyed by fungus parasites.

The orange rust mite occurs on the Island but it only seems troublesome on certain wet heavy soils.

Cocoa Stem Conker: This trouble was only observed in the neighbourhood of Port Maria, but it probably occurs in other parts of the Island. Slightly swollen areas occur on the trunk or larger branches. The tissues in the central part of the swellings soon die and the yellow perithecia of some Nectrinaceous fungus develop on the bark. The swelling continues to grow at the margin till finally it often girdles and kills the tree. Keeping the trunks and larger branches painted or sprayed with Bordeaux mixture should be a complete protection from this disease. It would also destroy moss and lichens and keep the trunks in a clean, healthy condition. Promptly cutting out of the diseased areas and painting the cut surfaces with sulphate of copper or sulphate of iron solution and then coating with tar or paint would probably in most cases save trees that are already attacked.

Cocoa Pod Rot: Examples of rotting cocoa pods were seen at various places. Apparently more than one species of fungus is concerned in this rotting. This point will be reported on later. This rotting is not attracting much attention, but with the Criollo variety at low altitudes, it is certainly very serious and under certain conditions it is liable to prove destructive to other kinds. Whether or not the blasting of the young pods is due to the growth of a fungus could not be certainly determined. This blasting occasions a very considerable loss especially to the fall crop.

Cocoa Root Disease: There is trouble from the dying of cocoa trees on certain areas. The roots examined all showed signs of having been gnawed much as in the orange trouble, but in addition the injured were attacked by some fungus mycelium. Want of time prevented a thorough investigation of this trouble.

Cassava Root Rot: It was stated by some labourers that cassava roots rotted if planted on land where logwood trees had died. A Cassava patch was examined that had been planted on such lands. A number of unthrifty plants were noted, and on digging them up the roots were found to be enveloped in a white mycelium and to be rapidly rotting. Dead logwood stumps were near these diseased plants. This was on a rather light, upland, red soil that was well adapted to the growth of cassava. The connection between the cassava rot and the logwood root rot could only be inferred.

In conclusion I would say that this somewhat hasty reconnaissance demstrates the presence in Jamaica of a number of diseases of economic plants, some at least of which are liable to prove destructive. The short time at my disposal was not sufficient for a thorough study of any of these and the few remedial and preventive measures suggested above are tentative only, and are intended simply as the bases for field experiments. I would respectfully suggest to the Jamaica Government that the Agricultural Department can do no more useful or practical work than to provide for a further study of these diseases.

While thus emphasizing the great importance of requiring a full knowledge of such diseases as do occur, I feel like congratulating the planters of Jamaica on the fact that these serious diseases seem to be so few. Most countries with equally diversified crops have to contend with a much greater number.

CASSAVA FROM COLOMBIA.

Analyses of Seventeen Varieties introduced from Colombia and grown by Mr. Robert Thomson, at Half Way Tree, Jamaica.

By H. H. Cousins, M.A. (Oxon) F.C.S.Government and Agricultural Chemist

Mr. Robert Thomson, formerly Superintendent of Public Gardens in Jamaica, has taken a leading part in urging the claims of Cassava as a food product for and districts in the tropics as also a profitable source of starch and glucose for commercial purposes. At the instance of the Hon. Sydney Olivier the Chairman of the Board of Agriculture, I was instructed to arrange with Mr. Thomson for the analysis of a unique collection of varieties of Cassava brought by him from Colombia as a guide to their economic value.

This has been done, and as the results show these Colombian varieties are marked by a very high Starch content and are practically free from prussic acid. These varieties were grown at Half Way Tree on the Liguanea

plain, and it is possible that some varieties, as Mr. Thomson suggests would succeed better in the hills. It is hoped, so soon as stock of these varieties has been established, to conduct careful experiments as to the Agricultural yield and the content of Starch. It will also be of interest to note whether acclimatisation will cause an increase in the amount of prussic acid obtainable from the tubers.

A comparative test of these cassavas against our creole stock of bitter and sweet varieties is eminently desirable. Should these Colombian varieties maintain their promising character, their introduction from the interior of Colombia by Mr. Thomson to the West Indies and the Indian Empire must be regarded as a signal service.

The seventeen varieties were delivered on the afternoon of November 28th, in a perfectly fresh state, and were immediately prepared and sampled for analysis. Determinations of moisture, total solids, starch and hydrocyanic acid were made. The latter was determined by Carmody's * method of soaking slices in water. The hydrocyanic acid was estimated after 24 hours soaking and again after 48 hours in a fresh quantity of water. The amounts so obtained were remarkably low, far below Carmody's minimum for sweet cassava grown in Trinadad. I anticipate as possible that these Colombian varieties may develop a higher prussic acid content when acclimatised to Jamaica. In their present state these cassavas are practically non-poisonous, and the analytical data fully support the reputation for harmlessness which Mr. Thomson ascribes to them as grown in Colombia.

Carmody's average for bitter cassava grown in Trinadad is 0.022 per cent. and for sweet cassava 0·010 per cent. and of the latter, peeled for use as a food product, 0·007 per cent. of hydrocyanic acid. The average of these seventeen Colombian varieties is only 0·0017 or only $\frac{1}{6}$ of that in Trinadad sweet cassava. Further experiments are in hand to test the distribution of the poisonous hydrocyanic acid as between the inner and the outer portions of the tubers. Carmody (loc. cit.) states that his experiments indicate that an analytical difference can be drawn between "sweet" and "bitter" cassava by the factthat in the former most of the hydrocyanic acid is derived from the external portion, while in the latter the poison is uniformly distributed.

—As regards starch yield the variety *Governor Hemming* leads with 36.5 per cent., a very high content closely followed by *Cabesa Dura, Negrita, Helada* and *Paloma*.

The three Pacho Varieties (2, 3 & 4) are the lowest in starch content with 22.3 to 19.3 per cent. Mr. Thomson states that these varieties should do well at a high elevation There is thus a variation of 90 per cent. in the starch content of these seventeen varieties. Given a high percentage of starch and large agricultural productivity, the yield of starch in Jamaica should be considerable.

The variation of moisture from 54 to 72 per cent. is also worthy of note, as also the variation of 3.5 to 19 per cent. in solids other than starch.

It is hoped on a future occasion to supply data in which the composition of the tubers shall be returnable as an agricultural yield per acre of food or of commercial starch and glucose.

Appended are the analyses in which I was assisted by Messrs. Hammond and Wortley.

An interesting Memorandum from Mr. Thomson follows:

In view of the importance of cassava both as a food product and a source of starch, arrangements have been made for a systematic trial of various

* Annual Report Government Analyst Trinidad, 1901.

native varieties of cassava which are held in repute. Analysis and field results will be published in this Bulletin when they are ready.

RESULTS OF ANALYSIS.

(IN ORDER OF STARCH-CONTENT.)

No.	Name.	Ref. No.	Moisture	Starch.	Solids not Starch.	Hydrocyanic Acid.
1	Governor Hemming (Notoseves)	21	57.17	36.50	6 33	0.0018
2	Cabesa Dura .	16	54 69	35.40	9.99	0 0010
3	Negrita .	15	55 10	34 80	10.10	0.0019
4	Helada .	5	55.41	34.30	10.29	0 0007
5	Paloma .	10	57.78	34.30	7.92	0.0017
6	Blancita .	18	54.22	33.80	11.98	0.0009
7	Pacho .	1	59.61	33.33	7.06	0.0029
8	Cajon Amarilla .	—	56.11	33 30	10.59	0.0030
9	Negrita .	12	59.31	31.10	9.59	0.0010
10	Helada .	6	56.93	29.90	13.17	0.0019
11	Negrita .	11	61.43	27.70	10.87	0 0020
12	Cenaguera .	23	67.21	25.00	7.79	0.0014
13	Montera .	28	71.42	25 00	3.58	0.0009
14	Negrita .	17	60.57	23.90	15 53	0.0035
15	Pacho .	3	58.57	22.30	19.13	0.0022
16	Pacho .	2	72.28	22.10	5.62	0.0010
17	Pacho .	4	64.19	19.30	16.50	0.0010
	Average .		60 12	29.53	13.6	0.0010

MEMORANDUM.

By ROBERT THOMSON.

The varieties analysed were collected in various provinces of the Republic of Colombia last year by my son, under my instructions. These are new to the West Indies. I resided many years in that Republic, and the importance of this culture attracted my attention, consequent on the enormous consumption of cassava as an article of human food—cooked in the same way as Irish potatoes. Indeed some of the varieties of Cassava, I concluded, were equal in point of flavour to that tuber. I was also struck with the capacity of the plant to resist droughts. Poisonous varieties are unknown to the people in the interior of Colombia, so that the people there entertain no shadow of suspicion in this respect.

Only a few cuttings of each variety were introduced, and these were planted only about a foot apart in nursery beds, with a view to subsequent propagation on a large scale. I now have cuttings enough to plant about two acres. I regret I have been unable to establish experimental plots of each variety with a view to test their respective productive capacity on the hot plains. Some of the varieties succeed best on the hills.

The result of the analyses of the 17 varieties is important. The leading variety contains the extraordinary percentage of 36·50 of starch. Other varieties closely approximate to this.

From plants systematically cultivated in the field here and planted contemporaneously with the Colombian varieties the return which I have obtained is only 17 per cent. Doubtless by chemical analysis the yield would be somewhat higher.

From the point of view of human and animal food the analysis is also extremely important. As is stated by Mr. Cousins the poisonous bitter cassava grown in Trinidad contains 0.022 per cent of hydrocyanic acid, and the sweet 0.010 per cent. Thus the sweet actually contains nearly half of the hydrocyanic acid of the bitter. The contrast in this respect with the Colombian varieties is remarkable. Mr. Cousins says :—"The average obtained for these Colombian varieties is only 0.0017 or only $\frac{1}{6}$ the amount contained in Trinidad Sweet Cassava."

The general result is that the Colombian varieties are *par excellence* the varieties to be cultivated for animal food, as well as for starch production.

A New Method of Treating Cereal Grains and Starchy Products.

By Dr. A. P. Anderson.

The cereal grains including wheat, rice, barley, oats maize, and rye form a most important part of the food of the human race. The chief value of the cereal lies in the starch which they contain, which may amount to as much as 50 to 80 per cent of the weight of the dried kernels.

Starch occurs in plants in the form of globose, ovoid and oblong bodies of rounded outlines, the exact shape assumed in any plant being, more or less characteristic of the species. Almost any growing green plant will be found to contain starch grains in all stages of formation from the most minute to the maximum size. Those of the potato often attain a diameter of a hundredth of an inch being visible to the naked eye. An examination of the granules with a magnification of a few hundred diameters shows that they are constructed of concentric layers or coats of alternating denser and watery layers, the centrum around which the layers are arranged being of the latter character. The granule contains from 15 to 22 per cent. of water when in an air-dry condition. Investigation of these interesting bodies with reference to their formation shows that they are really built up like crystals,, being in fact sphærocrystals.

Starch granules when intact are acted upon but slowly by chemicals especially the digestive enzymes. Consequently starchy substances are made more suitable for food by cooking or some method of treatment by which the granules are broken up. When starch granules are warmed in water they begin to swell at a temperature of 55° to 60° C., and burst at 75° to 80° C., being converted into a uniformly translucent mass known as starch paste in which the minute particles are suspended in the water, but are not dissolved.

It is well known that starch grains do not swell or break up to any great extent when heated in an air-dry condition at a temperature employed in breadmaking by ordinary methods. Although bread is one of the oldest and most widely used food preparations yet it is by no means to be considered as an economical use of starch since the granules in the centre of a loaf are practically unchanged and therefore digestible only with great difficulty. The desired changes do ensue to some extent in the crust, but in prevailing methods of preparation, the proportion of the whole amount of starch present made available for rapid digestion, is very small.

As a result of almost continuous work during the past year I have been so fortunate as to develop a method by which, with the application of heat to starch grains and to air-dry starch in many forms, the granules or particles are expanded to many times their original dimensions, being fractured into innumerable fragments during the process. As a result of this treatment a grain of rice is expanded to eight or more times its original volume, while still retaining its original form. Other cereals exhibit similar behaviour. The process is applicable to nearly all starchy seeds and starcy substances, greatly increasing their nutritive availability. The products obtained are pleasant to the taste, and the process may be varied to produce a great variety of flavours with any given cereal. Furthermore, the material prepared in this manner is absolutely sterilized and may be preserved or stored for long periods. I am led to hope from the approval the products have met from food and chemical experts that the process may prove of great economic and commercial value.

The experiments by which this method was developed were begun at Clemson College, South Carolina, in the spring of 1901, but no results of any direct bearing upon the process mentioned were obtained at that time. Upon my removal to Columbia University in August, 1901, time was afforded me to resume the investigations, and in the Laboratories of the New York Botanical Garden every facility was given me for the prosecution of the work. I am indebted to the latter institution for the use of a chemical laboratory which was placed at my disposal and for a plentiful supply of material of all kinds as well as for encouragement and helpful suggestions from the members of the staff. *Journal of the New York Botanical Garden, May, 1902.*

Dr. Alex. P. Anderson has resigned his position of curator of the herbarium of Columbia University, and has taken up his duties as expert to the syndicate now engaged in developing the new method of treating starchy grains, etc , recently discovered by Dr. Anderson in the laboratories of the Garden. Dr. Anderson is fitting up a special laboratory for the continuance of his work at Minneapolis. (*Journal, September, 1902*).

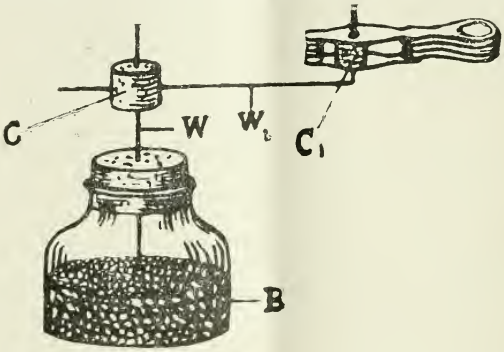
The U. S. Patent Office has granted Dr. A. P. Anderson letters patent No. 707892, dated August 26, 1902, upon the "Art of treating Starch Material." The product resulting from the application of this methods to seeds and other starch materials are highly porous bodies which though greatly enlarged preserve the shape and appearance of the original, and being readily acted upon by the digested juices form valuable and economic foods. The products are also readily emulsified by water and other liquids and lend themselves to use in the arts for sizing, pasting, etc. The method in question is essentially distinguished from other processes by being based upon the explosive action of the liquid contained in air dry starch, and the principal features of the invention are set forth in the twelve claims of the inventor as allowed in the grant. Dr Anderson's invention is based upon studies made in the laboratories in the Garden

and he is now engaged in the perfection of machinery and apparatus by which the products in question may be made in commercial quantities.—*Journal, November 1902.*

A CHEAP DISSECTING MICROSCOPE.

The following description and drawing of a cheap dissecting microscope is taken from Prof. J. B. Farmer's Introduction to Botany.

A hand-lens, with triplet combination, (costing about 3s. 6d.), can easily be converted into a very usefnl dissecting microscope by mounting it in the way shown in the annexed figure. The bottle (B.) contains shot in order to render it stable; through the cork passes a stout wire or knitting pin, W. On this a cork (C) slides stiffly. Through the latter a second wire (W 1) is passed, also sliding stiffly. The end is turned up at right angles, and passes through the holes made in the holder of the lens. In this holder is another cork (C 1) through which the wire passes, and which serves to fix the lens firmly on the wire.



Thus you have a lens, mounted on a firm support, capable of being turned in any direction and nearly as serviceable as elaborate dissecting microscopes.

SOIL PROBLEMS IN JAMAICA.

By H. H. Cousins, M.A., F.C.S.

Government Analytical and Agricultural Chemist.

The Director of Public Gardens and Plantations in his report to the Government on a recent visit to the United States, published in the Supplement to Jamaica Gazette, * made a suggestion as to the adoption of one or more of the methods of the Soil Survey as carried out by the Division of Soils under Professor Milton Whitney in place of those at present being employed by the Chemical Department in Jamaica.

I offer the following observations indicating that the problems awaiting immediate solution in Jamaica are local and detailed rather than classificatory and general, and that it is desirable for the present to pursue the work onSoils in Jamaica in a manner to meet these conditions.

* 15th January, 1903.

The United States Division of Soils sends us their publications, and I have closely followed the work of Professor Whitney and his staff. Their last report and soil maps have just been received. The objects aimed at in the American Soil Survey are quite different from those forced upon us here by the special conditions of the Agriculture of the Island. The American survey aims at a broad, general survey and classification of soils on the lines of a practical land valuer, based primarily on local experience and records and other geological and mechanical data rather than on crop returns and chemical analyses. It is instructive to note that the area surveyed in 1900 was equal to that of Jamaica at an average cost of 8/ per square mile. This work is of necessity superficial and general, and would have little critical bearing on the more pressing problems of cultivation in Jamaica.

I have acted on the conviction that the first object to aim at in a study of Jamaica soils is that of arriving at the physical and chemical properties affecting fertility and by the use of manurial experiments on the growing crops to arrive at a basis for the practical interpretation of the results of analysis. The report on the "Banana Soils" which appeared in the first number of this Bulletin represents the first fruits of this work. It has been demonstrated that the chief Banana Soils in Jamaica are not in present need of fertilisers and that the immediate problems of the industry are those of general cultivation and not of manuring. I fail to see how the American system of soil survey could have established this economic fact.

The methods of analysis employed at the Government Laboratory are, as regards conventions of sampling and solution, those of the Association of British Agricultural Chemists. The methods of analysis are those of the American Association, primarily based on the methods of Professor E. W. Hilgard.

Over ninety analyses of Jamaica Soils have been completed during the past year and a half, of which 30 are related to manurial experiments.

When the fundamental facts underlying the fertility of our chief agricultural areas have been established and the planters placed in possession of this information, it would undoubtedly be most advantageous to have a soil survey for the preparation of such soil maps as are being prepared in the United States by the Division of Soils.

I think it could be carried out at a cost of about £5,000 and would occupy 3 years.

BOARD OF AGRICULTURE.

Report of Meeting.

The usual monthly meeting of the Board was held at Head Quarter House on Tuesday, 13th January, at 9 o'clock.

Present:—The Hon. the Colonial Secretary, Chairman, the Hon. the Director of Public Gardens and Plantations, the Government Chemist, His Grace the Archbishop, the Hon. Henry Cork and Mr. C. A. Fursdon.

The Secretary read the Minutes of the last meeting which were confirmed.

The Chairman read minutes by Mr. Shore and Mr. Cousins on the report upon coco-nut disease, and also a circular which was to be sent to planters. After some discussion it was agreed to enlarge the circular upon the lines suggested by Mr. Cousins. The Director of Public Gardens was re-

quested to place before the Chairman a plan for putting several spots under control and observation, and to proceed with the same as soon as possible.

The Chairman read a letter from the Director of Public Gardens making various suggestions with regard to the working of the Industrial School. Mr. Fawcett was of opinion that better work might be done if the boys cultivated garden plots around the School instead of going into the Gardens for instruction. This suggestion however did not meet with the approval of the Board and the Chairman was asked to look thoroughly into the matter.

A report on the sample of Teak sent to the Railway was read, indicating that the sample sent was not of much value for Railway purposes. It was agreed that another sample should be sent.

Mr. Cradwick wrote suggesting the growing of the Tokay variety of grape. It was decided to adopt this suggestion.

In the matter of the carriage of plants from Hope to Kingston, it was reported that Mr. Clark's contract had been cancelled and a new one entered into with Mr. Bolton.

Mr. Cradwick reported upon work in Hanover and suggested the appointment of a local Instructor for the parish. The whole subject of Instructors was then considered and it was thought that with a view to preventing over-lapping, Mr. Cradwick should be located in the west end of the Island, leaving Mr. Young to attend to St. Ann, and Mr. Palache to Manchester. It was moved by Mr. Cork, seconded by Mr. Fursdon, and carried that Mr. Fawcett be asked to look out for a suitable man to look after Upper Clarendon and St. Catherine as well as Upper Trelawny and the Ulster Spring district and to report to the next meeting.

A letter was read from Prof. Milton Whitney recording the failure of an experiment to grow Sumatra tobacco in Bermuda.

Mr. Cousins submitted a report on the first term's work at the Agricultural College, and also a list of applications for admittance. It was agreed to approve the applications of Messrs. Hewitt and Nethersole and to admit Messrs. Sharp and Lindo provisionally. Fees to be paid.

It was agreed to make known the fact that scholars from secondary schools could attend the chemical demonstrations under Mr. Roberts on payment of a charge for gas of 2½d. an hour per pupil. The Secretary was instructed to inform the Chairman of the Schools' Commission of this.

His Grace the Archbishop stated that he wished to bring the whole agricultural work under review to see what further could be done in the way of co-ordinating the work of the various agencies. The Board approved of a further effort being made.

FERNS: SYNOPTICAL LIST,—LVIII.

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

Asplenium Harrisi.

This very fragile, delicately thin little species belongs to the A. viride group, from all which, however, it is characterised by several distinguishing features, but chiefly by its attenuation upwards into the naked thread-like tail, proliferous at the end, a feature which not only marks it from its Jamaican allies of the A. Trichomanes group, but also from the nearer Andean allies. The buds at the end of the tail form new plants,

the tip of the fronds of which are again rhizophorous, and so go on making new plants and forming more or less matted patches, as in *A. rhizophorum.*

Asplenium Harrisi (Euasplenium), Jenm., n. sp.—Rootstock little larger than a pin's head, densely clothed with minute dark scales ; stipites tufted, thread-like, dark glossy brown, 1 to 1½ inch long, often flexuose, channelled ; fronds pinnate, semi-erect or prostate, 3 to 5 inches long, ½ to ½ inch wide ; rachis very slender glossy, brown, channelled, slightly margined in the upper part, and extending its thread-like, naked tail 1 to 1½ inch, gemmiferous, and rooting at the end, pinnae bright, glossy, translucent, membranous, naked, apart, spreading, both the upper and lower gradually reduced, 2 to 3 lines long, rounded and crenate in the upper and outer part, the base truncate, dimidiate from the inferior side being cut away, the minute upper ones cuneate : veins fine, forked, flabellate, open, no mid-veins, terminating within the margin : sori medial oblique, ½ to 1 line in length, occupying both the superior and inferior veinlets ; involucres silvery, flat, eventually raised. Jamaica, Blue Mountain Peak, over 7,000 feet elevation, collected and communicated by Mr. Wm. Harris, November, 1894.

Gardeners' Chronicle, January 19th, 1895.

Asplenium Fawcetti.

This very interesting species, and beautiful addition to the Trichomanes group of the genus in Jamaica, was gathered last November by Mr. Wm. Harris, Superintendent of the Hill Gardens, and at his request, is named after his chief, the Director of Public Gardens and Plantations. Its distinguishing features are the numerous pinnæ (three doz. to five doz. on a side), their dwindling to nearly, but not quite nothing at the apex of the frond, the very fragile rachis and the markedly conspicuous, silver coloured involucres. The rachis which is occasionally wavy, sometimes bears a bud in the axis of a leaflet an inch or so short of the apex. The plant is widely distinct from *A. monanthemum*, L., as well as the other species of the group.

**Asplenium Fawcetti*, Jenm., n. sp.—Root stocks clustered, very small, fibrous the centre densely clothed with fine, attenuated castaneous scales, stipites in tufts, semi-erect, slender, wiry but fragile, margined, castaneous or darker, ½—2 inches long, fronds spreading, linear, and much narrowed to the apex, but without a naked tail, a span to 1 foot long, six to eight lines wide, narrowed at the base, thin, dark green, naked, rachis very slender, fragile, dark, glossy, channelled with scarious margins, pinnæ very numerous, sessile dwindling mostly to mere pin-dots in the outer part of the fronds, and reduced to auricles at the base, rhomboidal and subdimidiate, the superior base wide, but hardly auricled, the inferior base absent 4 to 5 lines long, 2 lines wide, spreading, contiguous, but not touching, broadly rounded, and conspicuously bluntly toothed along the upper and round the outer and inferior margins to where the base is cut away ; veins pinnate at an acute angle, falling short in the teeth, three to a side, all simple, but the inferior one on the superior base, which is once forked from below the middle, sori on both sides of the mid-vein, two or three to a side, lateral on the veins, about one line long distant from the margin, and usually short of the base, involucres conspicuous, bright, silvery.

Blue Mountain Peak, 7,300 ft alt., Jamaica.

—*Gardeners' Chronicle, August 12th, 1899.*

Polypodium Harrisii.

This highly interesting species comes in between Polypodium trifurcatum and Enterosora Campbelli, all three having a very close resemblance and evident connection. In all, the sori are more or less sunk, but extrude when mature. In this and P. trifurcatum, they are in oval or round pits,

while in Enterosora they are immersed in slit-like linear aperatures and are much longer, but extrude eventually. In both this and Enterosora the venation is connected, forming a series of two or three meshes on each side of the midrib, while in P. trifurcatum the branches are uniformly entirely free. The venation quite conforms to some of the states of Phymatodes, the costal series being narrow and unoccupied by either free branches or sori. Mr. Wm. Harris, F.L.S., the Superintendent of the Hill Gardens, the discoverer of it, whose name it bears, writes me that: "It is almost as rare as Enterosora, and like that plant, it grows on the high limbs of large forest trees, so that it is a difficult matter to detect it from the ground, and when detected, it is an exceedingly difficult matter to get within reach of it." Possibly this exalted elevation on large trees, almost beyond reach of sight, may be the reason, more than their rareness, of the late discovery of Enterosora in Jamaica.

Polypodium Harrisii, Jenm, n. sp.-Rootstock repent, fleshy, ½ to 1½ inch long, ery densely clothed with pale fulvous, acuminate, linear-lanceolate, reticulated, wavy scales: stipites mostly clustered, wiry, freely clothed with rusty, spreading, fine hairs, 2 to 4 inches long: fronds ligulate, 5 to 10 inches long, ¼ to ⅝ inch wide, merely sinuate or uniformly shallowly lobate, the lobes broadly rounded base and apex plain and tapering, the latter usually blunt; margins densely hairy other parts glabrous an glossy: substance coriaceous and brittle: midrib and veins on both sides covered in the parenchyma: surface wrinkled and striated more especially the upper; veins in groups, the lateral branches connected forming two to thiee series of meshes of varying shape and form, th outer short veinlets sometimes free Sori oval or round, copious, in two series mostly, sometimes in part three, on each side, one to each mesh, on a shorter or longer spur arising from the middle of the arch, generally medial but occasionally terminal: sunk in pits which are not raised on the upper side of the fronds. Near Mabess River, Jamaica, 3,000 feet altitude.

Gardeners' Chronicle, April 21st, 1900.

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Beihefte zum Tropenpflanzer, Dec. [Editor.]
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No. 79, A Grey Gum (E. punctata, D.C.) Reprint from *Agri. Gaz. of N. S. Wales, July 1902,*
4. On Eucalyptus Baueriana, Schauer.
5. On E. calycogona, Turcz. Reprint from *Proc of Linn. Soc. of N. S. Wales 1902, Pt. 2, June 25.*
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C. African Times, Sept. 27. Oct. 4, 11, 18, 25. [Editor.]

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United States of America.

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No. 36, The Woodsman's Handbook, Part I. By Henry Solon Graves.
Bull. No. 35, Eucalyptus cultivated in the United States. By Alfrd James McClatchie.
Bureau of Plant Industry: Bull. o. 26 Spanish Almonds.
Division of Agrostology: Bull. No. 14 (Revised) Economic Grasses. By F. Lamson-Scribner, No. 25 Field Work of the Division, of Agrostology. A Review and Summary of the work done since the organization of the Division, July 1, 1895. By Cornelius L. Shear. Prepared under the direction of F. Lamson-Scribner, Agrostologist.
List of Publications of the Office of Grass and Foliage Plant Investigations and the Division of Agrostology. By W. J. Spillman, Agrostologist.
Experiment Station Record, Vol. XIV, No. 2 & 3.

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Maryland. 86 (Influence of Preservatives upon the Food Value of Milk.)
New Hampshire. 4 (Effect of Acetylene Gas-light on Plant Growth). (Cold Storage of Apples).
New York. 216 (Report of Analyses of Commercial Fertilizers for the Spring and Fall of 1902.)
Virginia. 8 (On the production of Vinegar in Cellars). 9 (Orchard Studies. —I. The fruit plantation. Pome Fruits.)
Wisconsin. 97 (Licensed Commercial Feeding Stuffs, 1902.)

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Recent Investigations upon the embryo sac of Angiosperms. By D. H. Campbell. Reprint from *The American Naturalist, Vol. XXXVI, No. 430, Oct. 1902.* [Author.]

Central America.

Boletin del Instituto Fisico-Geografico de Costa Rica, No. 21. [Director.]

Polynesia.

Hawaiian Planters' Monthly, Nov., Dec. [Editor.]

Seeds.

From Lady Blake, Hong Kong—
Passiflora sp. (Australia) Rhododendron indicum.

From Mr. V. E. Silvera, Oracabessa.
Thrinax argentea (Silver Thatch)

From Mr. J. C. Harvey. La Junta, Vera Cruz, Mexico.
Stemadenia bella.

From Herr Fedor Deininger, San Salvador, C. America.
Inga vera.

From Acting Curator Botanic Gardens, Aburi, Gold Coast.
Borassus æthiopicum.

From Mr. Alfred Cartwright British Consul, Ecuador.
Carludovica palmata.

From Supt. Botanic Gardens, Trinidad.
Theobroma bicolor.

From Mr. W. Cradwick.
Yampie.

Plants.

From Mr. Alfred Cartwright, British Consul, Ecuadar.
Carludovica palmata.

From Messrs. James Backhouse & Son, Ltd., The Nurseries, York.
Abutilon Schwartzii; Acalypha Hamiltoni; Anthurium, J. B. & Son's strain; Azalea rosæflora; Bamboos in variety; Calamus ciliaris; Dracaena rubra; Euonymus elegantissimus; Ficus barbata; F. falcata; Gymnosta-

chyum, red; Hibiscus Cooperi; Micania pulverulenta; Nepeta glec. variegata; Phyllanthus roseo-pictus; Saintpaulia ionantha; Schisostylis coccineus; Sibthorpia europea aurea; and the following varieties of roses: Anna Marie de Montravel; Baroness Rothschild; Captain Christy; Captain Hayward; Countess of Oxford; Crown Prince; Ducher; Duke of Edinburgh; Duke of Teck; Georges Pernet; Hippolyte Jamain; Jean Liabaud; La France; Madame Eugene Resal; Madame Isaac Pierre; Magna Charta; Merveille de Lyon; Paul Neyron; Pierre Notting; Reine du Midi; Sanglant; Senateur Vaisse; Ulrich Brunner Fils; White Pet.

From Director Royal Gardens, Kew—
Bulbils of Lilium sulphureum.

From Imperial Commissioner from Botanic Station, Antigua—
Black Antigua Pines.

Herbarium.

From Mr. Alfred Cartwright, British Consul, Ecuador.
Samples of "Straw" prepared from leaves of Carludovica palmata.

From Hon. Geo. McGrath, Charlemont, Ewarton.
Specimen of Coco Plum.

From Prof. Dr. Urban, Berlin.
A Collection of 63 specimens.

Library (Books.)

Phycotheca Boreali—Americana. Fascicles XIX & XX and Fascicle C. [Purchased.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Threepence.

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

KINGSTON, JAMAICA:

HOPE GARDENS.

1903.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. I. MARCH, 1903. Part 3.

ON THE NUTRITIVE VALUE AND SOME OF THE ECONOMIC USES OF THE COCO-NUT.

By William J. Gies.

Few if any vegetable products furnish so many useful articles as the coco-nut. It forms the chief food of the inhabitants of most tropical coasts and islands, where the kernel is not only eaten in the ripe and unripe conditions, but is also prepared and served in various ways. It forms an accessory part of the diet, and is found in many of the confections of civilized man all over the globe. The milk is considered an agreeable cooling beverage in the tropics, although it is diuretic in its effect, and causes irritation of the mucous membrane of the bladder and urethra when taken too freely. Immoderate use of the fruit is said to cause rheumatic and other diseases.

Experiments recently published in the Bulletin of the Torrey Botanical Club by Professor Kirkwood and the writer, conducted in part in this garden and with the co-operation of Dr. MacDougal, indicate that the nutritive value of the endosperm of the coco-nut resides mainly in its high content of oil and moderate amount of carbohydrate. Of the former the fresh endosperm contains 35-40 per cent.; of the latter, approximately 10 per cent. The amount of proteid is very slight, being little more than 3 per cent. The quantity of inorganic matter is 1 per cent. The water amounts to nearly 50 per cent. The chief constituent of the milk, aside from water (95 per cent.), is sugar, nearly all of the solids being thus composed, as the very sweet taste amply testifies. Various alcoholic beverages have been made from fermented coco-nut milk.

The endosperm is very agreeable to the taste, and with the exception of the cellulose (3 per cent.), is readily digestible. Domestic animals eat it eagerly, and the coco-nut-orab feeds on it almost exclusively. The residue left over after the fat has been expressed from the "copra" is widely used in Europe as food for cattle, also as fertilizer.

The use of coco-fat as a substitute for butter among the poorer classes has been increasing, and it is frequently employed as a butter adulterant. The tendency of coco-fat to rancidity is not as great as that of animal fats, and for this reason "butters" made from it keep well, and hvae been

recommended especially for military and naval uses. Recent researches show that "coco butter" is quite as agreeable to the taste, and as easily and completely digested, as ordinary butter. Its heat of combustion is 9.066 small calories per gram.

"Coco-nut cream," a dietary product much used in the tropics, is made by grating the endosperm and squeezing the fluid from the finely divided material through cloth. In a warm climate the resultant mixture contains much oil and is a very delicious accessory food. Besides the oil, the "cream" contains chiefly carbohydrate and proteid.

Soaps made from coco-oil combine with, or hold an unusual amount of water, while retaining special hardness, and are characterized by great solubility in salt solution. The so-called "marine" or "salt-water soap" has the property of dissolving as well in salt water as in fresh water. The harder fats of the oil make excellent candles. Coco-nut oil and resin melted together yield a mixture capable of being used with success in filling up the seams of boats and ships, and in tropical countries for covering the corks of bottles as a protection against the depredations of the white ant.

The fibrous husk (coir) is widely used for the construction of ropes brushes, bags, matting, etc. The hard shell is easily polished, and lends itself to the formation of various utensils and ornaments. It also has a high fuel value. The powdered shell and husk are occasionally used as adulterants of ground spices.

The milk of the nut, as has already been pointed out, is strongly diuretic. The endosperm shares with milk the property of a *taenicide*, and has been used as a vermifuge in India for many years, where it is regarded as an excellent means of expelling the flat worm. The harder fats of the oil are used as constituents for suppositories and related therapeutic products. Medicinally the oil is employed repeatedly as a substitute for lard, olive oil and cod-liver oil. It is also made the chief substance by bulk in various salves and cold cream, pomade and similar cosmetic preparations. In ointments and cerates it is especially valuable because of its ready absorption when rubbed on the surface of the body, and on account of its ability to hold an unusual amount of water or saline fluid. It shows little tendency to produce chemical changes in substances with which it may be associated. (*Journal of the New York Botanical Garden.*)

SUGAR CANE EXPERIMENTS IN BRITISH GUIANA.

We have received the Report of the Board of Agriculture of British Guiana in which Professor J. B. Harrison, C.M.G., gives the results of the Co-operative Sugar Cane Experiments carried out during the crop year 1901-2.

We quote from the Report:—

"The Committee being impressed with the danger which underlies "hasty deductions from agricultural experiments conducted over the crops "of only one year, even when carried out on the relatively large scale these "have been, refrain from making any observations on the results, and from "drawing any deductions therefrom. The data are placed on record for "comparison with those which may be obtained in later series of Experi-"ments. The values of the data vary greatly. In the cases of D. 625 and "the Sealy variety the areas were small and the number of Experiments "reported were few.

The mean yields in tons of Commercial Sugar per acre reported, are as follows :—

Order.	Variety.	Tons Sugar per acre.	No. of Experiments.	Acres.
1	D. 625 .	2.95	4	11
2	Sealy .	2.49	4	9
3	D. 95 .	2.24	12	80
4	Bourbon .	2.18	11	1,104
5	D. 145 .	2.17	8	44
6	White Transparent .	2.03	13	380
7	D. 74 .	2.03	9	49
8	B. 147 .	1.99	13	283
9	D. 109 .	1.91	12	225
10	D. 78 .	1.39	7	93

These results should certainly encourage the Jamaica Board of Agriculture in the prosecution of their plans for a systematic trial of cane varieties on all the chief sugar producing areas of the Island.

TABLES OF SUGAR PRODUCTION.

By the Hon. Francis Watts, Antigua.

These tables were prepared for the Imperial Department of Agriculture by Mr. Watts and should be of value to Sugar Planters in Jamaica.

Table showing the Number of Tons of Cane and Gallons of Juice required to Produce One Ton of Sugar under varying Conditions of Manufacture and of Saccharine Richness of Juice.

Juices.	A	B	C	D
Pounds of Cane Sugar per Imperial Gallon of Juice	2.00	1.80	1.60	1.40
Total Solids	2.272	2.045	1.818	1.592
Purity	88o/o	88o/o	88o/o	88o/o
Specific Gravity 30—16.6 C	1.0834	1.0748	1.0660	1.0574
Case I.				
Crushing by Mill per cent	75	75	75	75
Extraction per cent	88	88	88	88
Gallons juice per ton sugar	1273	1414	1591	1818
Tons cane per ton sugar	8.21	9.05	10.10	11.44

Case I.				
Crushing by Mill per cent	70	70	70	70
Extraction per cent	88	88	88	88
Gallons juice per ton sugar	1273	1414	1591	1818
Tons cane per ton sugar	8.80	9.69	10.82	12.26
Case III.				
Crushing by Mill per cent	60	60	60	60
Extraction per cent	83	83	83	83
Gallons juice per ton sugar	1350	1499	1687	1927
Tons cane per ton sugar	10.78	11.99	13.38	15.16
Case IV.				
Crushing by Mill per cent	55	55	55	55
Extraction per cent	83	83	83	83
Gallons juice per ton sugar	1350	1499	1687	1927
Tons cane per ton sugar	11.87	13.08	14.60	16.54
Case V.				
Crushing by Miil per cent	60	60	60	60
Extraction per cent	78	78	78	78
Gallons juice per ton sugar	1436	1595	1795	2051
Tons cane per ton sugar	11.57	12.75	14.24	16.14
Case VI.				
Crushing by Mill per cent	55	55	55	55
Extraction per cent	78	78	78	78
Gallons juice per ton sugar	1436	1595	1795	2051
Tons cane per ton sugar	12.63	13.91	15.53	17.60
Case VII.				
Crushing by Mil per cent	55	55	55	55
Extraction per cent	74	74	74	74
Gallons juice per ton sugar	1514	1682	1892	2162
Tons cane per ton sugar	13.31	14.66	16.86	18.56
Case VIII.				
Crushing by Mill per cent	50	50	50	50
Extraction per cent	74	74	74	74
Gallons juice per ton sugar	1514	1682	1892	2162
Tons cane per ton sugar	14.61	16.10	17.97	20.36

Definitions.

Total Solids. The quantity of substance in solution in cane juice including sugar and impurities.

Purity or Co-efficient of Purity. The proportion of Cane sugar to 100 of Total Solids. Calculated by dividing the Total Solids into the cane sugar and multiplying by 100.

It has been assumed at 88 for the purposes of these calculations.

Crushing. The weight of juice expressed by the mill from 100 parts by weight of canes.

Extraction. The amount of marketable sugar obtained from every 100 parts by weight of cane sugar in the juice.

Francis Watts.

Gallons of Juice per Ton of Cane for different Percentages of Crushing.
Sp. Gravity 1.0750.

Crushing per cent.	Gallons of juice per ton of cane.	Crushing per cent.	Gallons of juice per ton of cane.
48	100.0	65	135.4
49	102.1	66	137.5
50	104.2	67	139.6
51	106.3	68	141.7
52	108.4	69	143.8
53	110.4	70	145.9
54	112.5	71	147.9
55	114.6	72	150.0
56	116.7	73	152.1
57	118.8	74	154.2
58	120.9	75	156.3
59	122.9	76	158.4
60	125 0	77	160.4
61	127.1	78	162.5
62	129.2	79	164.6
63	131.3	80	166.7
64	133.4	...	...

GRASS OILS.

By H. H. Cousins.

In view of the recent observations on the growth of the *Andropogon* grasses at the Hope Experiment Station and of the yield of oil obtainable, it appears desirable to compare these results with those recorded of the same products prepared in Trinidad by the Superintendent of the Botanic Gardens and subsequently investigated by the Hon. F. Watts in the Government Laboratory, Antigua.

TRINIDAD OILS.

LEMONGRASS OILS.

The prices of this oil fluctuated during the last few months between 4½d. and 5½d. equal to 14·50 to 17 marks per kilo purchase price, but the article appears to be scarce in India, as large parcels were rarely offered. We hear from Cochin that the yield of the harvest has been very small, and that in consequence the merchants are holding the goods back in order to obtain higher prices.

The decline of the sugar industry in the West Indian islands appears to lead to this, that the lands and the labour set free by the reduced cultivation of sugar-cane are employed for other purposes; and from a report which has reached us from a friendly quarter it would seem that it is intended to take up there the cultivation of the *Andropogon* grasses. That attempts to cultivate these grasses have already been made in those islands is proved by the fact, that the Superintendent of the Botanical Gardens at Trinidad, at a meeting in Barbados, produced among other essential oils, also the oils of *Andropogon Nardus* var., and *Andropogon Schoenanthus*, which were subsequently examined more in detail at the Government Laboratory in Antigua.

The following results were obtained there:—

for the first oil:

d $\frac{15.5^{\circ}}{15.5^{\circ}}$ = 0·9084, aD = + 0°1'; aldehyde-content 15·5 per cent.; saponification number 23, saponification number after acetylation 168·5, corresponding to a total alcohol-content of about 53 per cent.;

for the other oil:

d $\frac{15.5^{\circ}}{15.5^{\circ}}$ = 0·9315, aD = + 5°; aldehyde-content 48·2 per cent.; saponification number 31·1; saponification number after acetylation 69·6, corresponding to 20·2 per cent. $C_{10}H_{18}O$.

Whereas the first of the two oils, apart from the low dextrogyration, approximately agrees with Ceylon citronella oil (it does not dissolve in 10 volumes of 70 per cent. alcohol, but readily in the same volume of 80 per cent. alcohol), the other oil differs in its properties in a very marked degree from palmarosa oil, with which, according to the mother plant, it should be identical. But the oil cannot be considered as lemon-grass oil because (even assuming that the aldehyde it contains is actually citral), the aldehyde-content is too low; it shows a certain amount of similarity with a lemongrass oil from the same district (compare Report April 1902, page 48), inasmuch as it dissolves with great difficulty, and only makes clear solutions with 94 per cent. alcohol.—From Schimmels Semi-annual Report as given in Agricultural News p. 20.

JAMAICA OILS.

Andropogon Schoenanthus.

This the ordinary "fever grass" of Jamaica, grew strongly and furnished an abundance of grass for cutting. The results of distillation were, however, so disappointing that it was concluded that the cost of production per lb. of oil was far too high to enable this grass to compete with the *Andropogon Nardus* of Ceylon as a source of Lemon-grass oil, quite apart from the intrinsic value of the two products.

—Experiments were made to decide the best treatment of the grass before being placed in the Still. Uncut grass gave a lower yield of oil and took longer to distill than cut grass. It was found, however, that fine subdivision in a closely set Chaff Cutter was, if anything, detrimental to the yield of oil. The practical conclusion arrived at was that the grass should be cut fresh as wanted and cut up into lengths of about 6 inches for distillation. The Laboratory Still took 35lbs of grass at each charge. The yield of oil varied but little andamounted to 1 cubic centimetre per lb of green grass. This equals a yield of 4ozs. per cwt.

The oil was of a bright golden yellow colour and gave the following results:—

Specific Gravity $\frac{60^{\circ}}{60^{\circ}}$	0·8897
Optical Activity	— 1·0°V in 20 c.m. tube

T = 29.5. C.

On distillation the following fractions were obtained :—

Temperature. C.	Per Cent.	Optical Activity
215-225	22	— 1·0°V
225-230	34	— 0·8°V
230-240	20	— 1·0°V
Above 240	24	—-

Comparing these results with those recorded for the Trinidad oil of *A. Schoenanthus,* the following differences are to be noted.—The specific gravity of the Jamaica oil is markedly lower. Whereas the Trinidad oil is dextro-rotatory, the Jamaica product is laevo-rotatory. The Chemistry of this oil requires investigation and it is hoped that some research Chemist may come forward to elucidate its composition.

Andropogon Nardus.

This grass is the one grown in Ceylon. It appeared less vigorous and hardy at Hope Gardens than the Creole grass. The results of distillation were nearly three times as great as with *A. Schoenanthus.* A yield of 2·9 cubic centimetres oil per ℔ of fresh grass was consistently maintained. This equals 11·6 ozs. per cwt. of grass as against 4ozs. from *A. Schoenanthus.*

The following results were obtained :—

Specific Gravity $\frac{60° F}{60 °F}$ 0·8935

Optical Activity +17·0°V T=29·5°C.

on distillation the following fractions were obtained :—

Temperature. C.	Per Cent.
195–217	6
217–225	40
225–235	50
Above 235	24

As compared with the Trinidad oil the lower specific gravity and markedly higher dextro-rotation are notable. The Boiling Point of Citronellol is given in Watts' Dictionary as 210°—220°.

These oils have been sent to Messrs. Schimmel for their report, and it will then be possible to form an opinion as to the commercial production of Lemon grass oil in Jamaica. To the student of organic Chemistry these oils present an attractive subject for investigation. The Island Chemist will be pleased to supply to any Chemist who would undertake the investigation, a reasonable quantity of oil for that purpose. So pressing are the needs of our strictly technical work at the Government Laboratory, that it is quite impossible for the Chemist and his Staff to undertake this investigation under present conditions.

INTERNATIONAL CONFERENCE ON PLANT BREEDING AND HYBRIDIZATION.

Editorial From Expeimental Station Record.*

The second International Conference on Plant Breeding and Hybridization, which was recently held in New York City, exceeded in attendance and interest the previous meeting, held in London in 1899, and served to show the large interest in the subject in this country. An extensive programme of papers was presented, but only a portion of them were read. These discussed the principles of plant breeding and their application, as well as giving the results of years of work and observation in the production and propagation of improved varieties of plants.

In the theoretical discussion of the papers there was an almost universal acceptance of Mendel's law regarding the appearance of dominant and recessive characters in the later generation of hybrids. This law, although announced in 1865, has only recently been given wide publicity through its publication in various journals (E. S. R., 13, p. 744). It was the consensus of opinion that it is the best available working hypothesis for the plant and animal breeder, and that it seems to stand the test of experience to a remarkable degree. The methods of Mendel were commented upon, and in a number of papers his conclusions were reaffirmed relative to the necessity of large numbers of individuals in breeding experiments and the continuation of the investigations through many generations, in order that the results may be of permanent value. The futility of indiscriminate crossings and the necessity of working with pure strains or races was shown by abundant examples. A hybrid produced from a mixed ancestry is very liable to be inferior to either or both of its parents, unless by a long system of cultivation the characteristics of the parents have become definitely fixed.

In all kinds of breeding experiments it is necessary to adopt an ideal and adhere closely to it, rejecting for the time all secondary variations that may appear. If these seem very promising, they can be cultivated independently of the main investigation, but nothing should divert the breeder from continuing to follow to its conclusion the line of experimentation, which should be well formulated at the start. Once a hybrid is established, then selection and cultivation enter into the problem of fixing it. The selection requires keen discriminating powers, and is in many ways more important than the act which produced the hybrid.

Another thought brought out quite prominently was the necessity for

* Vol. xiv, November, 1902.

breeding to meet definite requirements. Changed seasonal, soil, and climatic conditions will often render worthless what are otherwise promising varieties. It is believed to be impossible to originate a variety of plant that is of universal value, and the transfer of valuable sorts to regions of markedly different character was said to be usually followed by disappointing results.

A high compliment was paid to the plant-breeding work that has been carried on in this country. One of the foreign guests declared that greater advance is being made along this line in the United States than in any other country, the great range of soil, climate, and necessities making such work possible.

The value of such a meeting in arousing an interest in the subject of plant breeding can hardly be estimated. The description of methods, criticism of results, and the application of principles were given and taken in a spirit of scientific earnestness, und the enthusiasm aroused will be continued and exhibited in the wide extension of the work.

The systematic work which is being done in plant breeding, including the study of principles governing it, is worthy of imitation in animal breeding. The field is quite as attractive, as far as possibilities of useful results are concerned. The breeding or selection of plants resistant to disease suggests that something might be done with animals in producing strains more vigorous or resistant to some of our troublesome diseases. In this connection some recent experiments reported from Algeria in attempts to combat Texas fever are interesting. In the search for some animal of the bovine kind which was immune to Texas fever, it was found that both the buffalo and zebu were naturally resistant to this disease. The buffalo could not be crossed with the domestic cattle, and appeared to be for other reasons less desirable than the zebu as a substitute for cattle. It was found that the zebu crossed readily with different races of cattle, and that all hybrids thus obtained were perfectly immune to Texas fever. The female hybrids between the zebu and domestic cattle were found to be very fertile, while the males were well adapted to the production of beef or to performing work of various kinds. The hybrids attained a weight of about 360 kg. (792 lbs.) at an age of 3 years and the dressed weight averaged about 62 per cent of the live weight. The large hump composed of muscle and fat tissue and situated over the shoulders of the zebu largely disappears in the hybrid. The bones are unusually small and of a delicate nature. The meat is said to be of good quality. The milk of the zebu or of the hybrid is claimed to be richer than that of the ordinary Arabian cow. The zebu gives from 6 to 8 quarts per day, while hybrids yield from 15 to 16 quarts. Three different races of zebus have been introduced into Algeria, one from Madagascar, one from Cochin-China and a third from India. The third, or Brahmin race, is the only one which proved to be of economic importance and is the one from which the present zebus and hybrids of Algeria have descended.

Review of Papers

By Walter H. Evans, Ph. D.

Of the U.S. Department of Agriculture.

An international conference on plant breeding and hybridization was held in New York City, September 30 to October 2, 19 2, under the auspices of the Horticultural Society of New York, with James Wood as president and Leonard Barron, secretary. About 80 delegates were prsent, representing different parts of the United States, Canada, England

West Indies, etc. A programme of more than 50 papers was presented, a number being sent from Germany, Austria, France, Holland, and England. All of the papers are to be published in full in the proceedings of the New York Horticultural Society, which it is hoped will appear early in the coming year. A brief account is here given of a number of papers which were presented at the Conference.

Prof. W. Bateson, of Cambridge University, England, considered the Practical Aspects of the New Discoveries in Heredity. He briefly reviewed Mendel's law of heredity, and pointed out some of the great advances which have been made since the enunciation of that law. In general it was stated that while great differences may exist in plants and animals, hybrids in their first generation represent the characters of one parent and not of both. The author believed that the time would soon come when the fundamental principles of plant and animal breeding would be known, so that the breeder would be able to control his work instead of depending upon chance results. For the practical man it is impossible to always determine the characters which exist in the parent plants. As an example, it is cited that green peas may be due to the union of 2 green varieties, of yellow and green varieties, or of 2 yellows all of which tends to complicate the special hereditary characteristics. The frequent occurrence of bearded wheats in plats of beardless varieties was mentioned, and their presence was attributed to the probable fact that the beardless variety had been developed from a bearded form, the plants still containing some of the germ cells of the bearded ancestors. The predominance of the recessive germs resulted in the appearance of bearded forms, and the presenee and influence of recessive germs can be eliminated only gradually. Species, according to the author, are not to be considered necessarily fixed or of long duration. Crosses or, as the author called them, heterozygote forms do not usually reproduce their kinds, but often result in reversion to ancestral types. A number of examples were cited of reversions which have taken place in the sweet pea, giant lavender, primulas, Andalusian fowls, etc., which show that in a number of instances the forms are not readily fixed, being the result of complex crosses that are for the most part infertile.

A paper by C. C. Hurst, entitled Notes on Mendel's Methods of Plant Breeding, was read by the secretary. Mendel was apparently the first to recognize the necessity of considering each single character on its own merits. In selecting constant characters, he avoided confusion by crossing only constant and fixed races of plants, each of which had been the product of repeated self-fertilization. If plants are chosen for crossing, the ancestry of which is unknown, the resulting offspring will either be incomparable or incomprehensible. The writer cited his experiments with orchids in which by choosing constant characters he had almost entirely succeeded in eliminating the possibility of reversion. It is stated that some of the apparent exceptions to Mendel's results are probably to be attributed to the crossing of species which were not constant in character. The consideration of differential characters was briefly discussed, and it was stated that Mendel in his experiments always chose his characters in pairs, so that they would be distinctly differential and capable of definite recognition in the offspring. The more clearly defined the differences between the parental characters, the more marked will be the single characters in the resulting offspring. The fourth point in Mendel's method is said to be distinctly new, and that is the crossing together only of dominant and recessive characters. If one of the characters of the differential pair is always distinctly dominant over the other, the latter is known as the recessive character.

Knowledge of this fact serves to give uniformity to the first generation and avoids the difficulty of continuing through subsequent generations breeding in which the results secured will not be uniform. The necessity of using large numbers of individuals was pointed out. In this there was great advance over Mendel's predecessors. After having secured hybrids they should be carried through many generations. Mendel in all cases carried his experimets to the third and fourth and in some cases to the fifth and sixth generations. Summing up the methods of Mendel, the author states that hybridists who desire to follow the footsteps of Mendel and help elucidate the problems of inheritance will find it essential in their work to select parents possessing characters which are at once single and constant differential and dominant, and they must also take care to raise large numbers of individuals through many generations.

A paper by Hugo de Vries, director of the Botanical Gardens Amsterdam, Holland, discussed Artificial Atavism. Atavism was defined as the occasional restoration of an old type in a compound cross. Crossing is said to not only combine characters, but to separate them. Among flowers as ordinarily listed in catalogues, there is usually the ordinary wild color as well as a white form, with various intermediates. If a cross be made between the white form and some of the intermediates, the resultant hybrids will fall into types, some of which return to the original color. The color variations and reversions produced by various crossings were shown by illustrations of well-known varieties. It is said to be possible to split up and produce new colors by crossing the original or wild color with any of the white forms. The results obtained usually follow the principles laid down in Mendel's law. A number of instances were cited in which it is shown possible to produce atavism artificially.

In commenting upon this paper, Professor Bateson stated that he believed synthesis in plant breeding, although sometimes apparent is not truly possible. A compound character consisting of 3 or more components, he believes, can not be recomposed from its original forms.

Some suggestions for Plant Breeding were made in a paper by Max Leichtlin, of Baden-Baden, Austria, which was read. In crossing plants the author states that the selection of a suitable time for crossing is of first importance. A warm, cloudy day offers the best conditions for about 60 per cent, of plants. For some a dry atmosphere is best as it more nearly represents the conditions of their original habitat. Fertilization should not be attempted before the stigmas are in proper condition. This can be easily recognized after some practice. The pollen should be neither too fresh nor over-ripe. After applying the pollen to the stigma in many cases it will be found advantageous to cover the flower with a hand-glass or some similar means for a day or two to give a higher temperature than that of the surrounding air. The pollen of many plants, if in good condition, can be kept in small glass vessels, well corked, for several days without loosing its fecundating power. Whether fertilization is possible or not can be easily ascertained by a microscopical examination of the forms of pollen grains. If their forms are fairly constant the pollen will do for fertilization, but if markedly different its use for this purpose is impossible, The prepotency of sex was shown by the statement that in 8 cases out of 10 the female parent has the greatest influence on the progeny. The staminate parent usually controls the color of the offspring, and in most cases the hybrid plants have larger flowers than those possessed by either parent.

In the discussion following this paper a number of interesting facts were brought out relative to the vitality of pollen. The president of the society stated that the pollen of tomatoes would retain its vitality for fully 6 months, as shown by the common practice of gathering pollen during the late summer and fall months from plants grown out of doors, for use in fertilizing tomatoes grown under glass during the winter. According to another statement, grape pollen retains its vitality for fully 2 months, and the date palm for a year or more. Carnation pollen may be kept in closely stoppered vials for several weeks, and may be shipped from one part of the country to another. In preparing pollen for keeping it should be thoroughly dried and placed in closely stoppered bottles. For plants grown in moist climates the drying should be done in the shade; for those growing in arid regions, it may be more quickly dried in the sun. It was stated that pollen of certain plants is commonly distributed through the West Indies on dry blotting paper inclosed in pasteboard boxes. In this way its vitality is retained for more than 3 weeks.

A paper giving some suggestions for the classification of Hybrids prepared by R. I. Lynch, curator of the Botanic Garden, Cambridge, England showed the desirability of the classification of all results, so that reference can be had to previous work. A plan previously published by the author in tho Journal of the Royal Horticultural Society of London, vol. 25, was briefly outlined. Investigators often want to know what plants have been found to respond in a certain way, or they may desire to reobserve from a new point of view, or carry further results in which they may be interested. This was cited to show the importance of classifying all experimental results, and action of the conference along this line was recommended. The writer requested that he be furnished with accounts of hybrids which at first were nearly barren and afterwards became fertile; also of hybrids which are less fertile than either of their parents. He also asked that suggestions be sent him regarding different systems of classification. In general, he proposes the classification of hybrids based upon their behaviour, rather than upon the classification of natural orders, genera, or species.

The Principles of Plant Breeding were discussed in a paper by Luther Burbank, of Santa Rosa, California, The two influences or forces which control plant and animal breeding are heredity and environment. To guide the interaction of these two forces is the sole object of the breeder, whether of plants or of animals. A general knowledge of the relations and affinities of plants is not sufficient for the successful plant breeder, He must be a skillful biologist, and, having a definite plan, must be able to correctly estimate the action of the inherent and external forces which he would control. A plant breeder before attempting to make new combinations should select with great care the individual plants which seem best adapted to his purpose. This requires an exceedingly keen perception of minute differences, great patience, and extreme care in treating the organisms operated upon. This applies more particularly to annuals or those plants generally produced by seed. In breeding perennials the first deviations from the original form are often of an almost unappreciable degree. By careful and intelligent breeding, any peculiarity may be made permanent, and there appears to be no limit to the improvment of plants. Cultivation and care may help plants temporarily, but by breeding, plants may be produced which will do better work in all places and for all times.

W. A. Orton, of this Department, read a paper on the Breeding of Disease-Resistant Varieties, in which a résumé was given of work being carried on by the Bureau of Plant Industry. The wilt disease of

cotton, cowpeas, and watermelon was described and photographs and material shown. As a result of continued selection of resistant varieties, it was stated, Sea Island cotton is now grown in regions which had been practically abandoned on account of the destruction caused by the wilt. No varieties are wholly resistant, but a number of strains have been found which are to a great degree able to resist the fungus. In general, upland cotton seems less resistant to wilt than Sea Island, and Egyptian varieties are more resistant than any of the others. The work so far has been one of selection, since hybridization is not practicable, as it tends to destroy the merchantable character of the fiber. Similar results in the selection of cowpeas and watermelons were cited, and the author believes that many other varieties of plants may yet be found that are resistant to disease.

W. M. Hays, of the Minnesota Station, presented a paper on Breeding for Intrinsic Qualities. He believed the value of plants and animals annually produced in this country could be readily increased 10 per cent. at an expense of less than 1 per cent. The greatest financial gains would probably be secured by the improvement of a score of plants and about 4 species of animals. By carefully growing and testing many thousands of individuals there will frequently be found some one individual of such superior merit as to repay all expense. In any hybridization work a good foundation stock must first be produced upon which to base the new varieties. The importance of working with large numbers of individuals and the value of correlated qualities were pointed out. During the progress of the work various side lines may enter, but these must be held subordinate to the main idea which controls the experiment. In choosing varieties, often very perplexing problems arise. As a rule crosses should be made between individuals which closely approximate the ideal, and not between those which are too dissimilar. An illustration of the value of using large numbers was given in the experiments in breeding wheats. To begin with, 500 plants were examined for foundation stock and tested from 3 to 5 years to see that they came to true seed. After continuing the work this length of time, all were rejected but about 50, which were given a field trial. This work has been continued, large numbers of individuals being constantly grown, and as a result 2 or 3 varieties have been found which are intrinsically of great value. In wheat breeding the author thinks that an increased yield, irrespective of distinguishing marks, should be the ideal sought.

A paper on the Correlation between Different Parts of the Plant in Form, Color, and Other Characteristics was read by S. A. Beach, of the New York State Station. By means of a number of specimens he showed the correlation which exists between different parts of plants. By the proper study of the correlation of form, color, vigor, etc., undesirable material may be eliminated to a great degree while the seedlings are still young. In this way much valuable time and space may be saved. Numerous examples were cited in which this early elimination is possible. Small foliage is said to be usually correlated with small fruit. The texture of the leaf and of the fruit are believed to be correlated to some degree. Dwarfed seedlings produce poor plants even when given good cultivation. Attention was called to the importance of considering groups of characteristics. In the case of the peach there seems to be a direct relation between the size of the foliage and the size of the fruit, and sufficient evidence is believed to be at hand to show that size and color of foliage and flowers may be depended upon in predicting the character of fruit. Pale or light colored blossoms are usually associated with small fruit in apples, while deep color is correlated with larger fruit. Pale

foliage in the raspberry is correlated with yellow or lighs colored fruit, and dark fruit is obtained from plants having dark foliage and canes. Roses, cannas, and asters generally follow the same lines—pale colored foliage indicating light colored flowers. In comparing these factors, fully matured leaves should always be examined and even then exceptions will be noted. A correlation is said to exist between the color of the flowers and the seeds of beans, between the color of the roots and stems and the flowers of carnations, between the color of the seed coats and character of plants of peas, etc. There is apparently some correlation between the size of the different organs of plants and possibly between their size and color, but as yet the evidence is not sufficient to formulate definitely.

O. F. Cook, of this Department, discussed Evolution under Domestication, claiming that it is not rational to attribute to environment all of the changes found in plants and animals.

The Varying Tendency and Individual Prepotency in Garden Vegetables was the subject of a paper by W. W. Tracy, of Detroit, Michigan. The author's long experience has enabled him to examine an immense number of specimens of different vegetables and note some of their peculiarities. These variations will frequently be apparent only from a careful study of a great number of plants. It is stated that different plants of the same natural order tend to vary along parallel lines, and variations that are frequently attributed to hybridization are due to ordinary variation. Different natural orders of plants are differently affected by soil, climate, etc. In some cases plants grown from seed from widely different regions did not show any appreciable difference; in others, marked differences may be noted in comparatively slight changes. An example was cited in which a variety of watermelon was grown in Michigan aud in a Gulf State, the seed being from the same source, and the progeny was so similar as to defy any detectable differences. The effect of cultural and climatic influences is cumulative. This was illustrated by the simultaneous occurrence in widely separated regions of bush forms of Lima beans, sweet peas, etc. These plants ordinarily grow in climbing forms, but bush forms suddenly appeared in different parts of the United States, seeming to indicate that the influences had been simultaneously working in different regions. Stock produced by an individual grower will vary widely during different seasons. Seed from the same stock, equally well grown under precisely the same conditions, show marked differences in the tendency to adhere to type in different seasons. Seeds from individual pedigreed stock plants vary widely in their progeny, and the only way to secure uniformity is to define an ideal, select carefully, and propagate carefully. so as to secure a lineal descent of a single typical plant.

Dr. D. Morris, Imperial Commissioner of Agriculture for the West Indies, read a paper on the Cross Fertilization of the Sugar Cane, in which he described the experiments in the West Indies in the improvement of sugar cane. The subjects for consideration are a greater tonnage of cane, a greater yield of juice, a higher sugar content, and a cane immune to diseases. More than 60 varieties of canes have been imported from all parts of the world and tested at the various West Indian stations. Special attention has been paid to bud variation, and a few examples have been found, which were briefly described. Some of these are quite promising as improvements over the older varieties, and so far they tend to come true to color. Nearly all of the bud variations or sports which have been under investigation originated from the ribbon or striped cane. Planting from different parts of cane has not given results of any great value or improvement, and selection by analysis of the cane juice does not appear to offer promise of definite results, nor has selection proved of value when

the richest canes have been taken individually. Where the richest clump in a field was tested there was some indication of value, and this is believed to warrant further investigation. A description was given of attempts to produce new varieties from seed. The fact that the sugar cane sometimes produced fertile seed was established about 1887. At that time fungus diseases had almost entirely destroyed many of the best varieties in Java and in the West Indies. A careful examination of the flowers, which are very small and very numerous, showed that occasionally a few seed in a panicle were produced, frequently only 2 or 3 being found in a panicle containing many thousand flowers. In the author's experiments the whole panicle was sown in boxes in the hope of the presence of some fertile seed. On account of the minuteness of the flowers and the rarity of the production of fertile seed, the ordinary method of cross fertilization could not be adopted. Staminate plants were planted to the windward of the pistillate ones, or in alternate rows. In another series the panicles were covered with bags and later dusted with pollen-bearing plants of known value. It was found that frequently the pollen was infertile, while the pistillate flowers were fertile. The most valuable varieties so far obtained through seed canes have followed the principal characteristics of the staminate parent.

So far as the writer's observation has gone, the seed canes tiller more extensively than the plants from the cane top. The Ribbon and White Transparent varieties have proved the best for mother plants, the mother plants governing the size, color, and to a considerable extent the sugar content of the cane. Purity of the juice has not been definitely determined as due to either parent. As to the yield of sugar, the average for the island of Barbados is said to be 1.7 tons per acre, while one variety shown by the writer, designated as No. 208, yields 3 tons of sugar per acre at Barbados, and its value has been further attested on the islands of Trinidad, St. Kitts, etc.

A paper on the Cytological Aspects of Hybrids, by W. A. Cannon, of Columbia University, New York, showed that the relation between the cytological and experimental studies could not be definitely stated in the present state of our knowledge on the subjects. A review was given of Mendel's laws in the light of modern cytological studies. So far these studies have been made on first-generation hybrids. It is said that the normal division of sex nuclei leads to fertility in hybrids, but abnormal division to sterility. Cytological studies on cotton and other hybrids, it is claimed, show (1) a possible cause of sterility, (2) that variation in the hybrid may or may not be associated with variation in spermatogenesis, and (3) that chromosomes tend to retain their respective individualities, as shown in many hybrids examined.

Improvement of Roses by Bud Selection was the subject of a paper by L. C. Corbett, of this Department, in which experiments were reported which were undertaken to determine the relative value of blind and flowering wood in rose production. It was shown that individual characteristics of a branch were perpetuated from generation to generation in plants asexually propagated, and also that cumulative results are not to be expected by the selection of parts showing like tendencies through successive generations. The flowering habit of plants produced from flowering wood through five generations was in no way increased, nor was it diminished when blind wood was employed in a like manner. From the commercial side this has an important bearing, as it is more economical for the florist to produce his roses each season from blind wood.

Under the title of Improvement of Oats by Breeding, J. B. Norton, of this Department, gave a description of the work recently undertaken in

the plant-breeding laboratory. This has included the selection and hybridization of oats to secure rust resistance, hardiness, increased yield, to prevent lodging. etc. As yet the results can not be definitely determined.

In experiments to increase the yield and hardiness of winter oats by selection, sowings were made at different dates late into the autumn, and the hardiness of the plants was tested by freezing out during the winter. It was found that the farther south seed oats are produced, the earlier the crop when sown at Washington; and there are apparently no varieties of oats which come absolutely true to type description. In experiments in crossing, only 5 to 10 per cent. of successful fertilizations were ordinarily secured. If cool, moist days were chosen for pollination, better results would be obtained, in some cases almost 100 per cent. of the pollinations resulting in the production of fertile seed. The presence of natural crosses was briefly commented upon, and it was stated that Rimpau in his work, covering many years, observed only 4 or 5 cases. This seems to indicate that oats are nearly always self-fertilized.

In commenting upon this paper, Director Saunders, of the Canada Experimental Farms, called attention to the Canadian work along the line of oats breeding, which has been carried on for about 10 or 12 years, and D. G. Fairchild referred to the work being conducted at the experiment station at Svalöf, Sweden, along similar lines.

The subject of breeding Florists' Flowers was treated in papers by E. G. Hill, of Richmond, Indiana, C. W. Ward, of Queens, Long Island, and A. Wintzer, of West Grove, Pennsylvania. In Mr. Hill's paper notes were given on breeding experiments with roses, carnations, and geraniums. Of many thousand hybrids produced, but few of desirable quality were obtained. Not one in a thousand was said to in any way approximate to the value of the ideal which was sought. When the great number of hybridizers who are experimenting with roses is considered, the number of valuable new sorts is very meager compared to the amount of labor expended. While rose fertilization is said to be very easy, the most important part of the work is in properly maturing the seed and propagating it. A number of successful hybrid roses were cited as being recently introduced into the market. Somewhat similar results were reported with carnations, in which out of thousands of seedlings grown every year by hundreds of growers, only a few improved forms are annually obtained. In experiments with chrysanthemums the best results have been obtained, it was said, when only double forms were used for parent stocks. The hybridizing of begonias was also commented upon, and the origin of a number of the finest new varieties was indicated. Attention was called to the fact that La France, claimed to be the parent of many new varieties, is absolutely sterile in some countries.

The result of experiments in crossing pumpkins were described by L. H. Bailey, of Cornell University, in a paper entitled A Medley of Pumpkins. The author began a series of experiments in 1887, which was continued for 10 years, to determine the immediate effect of pollen on fruit. After a number of years' investigation, no immediate effect of pollen could be recognized on cucurbit fruits. The experiments were continued, however, to see what would be the result of crossing 2 varieties of squash. These varieties were hand pollinated, the seed saved, and in the third generation the plants occupied between 8 and 10 acres. Of the product examined, fully 1,500 forms were noted which did not resemble either parent in form or shape. The plants seemed to be almost wholly self-sterile to their own pollen. The seed of one form, designated as Alpha, when planted, gave 110 distinct kinds of fruits and inumerable intermediates. The parent stock of this experiment was pedigreed and usually came true to type, but

the progeny resulting from crossing was so variable as to give nearly as many types as there were individuals. New characters continually appeared in the second and third generations, and the confusion became so great that the experi ent was abandoned. Another experiment was described, in which one of the small ornamental pear gourds was crossed with pollen from the typical Connecticut pumpkin. From the seed secured, 39 plants resulted and no two fruits were identical Nineteen forms were found that were fairly well marked, and these were described as types. In all the experiments seedlessness seemed to be a common trait of crossed cucurbits, or if seed were produced they were ordinarily sterile. An attempt was made to reciprocally cross *Cucurbita pepo, C. maxima,* and *C. moschata.* Only 3 fruits were obtained, and those, species hybrids, were between *C. pepo* and *moschata.* The progeny grown from these seed were more uniform in character than those obtained by crosses in the varieties of *C. pepo.* Continuing this work through a number of generations, the *moschata* type entirely disappeared and the plants were to all appearances *C. pepo*

Results of Hybridization and Plant Breeding in Canada was the title of a paper presented by William Saunders, director of the Canada Experimental Farms. He gave a brief résumé of 40 years' work in Canada along the line of production of new varieties of fruits, cereals, etc. His work with wheat, oats, barley, and various fruits was described. the methods of manipulation being given in considerable detail. Specimens were exhibited which showed the results of a number of the crosses. Among them were crosses of *Pyrus baccata* with several varieties of Russian apples, of different species of barberry, of gooseberry and black currant, of *Pyrus maulei* and *P. japonica,* and of various cereals.

During an evening session a number of papers were presented which were illustrated by specially prepared lantern slides. The first of these was by W. B. Allwood, of Virginia Station, in which an account was given of investigations in wine fermentation. The selection, propagation, and uses of pure cultures of yeasts in wine and cider making, and in brewing and distilling, were considered and the different methods of elimination and of cultivation described. Graphics were shown of the action of various wine ferments upon grape must.

The second illustrated paper was by W. Van Fleet, of Little Silver, New Jersey, on Hybridizing Gladiolus Species. In growing Gladioli, only summer-blooming varieties with good winter-keeping corms are desired in this country. Hybrids of large flowered species seldom prove valuble in the first generation but seem to improve in subsequent ones. Many species hybrids have been produced but few have proved of intrinsic value. As a rule, Gladioli do not grow well in clay. Sandy soil with an underlying of peat, if kept well wet, is the best soil for their growth. A number of hybrids were exhibited, one of which (Princeps) was said to have a flowering period of nearly 5 weeks, 4 or 5 of the huge flowers succeeding each other until the entire spike has blossomed. This same phenomenon occurs when flower stalks are cut and placed in water, if the water is frequently changed. During 16 years of active hybridizing, in which a number of species were used for breeding purposes andmore than 150,000 seedlings produced, many new commercial varieties would have been expected, and although there were many promising novelties only 2, Princeps and Lord Fairfax have been thought worthy of naming and commercial introduction.

The paper of C. W. Ward, of Queens, Long Island, on breeding Florists' Flowers was also illustrated by lantern slides. He gave the results of 12 years' work in the hybridizing of carnations. His work has been confined to 8 types of stock which were based on color differences. These have been

subjected to various crossings, and it was said that the staminate parent showed its effect in the color of the progeny. If crossed upon another flower of the same color the resultant plant would show reversion to prominent ancestral types. The writer claims that when the commercial habit of the carnation has been established any desired color can be bred into it. In breeding carnations, if it is desired to heighten the color in no case should purple or similar colors be used, as those colors tend to dull the color of the progeny. The most difficult colors to fix in hybrid carnations are the yellows and blues, and the variegated forms are almost impossible to fix. Of 60,000 seedlings grown to flowering, 36 have been considered of sufficient merit to continue propagation, and of this number 16 have been introduced to commerce. In the lantern slides accompanying this paper were shown the parentage and progeny of many of the hybrids produced by the writer.

N. E. Hansen, of the South Dakota Station, read a paper on the Breeding of Native Northwestern Fruits. The prairie regions of the Northwest require the breeding of new varieties of fruits, since all the Eastern varieties so far tested have proved too tender. The writer has been extensively engaged in originating new varieties and more than 100,000 seedlings have been under investigation. To induce variation he preceded on Darwin's theory that excess of food induces variation, and the writer believes that selection and cultivation are the chief factors to be considered in his region. His work with the sand cherry *(Prunus besseyi)* was described at considerable length. Of this promising fruit between 4,000 and 5.000 seedlings of the third generation are under investigation. The quality of the wild fruit is known to be very variable, and this has been taken advantage of in his propagation work. He has at present 75 varieties budded upon plum stock. The results obtained so far have yielded a larger and better flavored fruit. The sand cherry is said to cross readily with many species of Prunus, and valuable hybrids may possibly be secured. Experiments with raspberries, strawberries, currants, gooseberries, and huckleberries were briefly reported, and promising crosses have been obtained of all of them.

T. V. Munson, Denison, Texas, gave the results of his investigations and observations on the selection and hybridizing of grapes in a paper entitled Advantages of Conjoint Selection and Hybridization and Limits of Usefulness in Hybridization among Grapes. The author claims that the quality of grapes may be readily improved by increasing the vigor of the vine. To secure better varieties of fruit recourse should be had to selection and hybridization. Selection alone is considered too slow, and new flavors and characteristics can be obtained only in a limited degree through bud variation. On the other hand, indiscriminate crossing without selection may prove injurious, and it is only when crossing is followed by careful and continued selection that valuable results are obtained. The methods of securing crosses were described and the statement made that any method of crossing which is adapted to a genus of plants having many species will be found adapted to other genera possessing numerous species. Among the limits of crossing the author considered the possibility of double fecundation, stating that were it possible it would aid very materially in hybridizing so that in a single generation forms possessing several desirable attributes could be obtained. In grape hybridizing, as well as with other plants, so far as possible pure races alone should be used. Seasonal changes, soils, and climates influence the character of hybrids. A hybrid adapted to a given region in which it has exceedingly valuable characteristics may utterly fail in other regions with different conditions. Special sorts of

grapes and other plants should be produced for special conditions, and no attempt should be made to develop a variety that would be expected to contain all the desirable qualities and adapted to all regions and climates. A number of examples were cited of desirable parentage for new sorts for special qualities, conditions, and regions. The parentage of a large number of well-known varieties of cultivated grapes was traced at considerable length.

C. E. Saunders, of Ottawa, Canada, read a paper on the Variations in the Second Generation of Berberis Hybrids. In this paper the results of experiments in crossing *Berberis thunbergi* as a pistillate and *B. vulgaris purpurea* as a staminate parent, in which a large number of hybrids was obtained, are described. Some of the hybrids were intermediate in the size of the plant, and size shape, and color of the leaves, while in others the different characters were widely divergent. As a result of his observations it was found that these hybrids tended to uniformity in the first generation and wide variation in the second and subsequent generations, as shown by more than a thousand seedlings. In the first generation little or no purple color was observed, but the color of the foliage came out well in many specimens of the second generation. The leaves, thorns habit of plant, &c., varied widely in the later generations.

Bud Variation in the Strawberry Plant was the subject of a paper by R. M. Kellogg, of Three Rivers Michigan. This is said to be very common in the Strawberry Plant, and an account was given of 19 years' effort on the part of the writer to produce more vigorous types of strawberry plants by forcing growth through the use of the fertilizers, by tillage and continued selection. The effect of the different kinds of fertilizers in culture was shown, and an excess of nitrogen was used to stimulate vegetative growth and thus induce variation. The individual peculiarities of plants must be considered in producing new forms, and where valuable individual characteristics appear, as shown by bud variations these should be eagerly sought and propagated.

G. T. Powell, director of the Briarcliff School, New York, gave the results of 10 years' experiments in propagating bud variations of the Sutton Beauty and Tompkins County King apple, his remarks being illustrated by specimens of fruits.

H. C. Price, of the Iowa Station, read a paper on Hand Pollination of Orchid Fruits. This is not diffcult, but ordinarily the results obtained are very slow in development. The plan of cooperation maintained by the Iowa Experiment Station with orchardists throughout the State, in which pollen of known varieties is distributed, was described The seedlings resulting from the hand pollination of fruits are grown and carefully examined. In the cooperation it is, so far as possible, desired that the orchardist should produce his own seedlings rather than send them to the station, The effect of different kinds of emasculation of the flowers was described. Low emasculation, in which all the flower but the style was cut away, did not give as favourable results as high emasculation in which only the corolla and anthers were removed. Studies on the time for operation showed that the immediate transfer of pollen after the emasculation of flowers gave the best results. Pollen applied to the stigmas by a camel's-hair brush gave slightly better results than where transferred by the fingers. Pollen taken from the anthers just before the opening of the flowers seems to be the most potent and gave the best results.

H. F. Roberts. of the Kansas Station, read a paper on Cereal Breeding in Kansas, in which he briefly reviewed some of the efforts that have been in corn and wheat breeding. In breeding wheat for growth in Kansas, hardiness in winter, drought resistance, and increasod production are the

points sought. In a variety of wheat seeming to possess extreme hardiness a number of spikes appeared which showed a tendency toward the club-wheat form. These heads, to the number of 61, were collected and are to be studied during the coming season. Eleven of the heads were apparently of exceedingly great productivity. The grain will be planted and the results announced in due time. It is desired to secure a variety in which the spikelets and heads are more completely filled. Experiments in breeding macaroni wheats to secure greater drought resistance are also under way, and a number of other experiments were briefly mentioned.

William Fawcett, director of Public Gardens, Jamaica, gave a brief account of the plant-breeding work that is being conducted in Jamaica. Naturally the investigations have been conducted on tropical plants. The differences in the character of the different flower clusters of banana were pointed out. The lower or earlier ones are usually all female, and the ovary is twice the length of the rest of the style. Those next are both male and female, and the last ones to appear are all staminate. If the male flowers be cut from a bunch it results in early ripening and in uniformity of fruit. A number of attempts were made to artificially pollenize the banana, and some seeds were set but they failed to germinate. Experiments were reported in which the Smooth Cayenne and Ripley pineapples were crossed The flowers of the pineapples are said to be almost wholly self-sterile. Many seedlings have been obtained, most of which were intermediate between the parents, but as yet they have not developed valuable characters. Experiments with mangoes have not yet proved successful. The investigations have shown that the Avocada, or alligator pear, may be budded with success.

The remaining papers of the programme, read by title were as follows: Notes on New Hybrids, J. H. Wilson; Selection *v.* Hybridism, F. W. Burbidge. Some Laws of Plant Breeding, H. J. Webber; On Variation in Plants, J. B. Norton; Some Possibilities, C. L. Allen; Fertile Hybrids of Teosinte and Maize, J. W. Harshberger; A Study of Grape Pollen and What the Results Indicate, N. O. Booth; The Improvement of Corn by Breeding, C. P. Hartley; Improvement of Crops for Arid Regions and Alkali Soils, T. H. Kearney; Improvements of Cotton by Breeding, H. J. Webber; Practical Points from the Breeding of Strawberries and bush Fruits, F. W. Card; Crossing Species of Salix, S. W. Fletcher; Notes on Breeding Hardy Apples, J. Craig; The Ever-bearing Strawberry, P. de Vilmorin; The Musk-melon, F. W. Rane; Results in the Breeding of Species of Ricinus, E. M. Wilcox; On Orchid Hybrids, O. Ames; Hybrid Beans, R. A. Emerson; Hybrid Plums, F. A. Waugh; Cross Breeding of Cinchonas, H. H. Rusby; Notes on Plant Breeding in California, E. J. Wickson; Plant Breeding in New Jersey, B. D. Halsted; The Wild Hybrids of the North American Flora, D. George; Plant Breeding Work in Germany, J. C. Whitten; and Hybrids and Diseases, L. H. Pammel.

The afternoon session of October 2 was held at the New York Botanic Garden, Bronx Park, where the delegates to the conference were entertained as guests of the directors of the garden. On Friday an excursion was given the delegates up the Hudson to Poughkeepsie, in the vicinity of which a number of private estates were visited.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board was held at Head Quarter House on Tuesday 10th February, 1903: Present, The Hon. the Colonial Secretary (Chairman), the Hon. the Director of Public Gardens, and His Grace the Archbishop.

The minutes of the last meeting were read and confirmed.

The Board then proceeded to consider one or two points in connection with the estimates that required alteration.

An application for admission into the Agricultural College from Mr. B. Chase was considered. The Board desired that some evidence or educational qualifications should be ascertained by examination.

The admission of Mr. Carpenter was approved by the Board.

A letter was read from the Secretary of the Bath Agricultural Society requesting the services of Mr. Cradwick in connection with the Bath Show. The Secretary was directed to write Mr. Parnther that the Board regretted that as arrangements had been made for Mr. Cradwick's work in the western parishes, it was unable to send him, but would arrange for Mr. Thompson, who had been assigned as Instructor in that Parish, to attend and render what assistance he could.

The Chairman stated that it had been represented to him that there had been an adulteration of bees'-wax, and that the matter had, athis suggestion been taken up by the Beekeepers Association. The Archbishop also mentioned that he understood guava jelly was also being adulterated and hoped some enquiry would be made.

In regard to the proposed experiment in cotton growing, the chairman expressed the opinion that it would be better to try an experiment at the Prison Farm, and to set up there a gin. The Archbishop was anxious that inducements should be offered to outsiders in the disirict to grow cotton and bring in their crop for preparation at the Farm.

Mr. Fawcett handed in a memorandum on an insect which had been sent to him as causing injury to cocoa. Dr. Howard of Washington, to whom specimens had been forwarded, had, however stated that it was a burrowing wasp, probably living on the larvae of the "Fiddler Bug." It was decided to publish this together with a careful description of the wasp.

A letter was read from the Secretary of the Schools Commission stating that steps had been taken to make known to the Schools that the arrangements with regard to the teaching of Chemistry at the Laboratory.

A report by Mr. Cradwick on the Kendal Show together with observations by Messrs. Shore & Calder was considered.

The meeting then terminated.

ADDITIONS AND CONTRIBUTIONS TO THE DEPARTMENT.

Library (Serials).

Europe.

British Isles.

Botanical Magazine, Jan. [Purchased.]
Chemist and Druggist, Dec. 27, Jan, 3, 10, 17. [Editor.]
Garden, Dec. 27, Jan. 3, 10, 17. [Purchased.]
Gardeners' Chronicle, Dec. 27, Jan. 3, 10, 17. [Purchased.]
International Sugar Journal, Dec., Jan. [Editor.]
Journal, Board of Agriculture, England, Dec. [Sec. Board of Agriculture.]
Journal of Botany, Jan. [Purchased.]
Journal of the Society of Arts, Dec. 6, 1901. [Purchased.]
Journal, R. Colonial Institute, Jan.
Nature, Jan. 1, 8. [Purchased.]
Pharmaceutical Journal, Dec. 27, Jan. 3, 10, 17.
London Report, Jan. 10, 17.
Scottish Geographical Magazine, Mar. 1902. [Purchased.]

France.

Journal d'Agriculture Tropicale, No. 18. [Publishers.]
Sucrerie indigène et coloniale, Dec. 25, Jan. 6, 13. [Editor.]

Germany.

Symbolae Antillanae seu Fundamenta Florae Indiae Occidentalis. II, 3. [Purchased.]
Tropenpflanzer, Jan. (with Index for 1902.) [Editor.]

Belgium.

Bulletin du Jardin Botanique de l'Etat a Bruxelles, I., 1, 2 & 3.
Bulletin, Société d'Etudes Coloniales, Jan. [Editor.]

Asia.

India.

Annual Report, Gardens of Udaip r, 1901-02. [Supt.]
Planting Opinion. Dec. 6, 13, 20. [Editor.]
Proc. Agri. & Hort. Soc. India, July—Sept. [Secretary.]

Ceylon.

Times of Ceylon, Dec. 10, 18, 24, 31. [Editor.]

Java.

Proefstation East Java. 43. [Director.]
" West Java. 59. [Director.]

Australia.

N. S. Wales.

Agri. Gazette, Dec. [Dept. of Agri.]

Queensland.

Agri. Journal, Dec. [Sec. of Agri.]
Sugar Journal, Dec. [Editor.]

Victoria.

Journ. Dept. Agriculture, I, 1, 2 & 3. [Public Library of Victoria.]

Western Australia.

Journ. Dept. Agriculture, Nov. [Dept. of Agri.]

Africa.

Central Africa.

C. African Times, Nov. 1, 8, 15, 22, 29. [Editor.]

Natal.

Agri. Journal & Mining Record, Dec. , 19. [Dept. of Agri.]
Bulletin 2, Manures in the Natal Market, Season 1902.

West Indies.

Barbados.

Agri. Grzette, Jan. [Editor.]
Agricultural News, Jan. 17, 31. [Commr. Imp. Dept. of Agri.]

Jamaica.

Cornwall Herald. [Editor.]
Journal Jamaica Agri. Soc., Jan. [Sec.]

Trinidad—

Bulletin, Botanical Dept., Jan. [Supt.]
Proc. of Agri Society, Dec. 9. [Sec.]

British North America.

Ontario—

Ann. Report, Ontario Fairs and Exhibitions for 1902.
Report Farmers' Institutes, 1901, Part II. Women's Dept. of Agri. Institutes
Bulletin 125, Roup.

Ottawa.

Bulletin 41, Results obtained in 1902 from Trial Plots of Grain, Fodder Corn, Field Roots and Potatoes [Dept. of Agri.]

Toronto.

University of Toronto Studies: No. 2, Anatomy of Osmundaceae. No. 3 Observations on Blood Pressure. [Librarian.]

United States of America.

Publications of the U. S. Dept. of Agri. [*Directors.*]

Scientific Bureaus & Divisions

Field Operations of Division of Soils, 1900, (Second Report) with Maps.
Experiment Station Record, Vol. XIII., 10, 11. Vol. XIV., 4.
Geological Survey of Louisiana, Report of 1902.
Yearbook of the U. S. Dept. of Agriculture, 1901.

Experiment Stations.

Alabama. 121. (Dairy Herd Record and Creamery Notes.)
California. 131. (Phylloxera of the Vine.) 132. (Feeding of Farm animals.) 133. (Tolerance of Alkali by various Cultures.) 134. (Report on Vineyards in portions of Santa Clara Valley.) 135. (Potato-worm in California.) 136. (Erinose of the Vine.) 137. (Pickling ripe and green Olives.)
Illinois. 79. (The Corn Bill-bugs in Illinois.) 80. (Methods and results of field insecticide work against the San Jose Scale..) 81. (Forcing Tomatoes.)
New York. 217. (Inspection of Feeding Stuffs.) 218. (Variety Test of Strawberries.) 219. S me of the Compounds present in American Cheddar Cheese.)
Rhode Isl nd. 85. (Analyses of Commercial Fertilizers) 86 (Goose septicaemia) 87 (Fowl Typhoid) 88 (The Forests of Rhode Island) 89 (Commercial Fertilizers).
Virginia. 8 (Observations on production of Vinegar in Cellars) 9 (Orchard Studies. I. The Fruit Plantation. Pome Fruits.)
New Jersey. Additional Observations on Strand Flora. By J. W. Harshberger. Reprint. *Proc. Acad. Nat. Sciences, Philadelphia, Oct.* 1902. } [Author.]
Santo Domingo. The Queen of the Antilles. By J. W. Harshberger. } [Author.]
American Druggist and Pharmaceutical Record, Jan. [Editor.]
American Journal of Pharmacy, Jan. [Editor.]
Chicago. Report of Director to Trustees 1900-1901. Field. Columbian Museum.
Asters. Study of variation in the bracts, etc. By G. Shull. Reprint. *American Naturalist, XXXVI* 422. [Author]
Botanical Gazette, Chicago, Dec., Jan. [Editor.]
Iowa. Bulletin from Laboratories of Nat. Hist., State University. V 3.
Lloyd Library. Bulletin No. 4 References to Capillarity. Bulls. 3 & 5. Mycological Series, No. 1, The Genera of Gastromycetes. No. 2, The Geastrae. Mycological Notes, Nos. 5—9. [Lloyd Library, Cin., Ohio.]
Coffee. Extensive information and statistics. [Gillespie Bros.. N.Y.]
Cotton and Farm Journal, Jan. [Publishers.]
Forestry and Irrigation, Jan. [Editor]
Cincinnati Soc. of Nat. Hist., Journ. XX, 1 & 2.
Missouri Botanical Garden. Thirteenth Re ort, 1902. [Director.]
Piperaceae, on the Development of. By Duncan S. Johnson. [Author.]
Louisiana Planter, Jan. 3, 10, 17, 24.
Plant World, Nov., Dec., Jan. [Publishers.]
St. Louis, Trans. of the Academy, X, 9-11, XL, 1-11, XII, 1-8. [Acad. of Sci.]

Polynesia.

Hawaii. Agri. Exp. Station Bull. No. 2. The Root Rot of Taro.

Library. (Books.)

Bailey (L.H.) Lessons with Plants. Suggestions for seeing and interpreting some of the common forms of vegetation. Third edition. New York. 1902. 8vo. [Purchased.]

Bailey (L. H.) An Elementary Text Book for Schools. Fourth edition. New York. 1901. 8vo. [Purchased.]

Bateson (W.) Mendel's Principles of Heredity. A Defence by W. Bateson. With a Translation of Mendel's Original Papers on Hybridisation. Cambridge 1902. 8vo. [Purchased.]

Bower (F.O.) Practical Botany for Beginners. London. New York. 1895. 8vo. [Purchased.]

Leavitt (Robert Greenleaf) Outlines of Botany for the High School, Laboratory, and Class-rooms (based on Gray's Lessons in Botany.)

Gray (Asa) Field, Forest and Garden Botany. A Simple Introduction to the common plants of the U. S. east of the 100th meridian, both wild and cultivated. By A. Gray, revised and extended by L. H. Bailey, New York. 1895. 8 vo. Bound with the pr ceding. [Purchased.]

Potter (M. C.) An Elementary Text-Book of Agricultural Botany. Revised and enlarged edition. London. 1902. 8vo. [Purchased.]

Preuss (Dr. Paul) Le Cacao, sa culture, & sa préparation. Extract from Bulletin d'Etudes Coloniales, Belgium. Brussels. Paris. 1902. 8vo. [Purch sed.]

Underwood (Lucien Marcus) Moulds, Mildews, and Mushrooms. A guide to the systematic study of the Fungi and Mycetozoa and their literature. New York, 1899. 8vo. [Purchased.]

Seeds.

From Mr. T. W. Anderson.
Casabanana (Louisiana)

From Supt. Botanic Station, Belize
Mahogany.

From Curator Botanic Gardens, Entebe, Uganda Protectorate.
Spathodea nilotica.

From Royal Gardens, Kew.
Ilex paraguensis, var. genuina.

From Señor Carlos Dauphin, Seville, Spain.
Quercus Suber (Cork Oak)

Plants.

From Hon. J. W. Mitchell, Clarendon.
Eucalyptus rostrata.

From Mr W. J. Thompson, Supt. Parade Garden.
A Collection of Grape Vine cuttings :—Gros Maroc : Bowood Muscat : Foster's Seedlings : Muscat Hamburg : Gros Colman : Canon Hall Muscat : Mrs Pince : Muscat of Alexandria : Black Hamburgh : Trebbiano : Madresfield Court : Black Alicante : Golden Hamburgh : Mrs. Pearson : Black Monukka : San Antonio : Gros Guillaume : Syrian : Alnwick Seedling : Appley Towers.

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EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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KINGSTON, JAMAICA:

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JAMAICA.

BULLETIN

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Vol. I. APRIL, 1903. Part 4.

COCOA IN TRINIDAD AND GRENADA.

Notes from Dr. Paul Preuss.

In 1884 Kamerun became a German Colony. For nine or ten years Cocoa was planted only in a small way, but in 1896, a commencement was made of Cocoa plantations on a large scale. The soil and climate was all that could be wished, and the trees grew in a satisfactory manner, but the cured Cocoa did not get as high a price as was hoped. Researches were carried out, but with no satisfactory results. The surest and the quickest way to arrive at a solution of the question was to go and examine on the spot the methods of culture and preparation in the West Indies and Central and South America, where it has been longest cultivated and with the best results, to study there different species of Cocoa and their conditions of development, and to import into the German Colonies those species which are the most profitable and the most suitable. With this aim Dr. Preuss was commissioned to travel in Surinam, Trinidad, Grenada, Venezuela, Ecuador, Nicaragua, Salvador, Guatemala and Mexico.

The account of his travels and the results of his mission are presented in his Report entitled, "Expedition nach Central and Süd-Amerika," published in Berlin by the *Kolonial Wirtschaftliches Komitee*: the second part of which has been translated into French, and published by the *Société d'études coloniales de Belgique* under the title "Le Cacao, sa culture & sa préparation"

Notes from this valuable treatise will appear from time to time in this Bulletin.

Shade.—The distance of the plants is generally 14 feet for the cocoa trees and 28 feet for the shade trees. In many plantations the distances are 10 to 12 feet, but these are gradually being given up, and planters are adopting 14 by 16, or 16 by 16 feet. The distance of the shade trees from one another varies with that of the cocoa trees, being in the proportion of one shade tree to two cocoa trees. Dr. Preuss had long discussions with the Trinidad planters on the subject of the shade being too dense, but they maintained that it was necessary. As proof, they told him that cocoa trees ceased to yield whenever their shade trees were blown down. Moreover, they informed him that formerly when less shade trees were planted, the cocoa trees dried up by the hundred in years of great drought. Dr. Preuss, in his journey through the best cocoa districts of Trinidad, saw evidence that the trees had suffered much from drought, and that a great number had died in spite of the thickness of the shade. What was said then about the ruin by drought of entire cocoa plantations that were

insufficiently shaded, appeared to be quite credible, and the distance of 28 feet between the shade trees did not seem too small. The explanation seems to lie in the amount of the rainfall, the average at the Botanic Garden for 13 years being 68.19 inches. In other parts of Trinidad, for instance at the plantation "La Réunion," the rainfall was for 1896, 107 inches, for 1897, 101 inches, and for 1898, 93.5 inches.

The absence of shade trees in Grenada astonishes anyone who has seen the cocoa plantations in Trinidad so carefully shaded, and he asks with surprise how it is possible in the same latitude? The reason for this difference does not, however, lie in the fact that Grenada is extremely mountainous, and that it has deep depressions, so that the plantations are only exposed to the sun during a few hours in the day. This cannot be the cause, for in the first place the most extensive and the best plantations are not situated between steep hills, but on the contrary in the most level part of the island, where they are fully exposed to the sun. Besides, the morning and evening sun is not of much importance, and there is no mountain in Grenada sufficiently lofty to be able to protect cocoa plantations against the sun after 9 o'clock in the morning.

The principal reason is rather in the very large rainfall, in the sky being much more overcast, and in the very great humidity of the air. The resistance of the variety which is planted there, also counts for something. A rainfall of less than 100 inches is a rarity in Grenada, while it is the rule in Trinidad. In Grenada the annual rainfall is about 120 inches. Thanks to this circumstance, the chief cause disappears which leads the planters of Trinidad to shade their plantations, namely, the fear of seeing them perish through drought.

The absence of shade which the Grenada planters partially supply by planting the trees very near one another, results in a different method of working the estates.

The cocoa trees yield a crop much sooner without shade, if the humidity is sufficient, than with shade. In Grenada a very fair crop is obtained in the fourth year from planting, and a full crop in the fifth year; while in Trinidad the trees only commence to yield a full crop after the tenth year.

It must be noted that trees not shaded become exhausted much more rapidly than the others, above all when they are planted close; a distance of 9 by 9 feet is not rare in Grenada. If it is desired to preserve as long as possible the fertility of the trees, it is necessary to manure and cultivate the soil, and this is done to the greatest extent in Grenada, where manuring and tillage play a very important part. This fact constitutes a great difference between the methods of culture of Trinidad and Grenada.

The tilling is done by means of a four-pronged fork. No particular care is taken to avoid destroying sometimes a root that comes to the surface, but when this happens great trouble is taken to cut off the torn ends clean in order to prevent decay. The results obtained are considerable and far surpass those of the Trinidad plantations. In Grenada they cultivate very intensively, and the soil is completely exhausted at the end of a short time. The methods of culture in Trinidad is on the contrary more extensive, and they do not manure much. If manuring was given up in Grenada, the plantations would certainly

have attained the maximum of their production at the end of 10 to 12 years, after which they would go down very rapidly. In Trinidad, on the contrary, the trees only attain at the end of 10 years that degree of development when full production commences, and they remain then for a great number of years at this maximum without manuring.

Yield.—The following figures are quoted as a maximum crop in Grenada. The Rev. Mr. Branch, of Good Hope, obtains in his plantation of 16 acres, the soil of which is of medium fertility, and the situation is in a hilly district, 4 to 5 lbs of cocoa a tree per annum. The distance of the trees is 9 to 12 feet and less, the manuring is constant, pruning is not practised except to lop off the suckers. The manure consists of dung, leaves, and all sorts of vegetable matter, and care is taken to bury the manure. Mr. St. George of the Boulogue estate obtains on the best part of it, a valley of more than 10 acres, 27 cwt. per acre or more than 6 lbs of cocoa a tree. He prunes the trees with much care and intelligence. The distance of the trees is greater than at Good Hope.

The following information relates to one of the best plantations in Trinidad, namely, "La Tortuga":—

4,019 trees, 20 years of age, planted 12 by 12 feet yielded 10,300 lbs of cocoa = 2.5 lbs a tree.
1,250 trees, 17 years of age, planted 12 by 12 feet, yielded 4,450 lbs of cocoa = 3.5 lbs a tree.
2,382 trees, 10 years of age, planted 10 by 10 feet, yielded 5,400 lbs of cocoa = 2.3 lbs a tree.
1,080 trees, 25 years of age, planted 12 by 12 feet, yielded 3,600 lbs of cocoa = 3.3 lbs a tree.
918 trees, 10 to 12 years of age, planted 12 by 12 feet, yielded 3,150 lbs of cocoa = 3.4 lbs a tree.
2,770 trees 20 years of age, planted 12 by 12 feet, yielded 7,100 lbs of cocoa = 2.5 lbs a tree.
4,416 trees, 6 years of age, planted 12 by 14 feet, yielded 3,425 lbs of cocoa = 0.77 lbs a tree.

The average yield of a cocoa tree in Trinidad, is estimated in good plantations at 1.5 or 1.6 lb; it is a little higher in Grenada. The price of cocoa from Trinidad is, on the contrary, a little higher than that of cocoa from Grenada. The explanation in Dr. Preuss's opinion is to be found in the variety cultivated. In Grenada the variety "Amelonado" is principally planted, whilst in Trinidad "Forastero" is more grown.

Pruning. Great care is taken both in Trinidad and Grenada to give the trees a good shape. An essential principle for this effect is to cultivate them to maintain a low trunk, and the head in the form of a crown, but so that one can always pass under the trees without difficulty and without being obliged to bend too much, and so that all the labour of cropping and cultivating can be easily carried on. All lengthing of the trunk is prevented, as well as every attempt to form a second tier of branches.

In Trinidad the young cocoa-trees are allowed to grow until they fork naturally. This happens when the trunk has attained a height of 2½ to 5 feet. The number of branches in the whorl is 4 or 5. These are reduced to 3 or 4, and only rarely are 5 allowed to grow. In the varieties which have much wood developed and a thick mantle of leaves

it is well to leave 4 or 5 branches for if only 3 are left, the weight of each branch becomes too great, and the trunk is liable, during heavy winds to divide into 3 parts from above downwards. In varieties with feeble growth, only 3 branches are left in order to favour the development of solid branches. The pruning of trees takes places oftenest a little after the crop in June or in January. Dr. Preuss does not like the very heavy pruning practised in Trinidad. The ground is covered, after the pruning, with a thick layer of branches and leaves. Such treatment cannot be good for the trees. It results not in an increase, but in a diminution of the yield, for the trees have to devote a great part of their sap to form leaves again which are indispensable to them to nourish them properly. The planters say that the cutting off of a large number of leaves is of no importance since the trees re-cover themselves very quickly with new leaves, but this fact shows the evils of an exaggerated lopping since it has very little effect and the force and energy which the tree employs to cover itself again with leaves are lost to it, and the production of fruit is by so much lessened

It cannot be overlooked that the leaves have the same claim as the roots to be considered organs of nutrition. The workpeople use a knife to prune the trees, and when they cannot reach high enough, they climb on the branches. They very rarely use a knife at the end of a pole. Cutting branches an inch thick, a constant practice in Trinidad, should be absolutely forbidden. Pruning should commence as soon as the tree forks, and should be continued as often as possible, but always to a slight extent only. The shoots ought naturally to be always cut off. In large plantations it is difficult to spare a man to prune regularly and frequently. Pruning is therefore only done once every 2 or 4 years, or at the very outside once a year, and then heavily. Whilst a reasonable pruning favours fruit bearing, it is nevertheless a question whether, in place of pruning too severely it would not be preferable not to prune at all, and be content with taking away the dead wood. One of the two planters in Grenada who obtain the largest crops, prunes his trees very well, the other does not prune at all.

The trees attain sometimes, in Trinidad, considerable dimensions. In the plantation "La Vega," Dr. Preuss states that he saw a tree which had, at 6 inches from the ground, a circumference of 59 inches; and at a height of 40 inches a circumference of 45 inches; it was 25 years of age. Very old trees which no longer bear fruit, and those which have been blown over, are renewed by allowing one of the shoots which arise near the ground to develop and become a trunk, while the old trunk is finally removed.

THE SUGAR-CANE SOILS OF JAMAICA.

By H. H. Cousins, M.A., (Oxon.) F.C.S., Government Analytical and Agricultural Chemist.

PART I. E and S—CENTRAL.

At the present time there are some 200,000 acres of land in Jamaica representing the areas of sugar estates still in operation. Out of the large number of estates that formerly girdled the sea-board almost continuously and even flourished in the most inland districts, some 120 only, representing about 22,000 acres of effective cane-cultivation, now

remain. The northern estates have found a welcome salvation in the banana industry, and sugar production in Jamaica is now localised in certain special areas, chiefly in the western and south-central districts of the Island. To have survived the fierce competition of bounties and cartels, of modern sugar manufacture and skilled technical management with the imperfect methods available in Jamaica, speaks volumes for the intrinsic sugar-producing power of the soils in these districts.

Some 31 soils and 23 subsoils specially selected as representative of Jamaican sugar soils have been analysed in the Government Laboratory during the past twelve months, and the results are here recorded with certain observations thereon. In eleven cases manurial experiments have been carried out on the present crop, and the results of three series have been already obtained and are here recorded. Unfortunately in four cases the serious drought has resulted in a loss of results on this year's crop, and the experiments will have to be started again with a hope of more favourable results in the future.

Taking the districts in approximately geographical sequence from east to west, we must begin with the parish of

ST. THOMAS.

Plantain Garden River District.

The results of analysis of eight surface soils and a sequence of two sub-soils to a depth of four feet as made in this Laboratory, were published in West Indian Bulletin, Vol. 3, pp. 64 and 65, and are here reproduced for comparison with those from other districts of Jamaica.

Although not at present in sugar cultivation, these soils were formerly of high repute for the cultivation of sugar cane and it is proposed to establish a central factory in this district. It will be noticed that the soils consist of fine sand and silt with a lesser proportion of coarser and finer grades. The clay is moderate in amount.

These soils are of admirable texture for purposes of cultivation and the efficient depth of soil is alone limited by the level of drainage which it is found practicable to maintain. Banana cultivation on these lands, apart from loss by hurricanes, has been a decided success and has taught the value of deep drainage. The banana, owing to its marked objection to stagnation of soil, has taught the agriculturists of Jamaica to appreciate the great need for drainage in the management of the majority of the most productive soils in the Island. In the event of sugar cultivation recommencing in this fertile area, a due regard for drainage should serve greatly to increase the output of these lands. The Phosphoric Acid is unusually high, suggesting that the use of Phosphatic manures would be quite uncalled for. Considering the liberal and well distributed rainfall, it is more than doubtful whether any treatment beyond good drainage and thorough tillage are required to produce abundant crops. Indications of a low margin of available potash are given in two cases (3 and 7). It is probable that the Seedling Cane D. 95 would grow well and give a good yield on this land. Considering the frequency of 'blows' in the district and the high losses of bananas that seem to be inevitable over a period of years, it is to be hoped that a well-considered project for a Central Sugar Factory may shortly be realised to reap an assured success under the new auspices of a fair competition upon the abolition of the bounties.

I.—Analyses of Soils from Plantain Garden River, St. Thomas.

Chemical Analyses.

No.	Area in acres.	Combined water and organic matter.	Hygroscopic Moisture.	Nitrogen.	Humus soluble in Ammonia.	Insoluble Matter.	Soluble in Hydrochloric Acid.				Available	
							Potash.	Lime.	Phosphoric Acid.	Chalk.	Potash.	Phosphoric Acid.
1	150	10.28	6.90	0.172	1.81	62.44	0.853	2.56	0.246	1.56	0.0128	0.0435
2	50	9.38	7.85	0.143	2.02	62.31	0.352	3.96	0.168	2.91	0.0099	0.0247
3	250	9.49	9.58	0.172	1.75	60.45	0.395	2.63	0.199	2.47	0.0047	0.0252
4	150	9.52	8.04	0.196	1.67	61.50	0.783	2.80	0.201	0.29	0.0117	0.0228
5	125	9.85	6.63	0.186	1.67	63.17	0.359	3.64	0.158	4.17	0.0081	0.0296
6	125	9.22	8.00	0.170	1.86	61.50	0.458	2.95	0.204	1.83	0.0088	0.0287
7	125	8.87	6.96	0.168	1.75	52.09	0.507	10.67	0.244	14.15	0.0042	0.0138
8	125	7.89	6.55	0.152	1.36	63.72	0.240	2.67	0.139	1.99	0.0106	0.0148

Mechanical Analyses.

No.	Description.	Depth. Ins.	Stones.	Gravel.	Sand.	Fine Sand.	Silt.	Fine Silt.	Clay.	Moisture.	Total.	Retentive power for water.
1	Surface	1–9	Nil	1.39	4.74	26.91	51.46	7.24	1.81	6.45	100.00	54.5
2	"	1–9	"	2.92	7.94	29.16	45.00	6.15	1.55	7.28	100.00	52.0
3	"	1–9	"	0.69	3.81	29.33	45.83	10.29	1.30	8.75	100.00	53.0
4	"	1–9	"	1.16	8.22	26.83	48.36	6.73	1.26	7.44	100.00	52.0
5	"	1–9	"	0.94	15.45	30.30	38.74	7.16	1.19	6.22	100.00	56.0
6	"	1–9	"	0.17	1.99	39.67	46.38	6.02	traces	6.15	100.00	51.0
7	"	1–9	"	3.40	5.52	30.68	47.35	5.13	0.51	7.41	100.00	55.0
	Subsoil	9–24	"	0.40	9.06	30.41	42.57	9.75	2.85	4.96	100.00	
	"	24–36	"	0.62	4.73	34.71	45.63	7.12	2.64	4.55	100.00	
	"	36–48	"	0.20	2.49	41.11	44.71	6.23	0.92	4.34	100.00	
8	Surface	1–9	"	0.67	13.31	25.38	45.44	7.35	1.37	6.48	100.00	
	Subsoil	9–24	"	0.41	1.50	32.26	49.92	7.56	2.52	5.83	100.00	
	"	24–36	"	0.32	2.12	35.43	48.74	6.19	1.86	5.34	100.00	
	"	36–48	"	0.15	1.75	31.03	54.42	5.49	1.78	5.38	100.00	

Albion Estate.

By utilising the waters of the Yallahs river for irrigation, this estate is enabled to grow excellent crops of cane on land that would otherwise be almost valueless for any agricultural purpose. The owner, J. Grinan, Esqr., has found that the use of fertilisers is profitable and he recently demonstrated the possibilities of D. 95 on this soil by obtaining 32 tons of first sugar from 8 acres of this seedling variety.

The analysis of the soil from the field selected for manurial experiments gave the following results :—

SOIL ANALYSIS.

Reference Number—81. Source Details—Surface Soil. Experimental Plots. Albion Estate, St. Thomas.

Depth of Sample—9 inches.

Retentive Power for water—47.0 per cent.

Chemical Analysis.

(Soil passing through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter ...	71.120
Soluble in Hydrochloric Acid	28.880
Potash ...	0.339
Lime ...	0.567
Phosphoric Acid	0.387
Carbonic Acid as Carbonate of Lime	Trace
Combined Water and organic matter	6.750
Humus (soluble in Ammonia)	1.430
Nitrogen ...	0.148
Hygroscopic Moisture	2.849

Fertility Analysis.

Available Potash ...	.0013
Available Phosphoric Acid	.0432

This soil is of a very light nature and has little drought-resisting power. On the other hand it is admirably fitted for irrigation.

The carbonate of lime is so small in amount as to be incapable of exact estimation. This must undoubtedly affect the fertility of the soil and limit the rate of nitrification that obtains.

The available potash is very low, while an appreciable reserve of this material exists in the soil. The analysis indicates that phosphates—*quâ* phosphates—are superfluous additions; that owing to the absence of carbonate of lime the soil lacks available nitrogen and that nitrogenous manures should therefore be operative; further, that potash is needed.

The results of the manurial experiments will be obtained shortly and will be of interest as bearing on the interpretation of the analysis. It is very likely that the addition of lime to this soil will yield marked benefits by its indirect effect on the availability of nitrogen and potash, and, as has often been proved in similar instances, that a dressing of lime may prove the most profitable addition it is possible to provide. Mr. Grinan reports remarkable effects from the manures and has decided to model the treatment of the fields of the estate upon the results of the experiments.

The details of the experiments are as follows :—

Canes—"Albion" St. Thomas—J. Grinan, Esq.

Applied to (1) D 95 Canes.
(2) Mont Blanc Canes.

Plots $\frac{1}{10}$ of an acre.

	Mixed Phosphate. per Acre.	Sulphate of Ammonia. per Acre.	Sulphate of Potash. per Acre.
Plot 1 No Manure	—	—	—
" 2 Compl te Manure	3 cwt.	1 cwt.	½ cwt.
" 3 No Nitrogen	3 "	—	½ "
" 4 Double Nitrogen	3 "	2 cwt.	½ "
" 5 No Phosphate	—	1 "	½ "
" 6 Double Phosphate	6 cwt.	1 "	½ "
" 7 Double Superphosphate	6 "	1 "	½ "
" 8 Double Slag	6 " super.	1 "	½ "
" 9 No Potash	3 " slag	1 "	—
" 10 Double Potash	3 "	1 "	1 cwt.
" 11 Double Complete	6 "	2 "	1 "

It is proposed next year to add special plots for testing the efficiency of lime as deduced from the analytical data.

VERE.

A localisation of the sugar industry is the chief interest of the plains of Vere, and this has been maintained, despite grave climatic disadvantages and recurring periods of drought, by virtue of the very high qualities which the soils of this sultry plain possess for the growth of the sugar cane. When the newly executed irrigation works have been brought into working contact with the land of the estates, security of crop and a large increase of the average annual returns are self-evident.

Great variations in the structure of the soils of the Vere plain are apparent. There is, on the whole, a tendency for the soils to become heavier in texture the nearer the sea. But the gradations are by no means uniform and great variations are found on the same estate and even in the same field.

Appended are the results of a series of seven soils and their subsoils representative of the heavier type of land in this District.

Chemical Analyses of Soils from Vere. Surface Soils depth 9 inches.

No.	Combined water and organic matter.	Hygroscopic moisture.	Nitrogen.	Humus soluble in Ammonia.	Insoluble matter.	Soluble in Hydrochloric Acid.				Available.	
						Potash.	Lime.	Phosphoric Acid.	Chalk.	Potash.	Phosphoric Acid.
1	9.72	4.37	0.146	1.14	65.34	0.247	4.300	0.257	7.320	0.016	0.122
2	14.32	6.60	0.172	2.20	65.33	0.078	1.870	0.277	0.750	0.023	0.126
3	10.10	6.57	0.123	1.29	65.04	0.042	1.170	0.134	0.270	0.007	0.019
4	10.55	7.25	0.162	1.47	65.43	0.044	1.470	0.150	0.480	0.011	0.017
5	10.12	7.37	0.147	1.44	64.32	0.048	1.230	0.158	0.200	0.004	0.021
6	11.73	8.78	0.196	2.44	62.20	0.062	1.130	0.135	0.200	0.005	0.026
7	11.29	7.80	0.178	2.50	62.94	0.067	1.170	0.081	0.280	0.009	0.016

Mechanical Analyses.

No.	Description.	Depth. Inches.	Stones.	Gravel.	Sand.	Fine Sand.	Silt.	Agricultural Clay. Fine Silt.	Agricultural Clay. Clay.	Moisture.	Total.	Retentive power for water.
1	Surface	1–9	Nil	4.51	13.62	23.85	35.73	14.94	2.98	4.37	100.00	54.0
	Subsoil	9–36	"	2.78	5.23	24.58	38.93	17.47	6.23	4.78	100.00	
2	Surface	1–9	"	0.35	1.69	15.81	38.85	24.16	12.54	2.60	100.00	59.0
	Subsoil	9–36	"	0.75	1.59	15.18	45.03	19.12	11.45	6.88	100.00	
3	Surface	1–9	"	0.13	1.27	18.14	41.98	24.83	7.08	6.57	100.00	66.0
	Subsoil	9–36	"	0.39	0.86	9.06	50.39	18.52	14.77	6.01	100.00	
4	Surface	1–9	"	0.38	0.57	19.81	39.31	21.72	10.96	7.25	100.00	66.5
	Subsoil	9–36	"	0.78	0.35	6.14	32.56	27.43	25.18	7.56	100.00	
5	Surface	1–9	"	0.17	0.47	11 44	50.48	12.55	17.52	7.37	100.00	66.0
	Subsoil	9–36	"	0.17	0.48	12.83	48.00	18.38	11.15	8.99	100.00	
6	Surface	1–9	"	3.98	6.97	11.04	43.78	16.17	9.28	8.78	100.00	70.0
	Subsoil	36	"	0.78	1.06	10.96	39.93	19.89	18.19	9.23	100.00	
7	Surface	1–9	"	0.43	0.55	10.60	42.12	16.92	21.58	7.80	100.00	69.0
	Subsoil	36	"	0.43	0.54	10.21	42.82	13.37	23.65	8.98	100.00	

The agricultural clay varies from 18 to 36 per cent. in the surface soils while in the subsoils it may rise to over 50 per cent. It need hardly be stated that such soils would require great skill and care if subjected to irrigation and are better calculated to fight the drought on their merits with the assistance of deep drains and thorough cultivation. The natural retentive power of these soils is very great. The Nitrogen is above the normal in every case, the Phosphoric Acid is also so high that the need of Phosphatic manures is not indicated. In two cases there seems a low amount of available Potash while the reserve supply is undoubtedly low. A trial of Potash on these soils should be made. The proportion of Carbonate of Lime is adequate, although Lime should produce benefits as regards the tilth obtainable.

Hillside Estate.

This represents the lighter type of soil to be met with on the upper portions of the Vere Sugar area. Analysis of the surface soil and of the subsoil to a depth of 3 feet are here given :—

SOIL ANALYSIS.

Reference Number—66.
Source Details—Soil from Hillside, Vere.
Depth of Sample—9 inches.

	Physical Analysis.		Per cent.	
	Stones	...	Nil	
	Gravel	...	0.68	Fine Earth.
	Sand	...	2.02	
	Fine Sand	...	32.66	
	Silt	...	53.89	
Agricultural Clay.	Fine Silt	...	3.71	
	Clay	...	0.47	
	Moisture	...	6.57	
	Total		100.00	
Retentive Power for water		...	54.0 Per cent.	

Chemical Analysis.

(Soil passing through 3 m.m. sieve dried at 100° C.)

Insoluble Matter	...	70.727
Soluble in Hydrochloric Acid	...	29.273
Potash	...	0.251
Lime	...	0.607
Phosphoric Acid	...	0.058
Carbonic Acid as Carbonate of Lime	...	0.149
Combined Water and organic matter		8.149
Humus (soluble in Ammonia)		2.001
Nitrogen	...	0.173
Hygroscopic Moisture	...	7.032

Fertility Analysis.		Per Cent.
Available Potash	...	0.0125
Available Phosphoric Acid	...	0.0210

SOIL ANALYSIS.

Reference Number—67.
Source Details—Soil from Hillside, Vere. Subsoil A of 66.
Depth of Sample—9-24 inches.

	Physical Analysis.		Per Cent.	
	Stones	...	Nil	
	Gravel	...	1.01	Fine Earth.
	Sand	...	1.00	
	Fine Sand	...	45.84	
	Silt	...	44.69	
Agricultural Clay.	Fine Silt	...	1.76	
	Clay	...	trace	
	Moisture	...	5 70	
	Total	...	100.00	

SOIL ANALYSIS.

Reference Number—68.
Source Details—Subsoil from Hillside, Vere. Subsoil B, of 66.
Depth of Sample—24–36 inches.

	Physical Analysis.		Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.56	Fine Earth.
	Sand	...	2.72	
	Fine Sand	...	51.69	
	Silt	...	39.86	
Agricultural Clay	Fine Silt	...	0.88	
	Clay	...	trace	
	Moisture	...	4.43	
	Total	...	100.00	

These soils consist almost entirely of fine sand and silt. They are possessed of low drought resisting powers and without irrigation are subject to almost entire loss of crop when the Vere district is visited by a prolonged drought.

On the other hand, it is probable that these lands will respond splendidly to irrigation and the problems attending successful management prove of a simple nature. The reserve of Phosphoric Acid is not high. Otherwise this soil represents normal factors for a light soil of excellent fertility and high crop-producing power.

Manurial Experiments have been started on this estate, but owing to the exceptional drought the results have proved abortive. The arrangements were as follows:—

Canes—"Hillside,' Vere.—Fred. M. Ellis, Esq.

10 Plots each $\frac{1}{10}$ Acre.	Basic Slag.	Nitrate of Soda.	Muriate of Potash.
Plot 1 No Manure	–	–	–
,, 2 Complete Manure	3 cwt.	$1\frac{1}{2}$ cwt.	$\frac{1}{2}$ cwt.
,, 3 No Nitrogen	3 ,,	–	$\frac{1}{2}$,,
,, 4 Double Nitrogen	3 ,,	3 cwt.	$\frac{1}{2}$,,
,, 5 No Phosphate	–	$1\frac{1}{2}$,,	$\frac{1}{2}$,,
,, 6 Double Phosphate	6 cwt.	$1\frac{1}{2}$,,	$\frac{1}{2}$,,
,, 7 No Potash	3 ,,	$1\frac{1}{2}$,,	–
,, 8 Double Potash	3 ,,	$1\frac{1}{2}$,,	1 ,,
,, 9 ,, Complete	6 ,,	3 ,,	1 ,,
,, 10 Lime, 10 cwt.	–	–	–

The soil of the experimental plots gave the following results on analysis. I am forced to the conclusion that commercial fertilisers are not likely to be profitable on this soil, and that large crops of cane will be obtainable with irrigation without the use of manures.

SOIL ANALYSIS.

Reference Number—62.
Source Details—Experimental Plots Hillside Estate, Vere.
Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	1.12	Fine Earth.
	Sand	..	0.50	
	Fine Sand	...	32.32	
	Silt	...	54.72	
Agricultural Clay.	Fine Silt	...	4.57 (5.98)	
	Clay		1.41	
	Moisture	...	5.36	
	Total	...	100.00	
			Per Cent.	
Retentive Power for water		...	54.0	

Chemical Analysis.

(Soil passing through 3 m.m sieve dried at 100° C.)

Insoluble Matter	...	68.931
Soluble in Hydrochloric Acid	...	31.069
Potash	...	0.573
Lime	...	0.951
Phosphoric Acid	...	0.168
Carbonic Acid as Carbonate of Lime	...	0.296
Combined Water and organic matter		9.950
Humus (soluble in Ammonia)		2.810
Nitrogen	...	0.155
Hygroscopic Moisture	...	5.66

Fertility Analysis.

		Per Cent.
Available Potash	...	0.021
Available Phosphoric Acid	...	0.044

Amity Hall Estate.

Manurial Experiments have been conducted on this property, and the results have just been recorded.

The Soil Analysis is as follows:—

SOIL ANALYSIS.

Reference Number—60.

Source Details—Experimental Plots. 'Middle Hutchings,' Amity Hall Estate, Vere.

Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.17	Fine Earth.
	Sand	...	0.45	
	Fine Sand	...	22.23	
	Silt	...	65.32	
Agricultural Clay.	Fine Silt	...	5.97 { 4.57	
	Clay		1.40	
	Moisture	...	5.86	
	Total	...	100.00	
			Per Cent.	
	Retentive Power for water	...	57.0	

Chemical Analysis.

(Soil passing through 3 m.m. sieve dried at 100° C.)

Insoluble Matter	...	61.930
Soluble in Hydrochloric Acid	...	38.070
Potash	...	0.573
Lime	...	1.575
Phosphoric Acid	...	0.139
Carbonic Acid as Carbonate of Lime	...	1.307
Combined Water and organic matter		11.176
Humus (soluble in Ammonia)		1.222
Nitrogen	...	0.153
Hygroscopic Moisture	...	6.225

FERTILITY ANALYSIS.

		Per Cent.
Available Potash	...	0.0268
Available Phosphoric Acid	...	0.0579

The close similarity in the mechanical composition of this soil with those from Hillside is at once apparent.

The chemical analysis indicates a fertility beyond reproach and no results from commercial fertilisers should be obtainable under present conditions of crop-production.

It may be possible that the greatly increased returns under irrigation may make possible the profitable use of manures, but in my opinion their application would not be justified for a long time to come. The agricultural management of Amity Hall is excellent: deep and thorough tillage have enabled the production of 33 tons of cane per acre on this land in a year in which the rainfall was only 33 inches with 18 inches of it in the month of June.

The results of the manurial experiments have now been obtained and they bear out the deductions drawn from the analysis. I stated in a note published in the Bulletin of the Botanical Department, April, 1902, p. 57, with reference to an estimate as to the cost of cane cultivation in Vere, as follows:—

"The item of £500 for manuring canes (300 acres), is not in my opinion justified. That it is not a prevalent agricultural practice is proved by the fact that it represents ¼ of the total value of fertilisers at present being imported into Jamaica. That it is unnecessary, is brought home to my conviction by recent analyses of Vere soils showing an extraordinary standard of fertility. At present crops are limited solely by the water supply. If fertilisers were used, the yield per acre should be increased to such an extent as still further to reduce the cost of cane per acre. Eliminating this factor (fertilisers) the cost of canes comes out at 5/2 per ton instead of 6/8, a figure in accord with other data from this district which have have been submitted to me."

The plan of the experiments is as follows:—

Canes—"Amity Hall Estate," Vere—E. W. Muirhead, Esqr.

10 Plots each $\frac{1}{10}$ Acre.	Basic Slag.	Nitrate of Soda.	Muriate of Potash.
Plot 1 No Manure	–	–	–
,, 2 Complete Manure	3 cwt.	1½ cwt.	½ cwt.
,, 3 No Nitrogen	3 ,,	–	½ ,,
,, 4 Double Nitrogen	3 ,,	3 cwt.	½ ,,
,, 5 No Phosphate	–	1½ ,,	½ ,,
,, 6 Double Phosphate	6 cwt.	1½ ,,	½ ,,
,, 7 No Potash	3 ,,	1½ ,,	–
,, 8 Double Potash	3 ,,	1½ ,,	1 cwt.
,, 9 ,, Complete	6 ,,	3 ,,	1 ,,
,, 10 Lime, 10 cwt.	–	–	–

The Rainfall during the growth of the experimental crop of plant canes was as follows:—

1901.	*Rainfall.*	*Amity Hall.*	
October	4.75	1902.	
November	1.20	August	2.88
December	3.17	September	1.20
1902.		October	3.34
January	0.73	November	1.74
February	0.78	December	1.04
March	0.71	1903.	
April	1.41	January	Nil
May	1.60	February	1.00
June	17.70		
July	0.12	Total Rainfall during growth of crop, 17 months.	43.37

The plots were weighed on February 17 and 18 by Mr. W. J. Thompson of the Department of Agriculture, and we quote as follows from his report to the Director of Public Gardens :—

"The canes were planted out in the Autumn of 1901. There was only 33 inches of rain in 1902, and of this nearly 18 inches fell in the month of June There has only been one inch of rain this year up to the present. The weight of the cane tops is less than it should be on account of the drought in this district. The variety of cane grown on these plots was the 'White Transparent,' the variety which has been grown on this Estate for the last 100 years. Seedlings D. 95 and D. 102 are making good growth on this estate, and Mr Muirhead will send samples to the Laboratory to be tested."

"The megass from two tons of canes weighed 11 cwt. 100 lbs. (representing a crushing 70.27 o/o.) Better results are obtained in Estate practice."

The Amity Hall Mill is a very creditable specimen of a single crushing mill. It is a 3 roller mill 3′ 6″ x 3′ and requires a heavy feed to obtain the best result. The thanks of the Board of Agriculture are due to the owners of the estate and to E. W. Muirhead, Esq. and his assistants for all the pains they have taken in carrying out the experiments and the efficient manner in which they enabled the crop returns to be estimated.

The results recorded were as follows;—

Plot.	Descripton.	Tons per Acre.			Difference by Manuring.
		Canes.	Tops.	Produce.	Tons, Canes per acre.
1	No Manure ...	33.75	3 13	36.88	—
2	Complete Manure ...	34 87	3.00	37.87	+ 1.12
3	No Nitrogen ...	40.25	3.25	43 50	+ 6.50
4	Double Nitrogen ...	32.37	2.67	35.04	— 1.38
5	No Phosphate ...	31.00	2.75	33.75	— 2.75
6	Double Phosphate ...	31.50	3.25	34.75	— 2.25
7	No Potash ...	33.50	2.67	36.17	— 0.25
8	Double Potash ...	37.00	2.75	39.75	+ 3.25
9	Double Complete ...	25.00	2.37	27.37	— 8.75
10	Lime ...	32 72	2.75	35.47	— 1.03
Average	...	33.20	2.85	36.05	— 0.55

The sample of juice from the mixed canes of the 10 plots as expressed by the estate mill gave the following results—

ANALYSIS OF JUICE.

Juice by Mill	...	70.27 per cent.
Brix	...	20.30 "
Specific gravity 30-17.5 C	..	1.0807
Sucrose lbs. per gallon	...	1.8963
Glucose "	...	0.0825
Non-Sugars "	...	0.2142
Purity	...	86.47
Glucose Ratio	...	4.35

It will be noticed that the average returns from the 9 manured plots are practically identical with that from the unmanured plots. The small difference of half a ton per acre in favour of the unmanured plot is less than the inevitable error involved in an agricultural experiment of this sort. These results indicate that manures are not profitable on this soil under the conditions obtaining during the crop season of 1902.

The ratoon results are to be recorded, and the Hon. J. W. Mitchell has approved of a proposal for a manurial experiment on this estate on a poorer soil under irrigation conditions so soon as the service of water has been established.

MONEYMUSK ESTATE.

Experimental plots have been established at Carlisle, one of the four estates grouped together under the proprietorship of the Hon. Col C. J. Ward, C.M.G., and worked on central factory lines at Money Musk. Unfortunately Carlisle lands suffered severely from the prevalent drought and it was not considered practicable to weigh the returns. A repetition of the experiment under more favourable conditions is to be carried out

The plots were arranged as follows:—

Canes—" Moneymusk Estate," Vere—Isaac Fox, Esq.

10 Plots each $\frac{1}{10}$ Acre.	Basic Slag.	Nitrate of Soda.	Muriate of Potash.
Plot 1 No Mannre	–	–	–
" 2 Complete Manure	3 cwt.	$1\frac{1}{2}$ cwt.	$\frac{1}{2}$ cwt.
" 3 No Nitrogen	3 "	–	$\frac{1}{2}$ "
" 4 Double Nitrogen	3 "	3 cwt.	$\frac{1}{2}$ "
" 5 No Phosphate	–	$1\frac{1}{2}$ "	$\frac{1}{2}$ "
" 6 Double Phosphate	6 "	$1\frac{1}{2}$ "	$\frac{1}{2}$ "
" 7 No Potash	3 "	$1\frac{1}{2}$ "	$\frac{1}{2}$ "
" 8 Double Potash	3 "	$1\frac{1}{2}$ "	–
" 9 " Complete	6 "	3 "	1 "
"10 Lime, 10 cwt.	–	–	–

Samples of soil and subsoil were taken with the soil-auger from two sections of the field known as "Little Leicester" upon which the experiments were to be carried out, and gave the following results on analysis.

SOIL ANALYSIS.

Reference Number—44 & 45.

Source Details—Surface Soils A & B from Experimental Plots, Carlisle Estate (Money Musk) Vere.

Depth of Sample—9 inches.

Physical Analysis.

		A. Per Cent.	B. Per Cent.	Average. Per Cent.	
	Stones	Nil	Nil	Nil	Fine Earth.
	Gravel	3.34	2.42	2.89	
	Sand	3.21	4.39	3.80	
	Fine Sand	18.76	24.89	21.82	
	Silt	62.14	51.81	56.97	
Agricultural Clay.	Fine Silt	6.21	10.13	8.17	
	Clay	0.90	0.44	0.67	
	Moisture	5·44	5.92	5.68	
	Total	100.00	100.00	100.00	

	A. Per Cent.	B. Per Cent.	Average. Per Cent.
Retentive Power for water	58.0	56.0	57.0

Chemical Analysis.

(Soil passing through 2 m.m. Sieve dried at 100° C.)

Insoluble Matter	64.860	63.590	64.23
Soluble in Hydrochloric Acid	35.140	36.410	35.77
Potash	0.236	0.134	0.185
Lime	1.600	1.760	1.680
Phosphoric Acid	0.213	0.133	0.173
Carbonic Acid as Carbonate of Lime	0.400	0.330	0.365
Combined Water and organic matter	9.100	10.150	9.625
Humus (soluble in Ammonia)	1.920	1.960	1.940
Nitrogen	0 136	0.141	0.138
Hygroscopic Moisture	5.440	5.920	5.680

Fertility Analysis.

Available Potash	0.003	0.008	0.0055
Available Phosphoric Acid	0.077	0.064	0.0705

Subsoils.—Physical Analysis.

	A.	B.	Average.
Depth-inches.	9–36 inches.	9–39 inches.	9–36 inches.
	per cent.	per cent.	per cent.
Gravel ...	0.77	1.52	1.15
Sand ...	1.70	0.50	1.10
Fine Sand ...	11.07	12.82	11.44
Silt ...	72.76	72.72	72.74
Agricultural Clay { Fine Silt ...	6.90	6.24	6.57
Agricultural Clay { Clay ...	trace	trace	trace
Moisture ...	6.80	6.29	6.54
	100.00	100.00	100.00

The surface soil consists of about 75 per cent. of fine sand and silt with 8 to 10 per cent of agricultural clay. On the whole a more retentive soil than those just described from the two neighbouring estates. The chemical analysis indicates a high standard of total and available Phosphoric Acid, with a moderate reserve of Potash and a decidedly low present supply in an available form. The Carbonate of Lime is ample. The Humus also is up to a good standard.

An obvious deduction is that Potash salts should be of value while Phosphates are quite superfluous. The addition of Nitrogen might be profitable under irrigation, otherwise a limited rainfall would probably render them non-productive. As regards irrigation it is satisfactory to note the fact that the subsoil is lighter and more permeable than the surface soil. Stagnation of this land should never occur provided due attention to the use of water and a thorough system of drainage trenches be maintained.

ST. CATHERINE.

Large areas of land are available for cane cultivation in this district but at present the banana dominates the irrigable areas of cultivation. Specimens of these soils have been reported on by Mr. Francis Watts in the Journal of the Agricultural Society for 1899, and by the writer in a recent report on "Banana Soils." The lighter soils of St. Catherine possess an exceedingly high standard of available fertility, rendering the use of fertilisers absolutely inoperative Two sugar estates of importance are still active in this Parish and there have been schemes mooted recently for the establishment of a central factory at Spanish Town to be fed by the two lines of railway from the surrounding areas. Agriculturally the project is above reproach. The soil is there, the water is there, capital, organisation and business acumen are alone needed to establish the enterprise.

Experiments on fertilisers are being conducted in this district on Caymanas Estate and will be reported on in due course. It has been shown that the returns from this estate bear comparison with those from any other in the island. A high class grocery sugar is produced here on Demerara lines. The scheme of the experiments is as follows :

Canes—"Caymanas," St. Catherine —J Cameron, Esq.

	Mixed Phosphate, per Acre.	Sulphate of Ammonia per Acre.	Sulphate of Potash per Acre.
11 Plots each $\frac{1}{5}$ Acre.			
Plot 1 No Manure	—	—	—
" 2 Complete Manure	3 cwt.	1 cwt.	$\frac{1}{2}$ "
" 3 No Nitrogen	3 "	—	$\frac{1}{2}$ "
" 4 Double Nitrogen	3 "	2 cwt.	$\frac{1}{2}$ "
" 5 No Phosphate	—	1 "	$\frac{1}{2}$ "
" 6 Double Phosphate	6 "	1 "	$\frac{1}{2}$ "
" 7 Double Superphosphate	6 " super.	1 "	$\frac{1}{2}$ "
" 8 Double Slag	6 " slag	1 "	$\frac{1}{2}$ "
" 9 No Potash	3 "	1 "	—
" 10 Double Potash	3 "	1 "	1 cwt.
" 11 Double Complete	6 "	2 "	1 "

Analyses of soils from Worthy Park Estate, the Hon. J. V. Calder, are in prospect but are not yet complete. A magnificent stretch of

level land here bursts upon the eye on emerging from the mountains and the possibilities of this estate with sugar in a healthy state of normal prices should be most gratifying to the owner.

ST. ELIZABETH.

Experiments and analyses of soil have been made at Holland Estate in this Parish, representing a large area of level alluvial deposit on the banks of the Black River. Formerly the property of the Gladstone family, Holland is now in the hands of an enterprising proprietor ever ready to experiment and to learn. We predict considerable developments for this estate in the near future.

The soil consists chiefly of silt with about equal quantities of fine sand and agricultural clay and is somewhat heavy and retentive, becoming close and sticky in wet weather. Owing to the small fall of level, drainage requires the careful use of deep trenches and accurate grading to make the best use of the fall available. It is noticeable that the clay diminishes with the depth of the subsoil, and that the natural drainage improves therewith. The chemical analysis indicates a good standard of fertility. Given good aëration and suitable cultural conditions the soil should be capable of giving very large returns without assistance.

SOIL ANALYSIS.

Reference Number—58.
Source Details—Experimental Plots. Holland Estate, St. Elizabeth.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Soil. 9 inches		Subsoil. A. 9-24 in.		Subsoil. B. 24-36 in.
			Per Cent.		Per Cent.		Per Cent.
	Stones		Nil		Nil		Nil
	Gravel		1.05		2.47		1.89
	Sand		0.84		0.43		2.32
	Fine Sand		12.92		23.34		14.01
	Silt		66.75		63.76		71.79
Agricultural Clay.	Fine Silt	11.85	2.14	4.84	1.29	3 62	0.90
	Clay		9.71		3.55		2.72
	Moisture		6.59		5.16		6.37
	Total		100.00		100.00		100.00
							Per Cent.
Retentive power for water			...		...		60.0

CHEMICAL ANALYSIS.

(Soil passing through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter	...	...	49.690
Soluble in Hydrochloric Acid		...	50.310
Potash	...	...	0.481
Lime	...	...	0.506
Phosphoric Acid	...	...	0.151
Carbonic Acid as Carbonate of Lime		...	0.288
Combined Water and organic matter		...	16.680
Humus (soluble in Ammonia)		...	3.779
Nitrogen	...	...	0.165
Hygroscopic Moisture		...	7.056

FERTILITY ANALYSIS.

Available Potash	...	0.0182
Available Phosphoric Acid	...	0.0091

The results obtained in the experiments indicate that a complete manure was productive of a profit of £10 per acre—the value of 20 tons of cane. This is quite eclipsed, however, by the still greater results of deep drainage and special tillage operations.

The gross yields of cane per acre from this estate are remarkable and are here recorded to show that Jamaica soils can produce crops of cane that challenge comparison with any other soils of the West Indies.

The arrangement of the manurial plots was as follows:—

Canes—"Holland Estate," St. Elizabeth—M. H. M. Farquharson, Esq.

12 Plots each $\frac{1}{20}$ Acre.	Basic Slag.	Nitrate of Soda.	Muriate of Potash.
Plot 1 No Manure	–	–	–
„ 2 Complete Manure	3 cwt.	1½ cwt	½ cwt.
„ 3 No Nitrogen	3 „	–	½ „
„ 4 Double Nitrogen	3 „	3 cwt.	½ „
„ 5 No Phosphate	–	1½ „	½ „
„ 6 Double Phosphate	6 cwt.	1½ „	½ „
„ 7 No Potash	3 „	1½ „	–
„ 8 Double Potash	3 „	1½ „	1 cwt.
„ 9 No Manure	–	–	–
„ 10 Cowpeas	–	–	–
„ 11 Lime, 10 cwt.	–	–	–
„ 12 Pen Manure.	–	–	–

The canes were planted on Oct. 29, 1901, and were reaped on February 17, 1903—16 months old. The rainfall during the growth of the crop was 86.45 inches The drainage trenches were from 14″–27″ in depth, while the main drainage gut is 26 to 35 inches deep.

Mr. Cradwick of the Agricultural Department supervised the weighing of the experiments and reported the weights of cane and tops as also the crushing with the estate mills An average sample of the juice from the experimental canes was reserved for analysis.

Holland Experiments, 1903.

Plot.	Description.	Cost per acre.	Tons per acre.			Juice, gallons per acre 86° F.	Sucrose, lbs. per acre in Juice.	Increase by Manuring.			Profit per Acre 1 ton Canes=10/.		
			Produce.	Tops.	Canes.			Produce. Tons per Acre.	Canes. Tons per Acre.	Sucrose. lbs. per Acre.	£	s.	d.
1	No Manure	...	45.77	11.2	34.53	5,382	9,591	...	...	...		...	
9	No Manure	...	38.06	11.1	26 95	4,204	7,493	...	...	...		...	
Average	No Manure	..	41.92	11.1	30.74	4,793	8,542	...	...	...		...	
2	Complete	31/1	59.11	14.2	44.91	7,004	12,477	16.19	14.17	3,935	5	10	0
3	No Nitrogen	15/10	65.29	16.5	48.72	7,597	13,534	22 37	17.98	4,992	8	4	0
4	Double Nitrogen	46/4	56.74	13.0	43.70	6,817	12,146	13 82	12.96	3,604	4	3	0
5	No Phosphate	21/7	49.94	14.1	35.81	5,585	9,953	7 02	5.07	1,411	1	9	0
6	Double Phosphate	40/7	51.38	14.4	36.96	5,772	10,285	8.46	6.22	1,743	1	1	0
7	No Potash	24/9	54.31	16.8	37.42	5,834	10,397	11.39	6.68	1,855	2	2	0
8	Double Potash	37/5	72.77	18.3	54 41	8,486	15,126	29.85	23 67	6,584	9	19	0
10	Cowpeas	10/	52.43	14.2	38.21	5,959	10,619	9.51	7.47	2,077	3	5	0
11	Lime ½ ton	10/	64.38	15.2	49.17	7,675	13,673	21.46	18.43	5,131	8	14	0
12	Pen Manure	120/	53.36	12.8	40.54	6,344	11,307	13.44	9.80	2,765 *loss.*	1	2	0

Complete Manure.	Most profitable Manure.
3 cwt. Basic Slag	Plot 8
1½ cwt. Nitrate of Soda	3 cwt. Basic Slag
½ cwt. Muriate of Potash	1½ cwt. Nitrate Soda
	1 cwt. Muriate Potash
	3.5 casks @ £6=£21 per acre profit.

A neighbouring plot of the estates canes planted a fortnight before those on the experimental plots, and in receipt of 95.65 inches of rain during the growth of the crop, was reaped at the same time and gave a yield of 87 9 tons cane and 110.01 tons of 'produce,' i.e, canes and tops per acre. Double crushing with a water and steam mill working tandem gave an expression of 74.85 o/o of juice of the following composition.

Juice Analysis.

Brix (corrected)	...	18.9
S G. $\frac{30}{15}$c.	...	1 0746
Total solids lbs. per gallon	...	2.030
Sucrose " "	...	1.7817
Glucose " "	...	0.0847
Non Sugar " "	...	0.1636
Quotient of Purity	...	87.77
Glucose Ratio	...	4.75

In so far as it is possible to draw deductions from a single year's results it would appear that Lime and Potash are capable of marked results on this soil, while nitrogen fails to produce the effect naturally to be expected of it. It is noteworthy, and I believe almost a record in W. Indian Sugar experiments, that every manured plot in this series shows an increase by manuring.

These experiments are to be repeated with additional trials of Lime in various combinations. The proprietor will give the plots the same system of cultivation and the same grade of drainage as that on the other portion of the land cultivated on the estates lines. The thanks of the Board are due to Mr Farquharson for the great care and trouble he has taken in carrying out these experiments.

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Carissa arduina.

Plants.

From U. S. Dept. of Agriculture, Washington, D. C.
Sweet Potatoes, the following varieties :-- Belmont Yam : Southern Queen Nancy Hall : Yellow Jersey : Yellow Spanish . Pierson : Van Nest Red : Red Spanish : Red Jersey : Red Bermuda.

From Messrs. Reasoner Bros. Oneco, Florida
Psidium lucidum.

From Mr. W. J. Thompson, Supt., Parade Garden.
Begonia Gloire de Lorraine.

Herbarium.

From Mons. Eugene Autran, Herbier Boissier, Switzerland.
A Collection of 41 specimens.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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KINGSTON, JAMAICA:
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1903.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. I. MAY, 1903. Part 5.

THE SUGAR-CANE SOILS OF JAMAICA.—II.

By H. H. Cousins, M.A., (Oxon.) F.C.S., Government Analytical and Agricultural Chemist.

PART II. WEST and N—WESTERN.

WESTMORELAND.

Three soils from the Westmoreland sugar district are here presented. In one case, manurial experiments have been carried out, and the results will shortly be available.

The two soils A and B are samples of sugar lands that have been long in cultivation, and are locally considered to be somewhat exhausted.

SOIL ANALYSIS.

Reference Number—83.
Source Details—Surface Soil Westmoreland A.
Depth of Sample—9 inches.

Chemical Analysis.

	Per Cent.
(Soil passed through 3 m.m. sieve dried at 100° C.)	
Insoluble Matter ...	61.506
Soluble in Hydrochloric Acid ...	38.494
Potash ...	0.288
Lime ...	1.137
Phosphoric Acid ...	.318
Carbonic Acid as Carbonate of Lime ...	1.958
Combined Water and organic matter	11.390
Humus (soluble in Ammonia)	3.021
Nitrogen ...	0.236
Hygroscopic Moisture ...	5.263

Fertility Analysis.

Available Potash ...	0.0034
Available Phosphoric Acid ...	0 0317
Retentive power for water ...	60.0

SOIL ANALYSIS.

Reference Number—82.
Source Details—Surface Soil, Westmoreland B.
Depth of Sample—9 inches.

Chemical Analysis.	Per Cent.
(Soil passed through 3 m.m. sieve dried at 100° C.)	
Insoluble Matter ...	61.093
Soluble in Hydrochloric Acid ...	38.907
Potash ...	0.073
Lime ...	1.188
Phosphoric Acid ...	0.323
Carbonic Acid as Carbonate of Lime ...	1.877
Combined Water and organic matter	11.590
Humus (soluble in Ammonia)	3.415
Nitrogen ...	0.234
Hygroscopic Moisture ...	6.044

Fertility Analysis.	
Available Potash ...	0.0054
Available Phosphoric Acid ...	0.0156
Retentive Power for water ...	56.0

These two soils are both above reproach as regards all the factors here recorded with the exception of the available Potash which is decidedly below par in each case. I have advised the Attorney to try the effect of Potash on this cultivation. As regards the main elements of fertility it must be regarded as a soil of high quality. The local difficulties of management arise chiefly from drainage. Some of the Westmoreland planters have succeeded in growing canes in low-lying lands subject to prolonged flooding with great success by a heroic system of trenches.

Mount Eagle Estate.

The owner of this estate is the pioneer in this parish in the growth and trial of seedling canes. Some varieties tested here have given most promising indications of improvement over the old varieties. Manurial experiments have been carried out during the past season. The results are not yet ready but it would appear that Nitrogen exerts an appreciable effect on this soil The analysis is here set forth.

SOIL ANALYSIS.

Reference Number—70.

Source Details—Soil from Cane Experimental Plots. Mount Eagle, Westmoreland. E. R. Burgess, Esq.

Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	4.65	Fine Earth.
	Sand	...	1.74	
	Fine Sand	...	24.70	
	Silt	...	55.29	
Agricultural Clay.	Fine Silt	...	4.76	
	Clay	...	trace	
	Combined water Organic matter	...	8.86	
	Total	...	100.00	
			Per Cent.	
	Retentive Power for water	...	54.0	

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble Matter	...	54.465
Soluble in Hydrochloric Acid	...	45.535
Potash	...	0.373
Lime	...	1.091
Phosphoric Acid	...	0.244
Carbonic Acid as Carbonate of Lime	...	1.229
Combined Water and organic matter		14.736
Humus (soluble in Ammonia)		3.698
Nitrogen		0.253
Hygroscopic Moisture	...	9.721

Fertility Analysis.

Available Potash	...	0.0090
Available Phosphoric Acid	...	0.0156

This soil is composed principally of silt and fine sand, and is similar, as regards grades, to the lighter soils of the Vere plain.

All the factors determined in the chemical analysis are normal and some of them decidedly above the normal for a soil of high fertility. The nitrogen and phosphoric acid are particularly high, while the humus, for a tropical soil, must be regarded as rich.

The available potash is normal, while the phosphoric acid more than satisfies the standard we have laid down.

This would be a splendid soil for bananas, should it ever be desirable to grow them here.

ST. JAMES.

Analyses of four soils with their subsoils were submitted by Joseph Shore, Esq., of Cinnamon Hill Estate, where manurial experiments have been carried out during the past year.

The season has been disastrous for these calcareous soils owing to the prolonged drought. Mr. Shore was not surprised to find that the manures had in all cases depressed the yield, since this has been the past experience on these estates during a period of drought. The details of analysis of the four soils are as follows :—

SOIL ANALYSIS.

Reference Number—73.

Source Details—Surface Soil A. Cinnamon Hill. St. James. Longbreath Piece 1st Ratoons—Canes healthy. Experimental Plots.

Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	4.44	Fine Earth.
	Sand	...	3.32	
	Fine Sand	...	23.25	
	Silt	...	59.17	
Agricultural Clay.	Fine Silt	...	1.15	3.28
	Clay	...	2 13	
	Moisture	...	6.54	
	Total		100.00	
			Per Cent.	
Retentive Power for water		...	65 0	

Chemical Analysis.

	Per Cent.
(Soil passed through 3 m.m. Sieve dried at 100° C.)	
Insoluble Matter ...	33.100
Soluble in Hydrochloric Acid ...	66.900
Potash ...	0.182
Lime ...	27.560
Phosphoric Acid ...	0.751
Carbonic Acid as Carbonate of Lime ...	46.960
Combined Water and organic matter	18.498
Humus (soluble in Ammonia)	2.825
Nitrogen ...	0.146
Hygroscopic Moisture ...	6.998
Fertility Analysis.*	
Available Potash	0 0212
Available Phosphoric Acid ...	0.0485

SOIL ANALYSIS.

Reference Number—77.
Source Details—Subsoil A., Cinnamon Hill, St. James.
Depth of Sample—36 inches.

Physical Analysis.

			Per Cent.	
	Stones ...		Nil	
	Gravel ...		14.72	Fine Earth.
	Sand ...		3.47	
	Fine Sand ...		20.33	
	Silt ...		54.15	
Agricultural Clay.	Fine Silt ...	4.66	1.60	
	Clay		3.06	
	Moisture ...		2.67	
	Total ...		100.00	

SOIL ANALYSIS.

Reference Number—74.
Source Details—Surface Soil B. Cinnamon Hill, St. James, Long-breath piece. Places where canes turn white and die out.
Depth of Sample—9 inches.

Physical Analysis.

		Per Cent.	
	Stones ...	Nil	
	Gravel ...	24.16	Fine Earth.
	Sand ..	18.37	
	Fine Sand ...	29.34	
	Silt ...	24.69	
Agricultural Clay.	Fine Silt	1.22	
	Clay ...	0.33	
	Moisture ...	1.89	
	Total ...	100.00	

	Per Cent.
Retentive power for water	66.0

Chemical Analysis.

(Soil passed through 3 m.m. Sieve dried at 100° C.)	
Insoluble Matter	5.535

* Solubility in 1 per cent. Citric Acid after neutralization of carbonates with Citric Acid.

Soluble in Hydrochloric Acid	...	94.465
Potash	...	0.111
Lime	...	49 910
Phosphoric Acid	...	0.571
Carbonic Acid as Carbonate of Lime	...	85.290
Combined Water and organic matter	...	2.274
Humus (soluble in Ammonia)	...	1.305
Nitrogen	...	0.093
Hygroscopic Moisture	...	1.926

FERTILITY ANALYSIS.*

Available Potash	..	0.0116
Available Phosphoric Acid	...	0.0225

SOIL ANALYSIS

Reference Number—78.

Source Details—Subsoil B. Cinnamon Hill, St. James.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	15.89	Fine Earth.
	Sand	...	3.82	
	Fine Sand	...	18 96	
	Silt	...	55.93	
Agricultural Clay	Fine Silt	...	0.8 0.80	
	Clay	...	trace	
	Moisture	...	4.60	
	Total	...	100.00	

SOIL ANALYSIS.

Reference Number—75.

Source Details—Surface Soil C Cinnamon Hill, St. James. Double Piece—old canes—steep Hillside typical of C. Hill lands.

Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	39.07	Fine Earth.
	Sand	...	9.03	
	Fine Sand	...	16.15	
	Silt	...	25.46	
Agricultural Clay.	Fine Silt	...	1.83	
	Clay	...	2.16	
	Moisture	...	6.30	
	Total		100.00	

		Per Cent.
Retentive Power for water	...	60.0

CHEMICAL ANALYSIS.

(Soil passed through 2 m.m. Sieve dried at 100° C.)

Insoluble Matter	...	24.290
Soluble in Hydrochloric Acid	...	75.710
Potash	...	0.126
Lime	...	29.787
Phosphoric Acid	...	0.743
Carbonic Acid as Carbonate of Lime	...	49.338

* Solubility in 1 per cent. Citric Acid after neutralization of carbonates with Citric Acid.

Combined Water and organic matter	11.576
Humus (soluble in Ammonia)	2.859
Nitrogen ...	0.209
Hygroscopic Moisture ...	6.724
FERTILITY ANALYSIS.*	
Available Potash ...	.0340
Available Phosphoric Acid ...	.0215

SOIL ANALYSIS.

Reference Number—79.
Source Details—Subsoil C. Cinnamon Hill, St. James.
Depth of Sample—36 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	11.38	Fine Earth.
	Sand	...	4.81	
	Fine Sand	...	30.73	
	Silt	...	43.75	
Agricultural Clay.	Fine Silt	...	2.73	
	Clay	...	0.28	
	Moisture	...	6.32	
	Total	...	100.00	

SOIL ANALYSIS.

Reference Number—76.
Source Details—Surface Soil D., Cinnamon Hill, St. James. 'Bellyfull.' Plants. Near landslip.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	34.03	Fine Earth.
	Sand	...	4.43	
	Fine Sand	...	22.15	
	Silt	...	26.42	
Agricultural Clay.	Fine Silt	...	2.10	
	Clay	...	2.98	
	Moisture	...	7.89	
	Total		100.00	
			Per Cent.	
Retentive Power for water		...	65.0	

CHEMICAL ANALYSIS.

Soil passed through 3 m.m. Seive dried at 100° C.

Insoluble Matter	...	33.493
Soluble in Hydrochloric Acid	...	66.507
Potash	...	0.285
Lime	...	22.582
Phosphoric Acid	...	0.723
Carbonic Acid as Carbonate of Lime	...	35.610
Combined Water and organic matter		
Humus (soluble in Ammonia)		3.148
Nitrogen	...	0.315
Hygroscopic Moisture	...	8.566
FERTILITY ANALYSIS,*		
Available Potash	...	0.0105
Available Phosphoric Acid	...	0.0370

* Solubility in 1 per cent. Citric Acid after neutralisation of carbonates with Citric Acid.

SOIL ANALYSIS.

Reference Number—80.
Source Details—Subsoil D. Cinnamon Hill, St. James.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	Fine Earth.
	Gravel	...	7.22	
	Sand	...	3.83	
	Fine Sand	...	25.31	
	Silt	...	56 81	
Agricultural Clay.	Fine Silt	...	1.36	
	Clay	...	0.46	
	Moisture	...	5.01	
	Total		100.00	

Generalisations on the agricultural features of Jamaica, summing up conditions all over the island under one broad estimate are absurdly impossible. Agriculturally this island represents about six different countries, and what is true of one may be entirely wrong in another. These soils from St. James and the outcome of recent experiments on cane varieties and on manuring serve to emphasize this point.

Consisting of about 50 per cent of carbonate of lime, the Cinnamon Hill soils present a condition of moderate granulation and are light, free draining, and yet fairly retentive. The proportion of phosphoric acid is extraordinary, some eight times the normal content of a fertile soil. The potash is about normal. In the good soils the nitrogen and humus are high. It is not surprising that in a seasonable year such soils should give good yields of cane of excellent sugar-producing quality. Owing to the small rainfall in this district, crops are frequently discounted, and only a part of the natural productivity of the soil is realized. Irrigation on these lands should have marked success, and it is to be hoped that the water at present solely employed for power in grinding the canes may under a central factory scheme be utilized for irrigating the lands. Some such combination is necessary if these estates are to produce regular returns of remunerative crops.

Soil A.

This is the land upon which manurial experiments have been carried out. Mr. Shore's report shows that the manures depressed the yield and resulted in loss owing to the drought. He states that this has been the experience on these estates in the past. The available potash and phosphoric acid are not strictly comparable with those in the other analyses in this series The neutralization of the large proportion of carbonates in these soils as a preliminary to the action of the usual 1 per cent. citric acid solvent has given us figures that are approximately comparative on this particular series, but are in all probability too high in comparison with normal soils on account of the solvent action of the neutral citrate of Lime. An investigation on this matter is in progress.

On the analyses here presented, it is not reasonable to expect that fertilizers could be profitably used. Even more markedly than in the case of the Vere soils previously reported on, "the water supply dominates the crop" and not the limit of plant food in the soil.

REPORT ON MANURE EXPERIMENT AT CINNAMON HILL.

The canes experimented on were old ratoons cut in January 1902. The land was well forked in June and the manures applied early in July, 1902. The canes were again cut in February, 1903, with the following results. Each plot was one-tenth of an acre in area.

Plot.	Cwts. per acre.			Produce per acre. Tons.	Lbs. per plot.		
	Superphosphate.	Sulph. Ammonia.	Sulph. Potash.		Canes.	Bad Canes.	Tops.
1. No Manure	–	No Manure	—	25.29	3,370	1,236	1,060
2. Complete	3	1	1/2	24.06	3,000	1,330	1,060
3. No Nitrogen	3	0	1/2	16.46	2,430	633	615
4. Double Nitrogen	3	2	1/2	11.22	1,475	380	660
5. No Phosphate	0	1	1/2	11.83	1,595	340	720
6. Double Phosphate	6	1	1/2	9.09	1,325	349	360
7. Mixed Phosphate	6 mixed	1	1/2	15.93	2,265	685	620
8. Slag	6 slag	1	1/2	17.00	2,500	805	500
9. No Potash	6 super.	I	0	21.36	2,835	1,185	765
10. Double Potash	3	1	1	23.04	3,432	1,000	730
11. Double Complete	6	2	1	22.12	3,370	980	625
12. No Manure	—	No manure	—	26.22	3,800	990	1,085
		Totals	...	...	31,397	9,915	8,810

It will be thus seen that the two plots not manured turned out the best, which was the experience on these estates in dry years.

The juice of the non-manured canes stood 8° Baumé, and of the manured 7°, by the estates' test. This low test is due to a fall of 14 inches of rain in the last week of 1902 after a long period of drought but it is noticeable that the manured canes shew worse than the others in density of juice also. There were many suckers among the canes (weighed along with the bad canes) and the proportion was much greater than usual owing to the conditions mentioned before. The rainfall was :—

February	1902	2.05	
March	"	1 07	
April	"	3.25	
May	"	0.20	
June	"	2.70	
July	"	0.50	
August	"	0.60	
September	"	1.05	
October	"	4.62	
November	"	3.35	
December	"	14.31	(all in the last week)
January 1903		0.65	
		34.35	for the twelve months.

The long drought scorched the tops of the most forward canes and thus helped to increase the weight of bad canes which are used for rum making.

I propose to continue the experiment for another year, just loosening the soil and cleaning, so as to shew what effect the manures may have on ratoons the second year. The experience so far has been that the manure shews better the year after the drought.

The gallons juice obtained were 1737 from 14 tons canes, which gives a mill extraction of 58 o/o, the average extraction so far for the crop being 55 o/o, the usual extraction from same mill in ordinary years being 60 o/o.

JOSEPH SHORE.
20th Feby., 1903.

Analysis of Juice.

	Manured.	Unmanured.
Brix (corrected)	17.15	17.80
Specific Gravity $\frac{30}{17.5}$	1.0669	1.0697
Sucrose lbs. per gallon	1.5003	1.6046
Glucose " "	0.029	0.028
Non Sugars " "	0.2937	0.271
Quotient of Purity	82.28	84.27
Glucose Ratio	1.93	1.74

It will be seen that the analyses support Mr. Shore's statement that the juice of the manured canes, owing to the peculiar conditions obtaining, is markedly inferior to that from the unmanured canes.

Soil B.

This represents certain patches of soil where the canes turn white and die out Analysis shows that this soil differs greatly from soil A. Over 94 per cent. of it is soluble in acid of which the bulk consists of carbonate of lime The humus and nitrogen are greatly less, and the 'available' results less than one half those recorded for A This soil is unsuited for cane cultivation on account of the great excess of carbonate of lime, the coarse granulation and defective water-retaining power, the deficiency of humus and the low standard of general fertility. I doubt whether it would be profitable to attempt a forced cultivation by extravagant use of organic manures, considering the relative cheapness of good land in the island. Such soil under present conditions is most profitably left to nature.

Soil C.

This soil selected as typical of Cinnamon Hill lands, is coarser in grain than A but presents very similar characteristics, and the chemical data are in fairly close correspondence. Clearly a soil of high fertility and only requiring a water supply to produce large yields.

Soil D.

This soil is again very similar to the last. The available potash must be considered the weakest factor in the elements of fertility here recorded. This must be accepted as a soil of high natural fertility, with a great reserve of plant food.

TRELAWNY.

As representative of this important sugar parish, famous for the quality of its rum, arrangements have been made for experiments at Vale Royal, with the co-operation of Mr. Hoskins, attorney to the Hon H. Sewell.

The soil from the experimental plots gave the following results on analysis :—

SOIL ANALYSIS.

Reference Number—61.
Source Details—Experimental Plots, Vale Royal Estate, Trelawny.
Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	Fine Earth.
	Gravel	...	2.15	
	Sand	...	5.96	
	Fine Sand	...	11.65	
	Silt	...	66.54	
Agricultural Clay.	Fine Slit	...	6.67 (1.13)	
	Clay	...	(5.54)	
	Moisture	...	7.03	
	Total	...	100.00	
			Per Cent.	
Retentive power for water		...	56.0	

Chemical Analysis.

(Soil passed through 3 m.m. Sieve dried at 100° C.

Insoluble Matter	...	38.002
Soluble in Hydrochloric Acid	...	61.998
Potash	...	0.372
Lime	...	2.044
Phosphoric Acid	...	0.653
Carbonic Acid as Carbonate of Lime	...	2.592
Combined Water and organic matter		21.510
Humus (soluble in Ammonia)		4.227
Nitrogen	...	0.248
Hygroscopic Moisture		7.562

Fertility Analysis.

		Per Cent.
Available Potash	...	0.0024
Available Phosphoric Acid	...	0.0226

The mechanical analysis shows that the soil is fairly stiff, consisting chiefly of silt with an appreciable amount of clay. Such a soil would respond to deep cultivation and be benefited by efficient drainage. All the chemical factors are satisfactory, with one exception. The phosphoric acid is enormous; the nitrogen and humus unusually high for a tropical soil. The carbonate of lime is abundantly present.

The available phosphoric acid indicates that manures providing this ingredient are not likely to be required. On the other hand the available potash is so low that I conclude the otherwise extraordinary standard of fertility presented by this soil may be limited and rendered inoperative through a lack of potash. The experiments with manures should throw light on this point. The following scheme has been carried out: -

Canes—"Vale Royal," Trelawny—H. S. Hoskins, Esq.

12 Plots each $\frac{1}{10}$ acre.

	Mixed Phosphate.	Sulphate of Ammonia.	Sulphate of Potash.
Plot 1 No Manure	—	—	—
" 2 Complete Manure	3 cwt.	1 cwt.	½ cwt.
" 3 No Nitrogen	3 "	—	½ "
" 4 Double Nitrogen	3 "	2 cwt.	½ "
" 5 No Phosphate	—	1 "	½ "
" 6 Double Phosphate	6 "	1 "	½ "
" 7 Double Super.	6 " super.	1 "	½ "
" 8 Double Slag	6 " slag	1 "	½ "
" 9 No Potash	3 cwt.	1 "	—
" 10 Double Potash	3 "	1 "	1 cwt.
" 11 Double Complete Manure	6 "	2 "	1 "
" 12 No Manure	—	—	—

ST. ANN'S.

We are able to give a report on the soil from one sugar estate in this parish. Mr. A. J. Webb, of Llandovery, who is taking great interest in the experiments, reports that this soil is not considered the best grade on the estate. It is low-lying land, but little above sea-level. The soil is fairly fine in grain, but light, porous and friable. The chemical analysis indicates a standard above normal in all respects except that of available potash, which appears to be slightly below par. Long-continued cane cultivation may have reduced this constituent to a lower standard. The experiments should throw light on this matter.

Judging from the analysis it is not to be expected that phosphates will prove profitable. I am doubtful whether nitrogen as sulphate of ammonia will have paid its cost, although it would appear probable that potash should affect the yield of crop.

The following table gives the scheme of experiments that have been carried out on the current crop:—

Canes "Llandovery," St. Ann's—A. J. Webb, Esq.

12 Plots each $\frac{1}{10}$ Acre.

	Mixed Phosphate.	Sulphate of Ammonia.	Sulphate of Potash.
Plot 1 No Manure	—	—	—
" 2 Complete	3 cwt.	1 cwt.	½ cwt.
" 3 No Nitrogen	3 "	—	½ "
" 4 Double Nitrogen	3 "	2 cwt.	½ "
" 5 No Phosphate	—	1 "	½ "
" 6 Double Phosphate	6 "	1 "	½ "
" 7 Double Super.	6 super.	1 "	½ "
" 8 Double Slag	6 slag	1 "	½ "
" 9 No Potash	3 cwt.	1 "	—
" 10 Double Potash	3 "	1 "	1 cwt.
" 11 Double Complete	6 "	2 "	1 "
" 12 No Manure	—	—	—

SOIL ANALYSIS.

Reference Number—65.

Source Details—Soil from Cane Experiment Plots, Llandovery, St. Ann. A. J. Webb, Esq.

Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	Fine Earth.
	Gravel	...	2.32	
	Sand	...	6.91	
	Fine Sand	...	40.42	
	Silt	...	40.53	
Agricultural Clay	Fine Silt	...	2.49	
	Clay	...	0.61	
	Combined water, Organic matter	...	6.72	
	Total	...	100.00	
			Per Cent.	
	Retentive power for water	...	56.0	

Chemical Analysis.

(Soil passed through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter	...	61.686
Soluble in Hydrochloric Acid	...	38.314
Potash	...	0.284
Lime	...	3.731
Phosphoric Acid	...	0.154
Carbonic Acid as Carbonate of Lime	...	5.285
Combined Water and organic matter		11.181
Humus (soluble in Ammonia)		3.313
Nitrogen	...	0.249
Hygroscopic Moisture		7.204

Fertility Analysis.

		Per Cent.
Available Potash	...	0.0072
Available Phosphoric Acid	...	0.0356

Conclusions.

1. Jamaica must be divided up into districts and each considered as an agricultural entity on its merits.

2. There are large areas of land in Jamaica upon which sugar cane can be cultivated successfully, and which are not at present in adequate cultivation.

3. Sugar cane cultivation has survived on some 120 estates owing to the extraordinary fertility of the soils and the natural advantages of certain districts for sugar production.

4. The sugar-cane is successfully grown in Jamaica on soils varying from light, gravelly sands to stiff clays; on soils consisting of 50 per cent of chalk, as well as on lands in which this ingredient is almost absent.

5. Irrigation and climatic conditions affect the results obtained to an extraordinary degree. An increase of the irrigable area under sugar cane is higly desirable.

6. All the sugar soils herein reported on, upon which the cultivation is normally successful, present on the whole a very high standard of fertility. The proportion of phosphoric acid is particu-

larly high. Potash is the constituent of which there is the lowest reserve and the smallest available supply.

7. Unless crops far in excess of those at present obtained are made possible by irrigation and more thorough cultiuation, it would appear probable that in the majority of cases these Jamaica sugar soils would not repay any outlay in artificial fertilisers. In the majority of cases, good farming should suffice to maintain a high standard of crop returns over a period of years without any necessity for spending money on imported fertilisers.

I must, in conclusion, record thanks for the valuable co-operation of the managers of the various estates where soil analysis has been checked by manurial experiments. These, repeated on successive crops and modified as circumstances may suggest, should enable a reliable generalisation as to the manurial requirements of these several soils and districts to be made and to add greatly to the value of soil analysis as a guide to special local requirements. The chemical analyses were chiefly carried out by Mr. H. S. Hammond; the physical analyses by the writer with the assistance of Mr. E. J. Wortley.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board was held at Head Quarter House on Tuesday, 10th March. Present—The Hon. the Colonial Secretary (Chairman), the Hon. the Director of Public Gardens, the Island Chemist, His Grace the Archbishop, and Messrs. Fursdon and Shore.

The Minutes of the last Meeting were read and confirmed.

A letter was read from the Colonial Secretary enclosing a communication from Dr. Morris upon the subject of the representation of the West Indies at the Canadian Exhibition. After some discussion it was agreed to adopt Dr. Morris's suggestions so far as the sending of exhibits was concerned. It was thought that the best plan would be to ask Mr. Barclay to work up the exhibits under the direction of Mr. Fawcett. The Board was of opinion that the products of the Colony should be regularly represented at the four chief Exhibitions as a means of stimulating trade with Canada.

Reports were read from the Island Chemist upon:—

(i.) the Laboratory equipment, stating that the acetylene gas plant was now working satisfactorily and might be considered a thorough success, that the work of the Laboratory was being kept back by the insufficient water supply;

(ii.) the agricultural experiments, reporting progress in the matter of the sugar experiments;

(iii.) the educational work, submitting a syllabus of the examination upon which the Agricultural Scholarships are to be awarded. It was agreed to forward this to the Schools Commission for any observations, and to publish it upon its receiving the approval of the Commission;

(iv.) the Laboratory Apprentice Scheme, stating that two applicants had been chosen from a large number and recommending the appointment of two other apprentices. This was agreed to.

A memorandum re the supposed attacking of orange trees by ants writ-

ten by Entomologist of the Imperial Department of Agriculture, was read, together with observations by the Hon.T. H. Sharp. Mr. Fawcett was requested to write to Mr. Panton asking him to look into the matter.

The Quarterly Report of Mr. Buttenshaw, the Lecturer in Agriculture, was read.

Mr. Cradwick's itinerary was submitted and approved.

Mr. Cradwick wrote asking to be supplied with certain tools. Mr. Fawcett was asked to supply, as far as possible, from the store and to send in an estimate for the rest.

A report on the work of the Mico students at Hope Gardens by Mr. T. J. Harris was read. The Secretary was instructed to send a copy to the Mico Board of Directors.

Mr. Fawcett reported that he had received from America a number of new varieties of sweet potatoes.

It was also reported that the Government had made arrangements with Mr. West whereby he should be allowed the free occupation of Superintendent's quarters at Cinchona and land for the purpose of making experiments in bee-keeping, especially in the way of introducing new honey-producing flowers. Mr. West would also give instruction to the Hope apprentices in bee-keeping.

The Chairman read a letter from Mr. Capern of Bristol requesting the Government to grant him facilities for growing bird seed in Jamaica. The Board expressed its willingness to grow the seeds either at Hope or at the Prison Farm.

The Report on the amalgamation of the agricultural agencies drawn up by the Chairman, the Archbishop, and Mr. Barclay, was read. Its adoption was moved by Mr. Shore, seconded by Mr. Fursdon and carried.

The meeting then terminated.

DIRECTIONS FOR PLANTING COTTON.

By T. J. Harris, Agricultural Instructor at Hope Experiment Station.

No attempt should be made to cultivate cotton in districts where the wet and dry seasons are not well defined, as perpetually damp weather is apt to cause the plants to grow to an immense size and yield but little cotton ; and this invariably of an inferior quality.

Almost any soil, with the exceptions of clay and sand, will do, provided the drainage is good ; light and rather poor soil should be ploughed and harrowed before planting, rich soil to be left undisturbed except that a fork's width is broken up on each side of the line.

Sea-Island Cotton should be planted in rows four feet apart and one foot apart in the rows, every alternate plant to be cut out after the first crop and again after the second crop ; the third growing and ripening at four feet apart each way.

Egyptian Cotton is a larger growing plant and should be set out at two feet apart in rows four feet apart, cutting out every other plant after the first crop.

From six to eight seeds should be sown in each hole and covered about an inch ; these will germinate in four to seven days, and when

about eight inches high the seedlings should be thinned out to the three strongest, and later two of these are to be removed, leaving the strongest one. In thinning do not pull them up but cut them off with a knife close to the ground; or the roots of the remaining one may be disturbed.

If, when sowing, the soil is dry it is advisable to pour some water into the hole, drawing down just a little of the surroundiug dry soil with the fingers before putting the seeds in.

The time of sowing depends largely on the "seasons"; about a month or six weeks before the fall rains set in is a good time, say during August if the "seasons" fall in October and November; the idea is to have the plants up to a fair size so that they may make the best use of the rains when they come; the pods ripening in the dry weather that follows.

Weeds should be kept down by constant hoeing whenever dry weather permits of this being done, more especially during the first period of growth and the time of ripening; the loss of soil moisture is thus reduced to a minimum, it occurring only through the cotton plants; and which is perhaps as important, burrs and other seeds are prevented from adhering to the lint.

The plants during the ripening season, should be looked over every four or five days and all open pods relieved of their load of cotton; this must be carefully sunned for a day or two b fore gi ning and packing.

BIRD SEED.

Mr. Capern of Bristol has sent out bird seed of various kinds for experiment in Jamaica. Application for small quantities for trial may be addressed to the Director of Public Gardens and Plantations, Kingston P.O. The following notes will sufficiently indicate the nature of the plants and their requirements.

Hemp (*Cannabis sativa*) is cultivated either for hemp fibre, or for the narcotics, *bhang*, *ganja* and *churras*; the seed is a bye-product.

It is cultivated for fibre in European countries, and in India only in the inner valleys of the Himalaya between 4,000 and 7,000 feet. Rich moist soil, thoroughly cultivated, is requisite for a yield of fibre.

When the plant is to be used to produce fibre, it is grown close; but if for seed only, it is recommended to dibble 2 or 3 seeds at distances every way of 4 or 5 feet. When the seedlings are 3 or 4 inches high the weakest should be pulled up, leaving only one plant.

The male and female flowers are produced on separate plants, and the fibre of the male plant is of superior quality. About 13 weeks after sowing, the flowers on the male plants fade, and the leaves turn yellow and the stems whitish. Each of the male plants is then uprooted singly and carefully so as not to injure the fibre of the stem. The female plants require a month longer to ripen their seed, but by that time tha fibre has become coarse and of little value.

Sunflowers (*Helianthus annuus*) grow best in light, rich, calcareous soils well supplied with moisture, and without any shade from trees.

The seeds are sown 1 inch deep in rows, 18 inches apart, and 30 inches asunder in the rows, thus giving about 11,000 plants to the

acre. The quantity of seed required per acre is from 4 to 6 lbs. Weeds must be kept down, and the soil kept loose and friable for a depth of 3 or 4 inches. The inferior flower-heads should be removed leaving only 4 or 5 on the principal stem, yielding about 4,000 seeds. The large seeded Russian Sunflower produces only a single head, and is less esteemed for oil.

When the seeds are ripe, in 4 or 5 months from time of sowing, the plants are taken up by the root, and allowed to dry thoroughly The heads are then removed, placed face downward on a floor and beaten. The seeds are spread out thinly to dry. Great care is taken to prevent fermentation either in the heads or in the pile of seeds. The average yield is put down at 50 bushels of seed per acre.

Canary grass *(Phalaris Canariensis)* is grown for its seeds which form one of the best kinds of food for many sorts of small cage-birds. The soil must be friable, and fairly rich. Cultivation should be carried on where there is not much cover for grain-feeding birds. One-third bushel of seed suffices for an acre. It is recommended to dibble in the seed at distances of 6 inches every way.

The following letter from Mr. F. Capern contains useful information.

Mr. T. Capern to the Honourable the Colonial Secretary.

Lewnis Head, Bristol, Feb. 26th, 1903.

Sir—I beg to thank you for your cable of February 23rd, in which your Government offer to experiment on seeds for me, and for which please accept my very best thanks.

I am sending out per Messrs. Elder Dempster & Co.'s s.s. *Port Morant* one sack of canary seed, one sack of grey sunflower seed, and one sack of hemp seed. The agents of Messrs. Elder, Dempster & Co. will deliver to your order. I should be glad if the following experiments could be made, but in conjunction with the experiment, the cost of production should be kept in detail, as of course if it cannot be produced so cheaply in Jamaica as in Spain or Morocco, it would militate very much against it. I should like one acre of canary seed to be sown: this must be planted the same way as wheat, and also harvested and thrashed. If possible as dry a climate as you have here should be found, but I need not tell you it should be in close proximity to a railway is also a *sine qua non.* But I do not know if you have cheap cartage from the interior to the wharves.

Sunflower seed—I have sent you two kinds, gray and white. This seed is grown in Russia and is sown like kidney beans If you have much wind they would have to be staked, probably you would use bamboo.

Hemp seed—Of course your Agricultural Society would know how to manage this. There are two products, the seed and the hemp; I only want the seed. I ne d not again say that in each case the cost of production should be minutely kept. I intended to come out to Jamaica myself, but am prevented, and my son will come instead and will give me reports, as if I think I can grow different seeds I shall certainly come over and attend to things myself. A very large trade in bird seed is do e here. England imports 160,000 bags of Canary seed and a very large quantity of hemp and sunflower seeds, besides others which I have not mentioned.

DEAD WOOD IN FOREST TREES.

It is frequently said that we have more insect and fungoid pests to contend against now than was the case a comparatively few years ago. How far this is correct is open to question. But, supposing it to be true, there is no doubt about the blame resting on our own shoulders In every direction, including some of the best managed estates, we see quantities of dead branches and dead trees which are absolutely teeming with fungi, and are therefore a standing menace to all surrounding trees, the fungi on them only waiting for a favourable opportunity to attack fresh subjects, working destruction possibly slowly, but none the less surely. We have pointed this danger out to more than one tree-lover and planter, and the answer is, almost invariably: "Oh, I think dead trees (or dead branches) very picturesque, and I would not have them removed and burnt on any account; and, after all, the danger can only be very remote." In the case of Oak-trees, we have heard it said that it is bad forestry to cut the dead limbs out of the trees. But why? We should like to know the reason why Oak-trees, more than others, resent the dead wood being removed.

In our opinion the cause of death or decay in so many comparatively young trees, is in great part due to permitting so much dead wood to remain. Not only is it worse than useless, for its beauty is at least open to doubt, whereas its danger is absolutely certain, for it swarms with fungi and with insect foes, which immediately enter a fresh tree whenever a branch is broken or a limb cut off, and so the enemy goes on working destruction without a check. Not only should dead trees be promptly cut down and removed to the woodyard, but also all dead or dying limbs, taking care, of course, to paint the wound over at once with a good coat of tar, thus preventing any fungi entering. If left only for a day or two, the enemy has very likely entered the tree, and it is then little good painting the wound afterward. If tree lovers would remember this and act upon it, injury to our trees would be greatly reduced, and the beauty of the countryside improved.

The question of how to prune forest trees is not so well understood everywhere as it ought to be. This is proved by seeing limbs sawn off sometimes a foot or more from the trunk or main branches. The consequence is that the portion left decays back into the tree itself, giving a free entry to all foes, and also to wet, the certain parent of decay. On the other hand, if the branch is cut off close to the trunk, and the edge of the wound pared round with a sharp knife or with a chisel, and followed up with a coating of tar at once, the tree quickly begins to cover the wound with new bark, and in a few years it is quite covered up—that is, of course, if the tree is healthy and in vigorous growth.—*(Journal Royal Horticultural Society, England)*

COCO-NUT BUTTER.

By John R. Jackson.

Amongst the many new vegetable products, good, bad and indifferent, that are frequently being introduced for trading purposes, Coco-nut butter has recently attracted some attention. * In May last it was referred to in the *Journal of the Society of Arts* as follows "The manufacture of Coco-nut butter is an industry of some importance in the City of Mannheim. The Mannheim factory is said to be the only one of any importance in Germany; it has an output of about 10 tons of butter a day. The product is sold under the name of 'Palmin,' a registered trade name, or coco-nut butter. It is manufactured from the kernels of Coco-nuts, and is used as a substitute for butter and lard in cooking. As sold it is generally white in colour, almost tasteless, melts at about 80° Fahr., and is of the consistency of mutton or beef-tallow. When desired by retail customers who are bakers, confectioners, &c., the product is coloured to resemble ordinary butter. When furnished to dealers it is unlawful to colour it. The proprietors of the factory at Mannheim claim that an analysis of their product shows it to contain more than ninety per cent. of vegetable fat with but a slight trace of water; while ordinary butter contains about 85 per cent. of fat, and nearly 15 per cent. of water. It is stated that the substance does not become rancid easily, that it will keep for three or four months in a cool room, and that it is much more wholesome and easily digested than the ordinary fats used for baking and cooking. For these reasons the product has met with considerable favour in German hospitals and other institutions, and for use in army camps. Coco-nut butter is generally put up in square packages, wrapped in parchment-paper, a small proportion being sold in tin cans, which are hermetically sealed for shipment in hot weather. It is sold at one price throughout Germany, namely, about 8d. per pound, or about half the price of ordinary butter. The kernel of the Coco-nut is imported in thoroughly dried strips, forming the Copra of commerce. It is subjected to various refining processes, by which all the free acids and other substances are separated, leaving only the vegetable fat. In the latter stages of the manufacture the product resembles ordinary butter recently churned. It is placed in machines similar to the separators used in creameries, in which the water and other foreign substances are separated by centrifugal force. In the manufacture of Coco-nut butter a by-product, consisting of free acids and other substances, is obtained, and sold to soap manufacturers."

Later on, namely, in June of the present year, the British Consul at Marseilles, reporting on the trade of his consular district for 1900, says a new fatty substance for consumption in the United Kingdom, to take the place of butter, is being put on the British market. It is called vegetaline, and is nothing else than the oil extracted from Copra, refined, with all smell and taste neutralised by a patented process. It becomes sweet, like lard, and is intended to compete with margarine, and on the breakfast-table as a substitute for butter. A local factory has been at work for the past five years, and an effort was to be made to get hold of the British market through a Liverpool firm.

* It is made in Kingston by Mr. F. W. Stockhausen, 59 East Street.

A new light, however, has been put on this statement that the so-called Coco-nut butter is a product alone of Germany, by a letter communicated to the *Journal of the Society of Arts* in the early part of August, from an English firm having their works at Silvertown, in which it is stated that the product was originally invented and manufactured in this country, and this, indeed, at Silvertown, and so large has the trade now become, that a second factory by the same firm has been established at Liverpool. It is pointed out that in this particular industry our continental rivals have failed to secure the lead, and that the output of the two English factories is believed to be greater than that of all other makers put together.

Coco-nut butter in English trade is known as "Nucoline," while Coco-nut suet is called "Vejsu." The first appears in store lists, and is quoted at a price lower than cooking butter, for which it is said to be preferable. It is remarkable that this product is reported to have become much in demand amongst vegetarians, Jews, Mahommedans, who prefer vegetable to animal fats, either on account of their guaranteed purity, economy, or by reason of their religious faith.

There is one thing certain, that if the fresh oil is always used and not expressed from very stale Copra, a wholesome oil is thus guaranteed, and moreover, considering the enormous quantities of Coco-nuts that are always arriving, both for the sake of the oil as well as for the fibrous husk or coir, there is no fear of a failure in the supply of material. *The Gardeners' Chronicle.*

VARIETIES OF GRAPE VINES FOR TRIAL IN JAMAICA.

Mr. T. V. Munson read an interesting and useful paper on the selection and hybridising of grapes at the International Conference at New York last October (See Bulletin, March, page 66). In response to a request from the Director, he has very kindly sent several varieties of Vines, see "Additions and Contributions," page 120. In the letter below he states that the highest price given for grapes is during winter.

From T. V. Munson & Sons, Denison, Texas, to Director of Public Gardens and Plantations.

February 23rd, 1903.

We take much pleasure in sending you by express, a collection of grapes we deem best for trial, in Jamaica, both European and American varieties, including several of our own production.

In exchange for these, in addition to herbarium specimens sent a few years ago, I shall thank you heartily for two or three ounces of ripe seed of the *Vitis caribaea*, native of Jamaica, of the next fruitage that ripens.

Fine grapes sell at the highest price in our large cities during winter. Then the Malaga grapes from Spain packed in cork-dust, are in all our city markets, and sell at 20 to 30 and 40 cts. a pound. The demand would continue up to June.

We send rooted vines. as we have no cuttings at this season that would probably root well. Our vines are entirely exempt from Phylloxera, and other serious maladies.

FERNS: SYNOPTICAL LIST LIX.

*Additions to Synoptical List, with descriptions, of the Ferns and Fern-Allies of Jamaica. By the late G. S Jenman, Superintendent, Botanical Gardens, Demerara.**

Trichomanes solitarum, Jenm.—Rootstock thread-like, freely repent, sinuated, tomentose, and much branched; fronds dark, dull green, abundant, scattered; stipites 1–1½ line long, rusty like the rootstock; blade finely striated, 3 or 4 lines long, 1–4 lines wide, the base cuneate, or subcordate, barren ones lanceolate or suborbicular entire, indented or sometimes cleft; fertile, often bat-like, the sides spreading and incised, deeply cleft and open at the top, with 1–4 stipitate, entirely free sori in the cleft, sunk within or much protruded; midrib evanescent above the base, veins fine, close, flabellate, forked; involucres urn-shaped, with rounded club-like lips.—Gard. Chron., Nov. 17. 1894.

Jamaica and Grenada.—The barren fronds of this might easily be taken for those of *T. setiferum T.* or *apodum*, the species being of like small size, but the fertile fronds of each are quite different, many in this resembling a pair of spreading incised wings, with the free sorus extended or not, neck and head—as of a water-bird when flying—in the deep cleft between. Occasionally a fertile frond is linear.

Adiantum dissimulatum, Jenm.—Stipites erect, ¾ 1½ ft. l., black, polished; fronds erect, 1–1¼ ft, l., 5–10 in. w., bipinnate, firmly chartaceous, naked, dark green, consisting of a long central pinnate portion and two to three basal, much smaller, spreading, pinnate branches; rachis and costae like the stipites; leaflets apart or contiguous, sessile, deltoid-rhomboidal on the central branch, varying to oblong or ovate-oblong in the inferior ones of the lower branches, the terminal elongated; veins free, fine, close, flabellate, repeatedly forked; margins dentate when barren; sori continuous around all but the basal and interior margins.—Gard. Chron., Dec. 1st 1894.

Jamaica, Bull Head. Clarendon, 8,000 ft. alt., collected by Mr. Hart. Resembling in general habit *A Kendalii*, but with different shaped pinnules, firmer texture, striated surface, and different arrangement of the sori.

A. littorale, Jenm. n. sp.—Stripes tufted, polished, ebeneous, or dark chestnut, slender, 5–10 in. l.; fronds tripinnate, ½–1 ft. l., nearly as w. papyraceous-herbaceous, clear green, naked, rachis slender, polished; pinnæ spreading lower largest and most compound, upper simply pinnate, all parts freely petiolate; segments deciduous ½–1 in. b. and d. varying from rhomboidal to flabellate-cuneate, the outer margin usually rounded and freely incised, the incisions deeper in the barren fronds, pedicels hairlike 1–1½ li. l. articulated at the top; veins free, flabellate, fine and close, repeatedly forked; sori oblong or subreniform, varying in length as the lobes of the margin vary in width.

Jamaica.—Very abundant on the rocky cliffs of the coast, in some places within wash of the sea spray. The freely and deeply incised margins gives this s close resemblance to *Capillus veneris*, from which it is however clearly distinguished by the articulation of the segments, which are almost as deciduous as those of *fragile*. It is generally a

* *From Bulletin of Miscellaneous Information, Botanical Department, Trinidad.*

smaller plant than *tenerum*, which in general habit it resembles, the segment larger and much more deeply cut, the incisions being from 1–3 li. d. In my Jamaica Fern Flora, on a false identification of a specimen received, I accepted this with great doubt as "A. emarginatum, Bory Wild," an Eastern species, with round even-edged leaflets, merely notched here and there and bearing no resemblance to the large deeply incised leaflets of this.—Porto Rico.

Pteris regia, Jenm.—Stipites stout, erect, freely aculeated, 4-5 ft. l., brown, the base palaceous; fronds subdeltoid, tripartite, quadri-pinnatifid, 5–6 ft. l. and w., the lateral lower divisions largest and more compound, chartaceous, naked, light green, the vascular parts light brown and glabrous, the rachis sparsely prickly at the base; largest central pinnae $1\frac{1}{2}$-$2\frac{1}{2}$ ft, l., 6–8 in. w., pinnules connected, with an open rounded sinus or entirely disconnected and contiguous or twice or thrice their own width apart, 3–4 in. l. $\frac{1}{2}$–$1\frac{1}{2}$ in. w. serrate-acuminate, entire or the larger cut in part or wholly, usually only in the centre on one or both sides, into oblique acute serrate-pointed lobes 2 li. w., and $\frac{1}{2}$–$\frac{3}{4}$ in. l. with an acute or broadly open rounded sinus between; veins fine areolae 1–2 serial with free corked or simple exterior branches, costa arch incomplete falling short of the outer rib; sori continuous, or interrupted in the sinus reaching the serratures of the outer part of the segments.—Gard. Chron. 12th Jan. 1895.

Jamaica; 3,000–4,000 ft. alt., in woods in the Eastern parishes The fronds are of a bright, light colour, resembling those of *aculeata* of which it may possibly prove to be the maximum state when fully known, though the material of this at present known, while suggesting does not confirm this conjecture.

ADDITIONS AND CONTRIBUTIONS TO THE DEPARTMENT.

Library (Serials).

Europe.

British Isles.

Bee-Keeper, Feb. Mar. [Editor.]
Board of Agri. Leaflets, Nos. 79, 80 and 81. [Secretary.]
Botanical Magazine, Mar. [Purchased.]
British Cotton Growing Association, Correspondence, &c. No. 2. [Secretary.]
Bulletin, Kew Gardens, App. II. [Director.]
Chemist and Druggist, Feb, 21, 28, Mar. 7, 14. [Editor.]
Colonial and Diplomatic & Consular Reports, Jan, Feb, Mar. [Col. Sec.]
Garden, Feb. 21, 28, Mar. 7, 14. [Purchased.]
Gardeners' Chronicle, Feb. 21 28, Mar. 7, 14. [Purchased.]
International Sugar Journal, Mar. [Editor.]
Journal of Botany, Mar. [Purchased.]
Journal R. Hort. Soc., XXVII, 2 & 3. Report of the Council, 1902; Arrangements for 1903.
Journal, R. Colonial Institute, Pt. IV, Vol XXXIV.
Nature, Jan. 15, Feb. 19 26, Mar. 5, 12. [Purchased.]
Pharmaceutical Journal, Feb, 21, 28, Mar. 7, 14.

France.

Journal d'Agriculture Tropicale, No. 18. [Publishers.]
Revue des Cultures Coloniales, No. 118. [Editor.]
Sucrerie indigène et coloniale, Feb. 17, 24, Mar. 3, 10. [Editor.]

Germany.

Bericht über die Tätigkeit der K. k. landw-chemischen Versuchsstation und der mit ihr vereinigten K. k. landw-bakteriologischen und Pflanzenschutzstation in Wien, im Jahre 1902. [Director.]

Belgium.

Société d'Etudes Coloniales No. 2 Feb. [Editor.]

Hungary.

Les Stations Royales Hongroises Agro-Chimiques. Extrait d l'ouvrage intitule le service des Stations Agronomiques Hongroises [Director.]

Asia.

India.

Planting Opinion. Jan. 31. Feb. 7, 14, 21. [Editor.]
Proc. of United Planter's Association of Southern India, 1902. [Secy.]

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Java.

Proefstation West Java, No. 61. [Director.]

Australia.

Queensland.

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Sugar Journal, Feb. [Editor.]

Western Australia.

Journal Dept. Agriculture, Jan. [Dept. of Agri.]

Africa.

Cape of Good Hope.

Agri. Journal, Feb. [Dept. of Agri.]

Natal.

Agri. Journal & Mining Record, Feb. 6, 20. [Dept. of Agri.]

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C. African Times, Dec. 6, Jan. 3, 10, 17, 24, 31. [Editor.]

Mauritius.

Station Agronomique, Bull. 7 Les Borers de la Canne á Sucre. Insecticides et Fungicides. [Director.]

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Barbados.

Agri. News. Mar. 14, 28.
Information relating to Cotton Cultivation in the West Indies.
Leaflet Series, No. 7—Hints and Information in regard to Cassava Poisoning.
Sugar Cane Experiments in the Leeward Islands:—Report on the Experiments at Antigua and St. Kitts, Pts. I & II.
West Indian Bulletin, Vol. III, No. 4.
[Commr. Imp. Dept. of Agri.]

Jamaica—

Cornwall Herald. [Editor.]
Journal Jamaica Agri. Soc., Mar. [Sec.]

Montserrat.

Report on the Experiment Stations, 1901-02. [Agricultural Instructor.]

British North America.

Ontario.

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Ottawa—

Report, Botanical Club of Canada 1902-1903, and other pamphlets. [Dr. A H. MacKay.]

Toronto

Cassava as a competitor of Maize in the production of Starch and allied products. By Geo. Archbold. [Author & G. Campbell Arnott.]

Montreal—

Pharmaceutical Journal, Feb. [Editor.]

United States of America.

Publications of the U. S. Dept. of Agri. [Directors.]

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Report of the Forester for 1902. By Gifford Pinchot. From *Annual Reports Dept. of Agri.*

Experiment Stations.

Alabama, 122, (Grazing and Feeding Experiments with pigs.)
Florida, 63, (Diagrams for packing Citrus Fruits.)
64, (Texas Cattle Fever and Salt-Sick.)
Hatch, 86, (Orchard Treatment for the San Jose Scale. One year's experiments in Massachusetts.)
Illinois, 83, (Feeds supplementary to Corn for fattening steers.)
84, Dairy Conditions and suggestions for their improvement.)
Kansas, 116, (Destroying Prairie-dogs and Pocket-gophers.)
Louisiana, 73, (Analyses of Commercial Fertilizers and Paris Green.)
South Dakota, 75, (Treatment of Smuts and Rusts); 77, (Macaroni Wheat.)
Texas, 65, (The Tomato.)
Virginia, 129, (Orchard Studies—II. The Fruit Plantation—Stone Fruits.)
130, (Orchard Studies—III. Notes on some of the more important varieties of Apples.)

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American Journal of Pharmacy, Mar. [Editor.]
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Mycological Notes. By C. G. Lloyd. [Author.]
New York Botanical Garden Journal, Mar. [Director.]
Plant World, Feb,, Mar. [Editor.]
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Polynesia.

Hawiian Planters' Monthly, Feb, [Editor]

Seeds.

From Messrs. Dammann & Co., Naples.

Acacia dealbata; Chrysanthemum coronarium luteum plenum.

From Major W. Wright, Hideote, Campden, Glos.

Seeds from N. Queensland;—Sterculia quadrifolia: Bothi Bail; Terminalia macrocarpa; Erythrina vespertilis: Lucuma sericea; Boerhaavia diffusa; Ebnona Wardiana.

From Lady Blake, Hong Kong.

Tallow Tree - White Bauhinia.,

Plants.

From Mr. T V. Munson, Denison, Texas.

Grape Vines, the following varieties—Blondin: Brilliant Calabrian Captain: Carman: Cloota: Faher szages; Fern Munson: Flame Tokay: Herbmont: Herman Jaegar: Kiowa: Manito; Perle of Anvers: R. W. Munson; Shala: Violet Chasselas: Xenta.

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EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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JAMAICA

BULLETIN

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COCOA II.*

NOTES FROM DR PAUL PREUSS.

SHADE TREES.

The two trees which are employed generally in Trinidad to give shade are the "Anauco" (*Erythrina Amasisa* or *E. micropteryx*) for the hilly regions, and the "Bucare," (*E. glauca* or *E. umbrosa*) for the low plains. The two kinds are known by the common designation of "Immortels." Trials have also been made of other trees, as, for example Sand-box (*Hura crepitans*) and Bread-fruit (*Artocarpus incisa*) but without great success The Immortels have the property, injurious in shade trees, of shedding their leaves in periods of drought, and of remaining stripped or with only a few leaves during the time of the greatest heat. If, besides this, they draw much moisture from the soil, it is not astonishing that the cocoa trees suffer from drought.

Shade trees should always be full of leaf at least in countries as dry as Trinidad, or the cocoa trees die immediately in consequence of too great heat and drought. In regions where this is not the case, as for example in the Cameroons where the rain is much more abundant, the fall of the leaves and the strongest exposure to the sun which results, can only act in a salutary manner, for the consequence is that a more abundant flowering is induced. It is the same for coffee and vanilla. Mr. Hart recommends as shade trees, the Guango (*Pithecolobium Saman*) which ought to be planted 50 to 60 feet apart. Dr. Preuss saw it so employed as a shade tree in Venezuela both for coffee and cocoa; they were not old, and acted very well, f r their shade is light, and the foliage remains throughout the year; they grow very quickly and the leaves close up at night, thanks to which the formation of dew during the night is very active. However in a plantation of coffee where the trees had become too old, they visibly overpowered the coffee shrubs, and reduced their yield considerably. The rapid growth and the gigantic dimensions of the Guango prevents Dr. Preuss from recommending it as a shade tree for plantations. For, if they are given the proper distance from the first, the cocoa trees planted in the interval remain too long without shade; and if they are planted from the com-

*Continued from Bulletin for April, pages 73–76.

mencement as close as the species of Erythrina, some of them have to be removed later, which causes much damage to the cocoa trees. Dr. Preuss saw several Guangos growing in a large sugar plantation in Surinam but the Manager told him that it was solely because no shrubs nor bad weeds could grow under them.

The property which many leguminosæ possess, in consequence of their symbiosis with a fungus, of accumulating nitrogen in tubercles which decay at the end of the period of growth and enrich the soil with nitrogen, belongs probably also to the Immortels and the Guango &c., although the fungus acts principally in soils pour in nitrogen, and such soils are not usually met with in cocoa plantations. These shade trees will not in every case take nitrogen from the soil, because they possess in a high degree the power of borrowing it from the atmosphere. For this reason they take very little nourishment from the cocoa trees. It is necessary as far as possible to choose shade trees from amongst the leguminosæ. If this rule has been followed everywhere in the New World without the planters having understood the reason, it is a proof in favour of the truth of the theory, and of the aptitude for observation of the planters.

Cocoa in Venezuela.

Cocoa is the most renowned of the products of Venezuela. It is known commercially as Caracas Cocoa, because Caracas was formerly the centre of the trade. At the present time Puerto Cabello, and especially La Guayra have withdrawn the trade to themselves. There are no large plantations in the vicinity of Caracas. The finest and the most numerous plantations are situated near the coast in the States of Carabobo, Guyman Blanc and Lara. The part of the coast between La Guayra and Puerto Cabello is particularly famous. There are situated the valleys of erosion of the coast Cordilleras, abundantly watered, generally narrow, and separated one from another by high chains of mountains, and in these valleys are found the best cocoa plantations. The soil is composed principally of products of disintegration of micaceous schist and gneiss, mixed with an abundant quantity of humus carried down by water from the forests situated in the upper part of the mountains.

The high walls of the valleys protect them against wind. The streams contain abundance of water during the whole year. The soil is of extraordinary fertility; nevertheless the portions that can be cultivated are relatively small,—they comprise, even when they attain a high figure, only some hundreds of acres. Immediately beside the black soil of the valley, occupied by the cocoa plantations, rise the mountains precipitous and entirely barren, poorly furnished with agaves, cacti and stunted bushes, at the foot of which the cocoa planter finds the red earth with which he colours his cocoa.

Here is the celebrated region of Chuao, of which the cocoa was formerly reputed the best in Venezuela, indeed even in the whole world, but which has had to yield the first place to new plantations. Another centre of cocoa is at San Felipe, which produces cocoa beans with very thin shell of excellent quality. The cocoa of the coast near Rio Chico is also appreciated. At the south of the lake of Valencia, the region of Guigue on the plateau of Valencia is particularly known. It is

situated 1,480 feet above sea level, but the Criollo cocoa nevertheless develops there very well. There is even a small plantation at 3,280 feet above sea level. Cocoa is cultivated also in the valley of Tuy, and near Los Teques there are well developed trees at an elevation of 3,120 feet. At these altitudes however only the most hardy species and at the same time the least valuable can be cultivated; while on the coast the finest species, but the most sensitive of the Criollo furnish the celebrated "cacao de la costa."

Two varieties of cocoa are in reality distinguished: first, the Criollo Cocoa, and secondly the Trinitario or Carupano Cocoa. The Criollo represents the best, and the Carupano the least good quality. The differences of prices are extremely marked,—more so than between the different species of cocoa of every other country. In 1898, the prices varied, even in Venezuela, from 57 marks per 50 kilos for the lowest priced Carupano to 134 marks for the best Criollo; in 1897 the prices went from 41 to 131 marks. It is only Criollo which is perfectly pure that fetches the highest price; it loses in value as soon as it is mixed with Carupano.

More precise observations are necessary in order to decide whether the distinction between Criollo on the one hand, and Trinitario or Carupano on the other, constitutes a simple variety, or whether they are distinct species. The two kinds appear in commerce mostly separated, although Criollo is rarely pure. The word Criollo is not, to my knowledge, in use as a commercial designation; it is rather the Chuao of which the reputation is universal, which lends its name to the good Criollo. Even the plantation of Chuao produces actually only 500 fanegas as a maximum per year. The Criollo, called also "Cacao Dulce," consists of several sub-varieties: (1) Criollo proper, of which the fruits are dark red-brown and the fresh beans a bright violet; (2) "Criollo amarillo" of which the fruits have a yellow shell and the beans are white. Between these two varieties there is a third, of which the fruits are red or yellow, called "Criollo Mestizo," but which are very rare.

The Trinitario or Carupano cocoa is divided into a series of sub-varieties, under names about which the planters are not unanimous. This is easily explained, because it is not possible to trace the precise limits between the different classes, and because all the varieties intercross. The distinction, on the contrary, between the Criollo and the Trinitario is quite pronounced.

In spite of numerous transitions certain types can be established in the Carupano or Trinitario. The following may be mentioned: (1) Angoleta; (2) Cundeamor, which is divided into Cundeamor proper, with red shell, and Cundeamor amarillo with yellow shell; (3) Carupano proper and its sub-varieties, such as Carupano grande and Carupano mestizo; its fruit is generally red, mixed more or less with yellow; (4) Carupano parcho, of which the fruit is greenish yellow, or of parchment colour; (5) Carupano taparito, yellow, or brown yellow; (6) Sambito, red or yellow fruits, short, stout, and rather smooth; (7) Trinitario amargo, or "Cojon deToro" [Calabacillo] fruits red or red-brown, quite smooth, rounded or terminating in a short point.

From the point of view of quality of these different types, it is generally admitted that the fruits long, strongly furrowed and very rough

as, for example, those of Angoleta and of Cundeamor furnish the best cocoa and that the smooth fruits of "Cojon de Toro" yield the worst. Every planter knows the character of the last; nevertheless trees of this bad variety are found in all the plantations of Criollo.

The Criollo tree is readily recognised by its feeble growth, its sparse foliage, and its small leaves. The fruits are of medium size, somewhat strongly furrowed and rough, somewhat massive and very rarely symmetrical. The typical fruit of Criollo has an oblique point of moderate length, which is always directed downwards. In general the fruits have a deformed appearance. They have no constriction at the base. The shell is relatively thin, and of a consistence less strong than that of the variety Carupano. According to the tint of the fruit, they distinguish Criollo proper with deep red shell, Criollo amarillo with yellow shell and Criollo mestizo with yellow and red shell. The Criollo proper constitutes the Criollo *par excellence.* It represents 99 per cent of the Criollo of Venezuela. The interior of the fresh bean is bright violet. The Criollo amarillo has beans which are quite white. In spite of the striking characteristic the planters do not distinguish it from Criollo proper; and most of them did not even know that they had cocoa with white beans in their plantations. They have never cultivated the two varieties separately. Dr. Preuss was not able to find out how the cured beans of the white variety differ from those of the violet variety, if, indeed, there is any difference. The form of the beans in the fresh state was the same in the two varieties; the taste of the white beans appeared to be sweeter and less bitter than those of the bright violet beans.

(*To be continued.*)

THE QUESTION OF SHADE FOR COFFEE AND COCOA.

Prof. O. F. Cook, Special Agent for Tropical Agriculture in the United States Department of Agriculture, wrote a very interesting Bulletin a short time ago on "Shade in Coffee Culture."*

The subject is discussed under the following headings:—I. The direct effects of shade, (a) Natural habitat of coffee, (b) Effect of shade on yield, (c) Effect of shade on quality. II. The indirect effects of shade, (a) Protection against drought, (b) Protection against erosion, (c) Shelter from winds, (d) Fallen leaves as fertilizer, (e) Nitrification through shade, (f) Shade and fungus diseases. III. The effects of unwonted exposure, (a) The use of volunteer seedlings, (b) Overshading, (c) Removal of shade, (d) Shade and the coffee leaf miner. IV. Methods of applying shade. V. List of coffee shade trees.

The natural habitat of species of coffee is the somewhat open, partially wooded country which borders the many disconnected forest areas of Africa where partial shade is a very general natural condition of such species. But most of the plants growing under such conditions are not assisted by deficiency of light, but will thrive much better and

*Bulletin, No. 25, Division of Botany, 1901.

become more vigorous and productive when the competition of the masses of other vegetation is removed.

That sunlight is necessary for the processes of plant assimilation, that the sugar content of vegetable tissues depends upon access to light, and that sugar is the material from which most of the alkaloids and other plant substances are elaborated, are well-known facts indicating the necessity of light for a maximum of functional activity. Even those who advocate the use of shade admit that the yield is diminished, though the existence of compensating advantages is maintained. In Java the largest trees are described as growing without shade on terraced, carefully cultivated mountain sides with the slopes grassed over to prevent washing. The coffee is planted 25 feet apart, and permitted to grow to its full height—sometimes reaching 30 or 40 feet. These giant trees bear each a crop which, when cured, weighs 6 or 7 pounds.

The production without shade of the most valuable grades of coffee show that the claim that shade is a necessity to the production of coffee of good quality cannot be admitted.

However untenable may be the position of those who argue that shade is directly beneficial to the coffee tree, the possibility is not excluded that shade in coffee plantations may often be indirectly beneficial by conserving soil moisture, keeping down the growth of weeds and grass, preventing erosion, protecting the coffee trees from the violence of the wind, and other ways.

Prof. Cook's general conclusions are, that there is no basis in reason or in observed fact for the belief that shade is a general necessity for the coffee plant, even when grown at low elevations. On the contrary it is extremely probable that the beneficial effects resulting from shade are quite apart from the shadow cast upon the coffee tree.

The beneficial effects connected with shade arise from the protection afforded against drought, erosion and winds. The planting of shade trees for these purposes is accordingly determined by local conditions of climate and soil, and furnishes no reason for the general planting of shade trees.

In regions not affected by injurious climatic extremes the planting of shade trees is justified from the cultural standpoint only by the increased fertility imparted to the soil by means of the nitrogen-fixing root tubercles of leguminous species. This view has not been made the subject of experimental demonstration, but it seems to accord with all the facts thus far ascertained.

The benefits of leguminous fertilizing are quite apart from the shading of the coffee, and under suitable cultural conditions are also to be secured from shrubs and herbs belonging to the same natural family.

The relative utility and availability of the various shade trees and soiling crops is a subject of vast importance in coffee culture and in other agricultural industries of the tropics..

The combinations of such cultures as coffee and cocoa with leguminous trees and plants of maximum cultural and commercial value afford many complex, scientific, and practical problems bearing upon the rise of mixed farming in the tropics and are thus worthy of serious experimental attention.

These conclusions of Prof Cook are of the greatest interest in Ja-

maica, and are deserving of the most careful consideration, not only in connection with the coffee and cocoa industries, but with other agricultural plants in cases where the ground is only partly covered.

The Blue Mountain Coffee grown from about the elevation of 2,500 ft. upwards gets the highest price in the market, and it is produced without any shade. At about 2,500 ft. according as the ground slopes to various points of the compass, and at all lower altitudes shade is considered necessary. The tree that is used universally in the Blue Mountains is the West Indian Cedar.* The principal reason given for using this particular species is that it drops its leaves during the winter months when coffee requires all the sun it can get, and shade would be injurious. These months are just those that are the dry months of the year. Shade therefore is not necessary at these lower altitudes of the Blue Mountains for the purpose of maintaining a moist atmosphere or for the retention of moisture in the soil.

Now, although the temperature in the shade is much less than that in the sun, Prof. Cook has given samples of coffee doing well in Porto Rico at sea level without shade.

It appears therefore that it is the soil that requires shading from the sun, and not the coffee shrub. The temperature of the ground through which the coffee roots penetrate varies with elevation above sea-level, and with amount of shade; and when we come down from the higher coffee fields to an altitude of 2,500 ft. the temperature of the soil there, and at lower levels, is possibly greater than the roots of the coffee, or the microbes in the soil, can bear.

At the Agricultural Conference in Barbados in 1901 in the discussion on Mr. Watts' paper on "The treatment of soils in 'orchard' cultivation in the tropics,"† the writer of these notes said that "the exposure of the soil to the direct rays of the sun causes great injury both to the soil and the crops growing thereon," and this is the point in the whole subject to which attention should be directed.

It is known that in a general sense the soil is prepared for plant use by the action of microbes, particularly in the upper layers of the soil. These microbes are enabled to carry on their important work only whilst certain conditions of moisture, air, and temperature are suitable. If the temperature for instance is too high, the microbes cannot act, the consequence being that a sufficient quantity of material is not absorbed by the plants, and the crops produced by the plant are small in quantity

Mulching which is so beneficial in preventing escape of moisture from the soil, is also of the greatest benefit in shading the soil and so allowing the microbes to prepare it for the use of the plant. Mulching certainly does not add nitrogen to the soil as leguminous trees do, but neither does it rob the soil of other necessary ingredients which shade trees of any kind actually do.

On large estates the difficulty of obtaining large quantities of material for mulching would be great, and probably the best plan to adopt would be to grow some deep rooting leguminous herb, such as alfalfa, in spaces between the cocoa, coffee, or orange trees, and to cut it down

* Cedrela odorata.

† West Indian Bulletin, Vol. II, 1901, page 96.

for mulching when about to flower. In this way there would only be the preliminary expense of establishing the herbaceous perennial, and the small expense afterwards of cutting it down. Quantities of valuable food material would thus be brought up from the subsoil, and deposited in the mulch on the surface to decay for the benefit of the cocoa, coffee, or other plant.

NOTES ON PHOSPHATE MANURES.

BY

H. H. Cousins.

Apart from the material question of cost, I have always advocated that planters would be well-advised to avoid the complete fertiliser and the special manure of commerce and to purchase the special ingredients required at current market rates.

Our experience in the purchase of fertilisers for the Manurial Experiments of the Board of Agriculture indicate that there is a saving of quite 25 o/o in cost, apart from the special advantages arising from adjusting a manurial mixture to the needs of particular soils and crops.

My chief objection to the ordinary 'complete' manure of commerce lies in the fact that there are three types of phosphatic fertilisers, each peculiarly suited to a particular type of soil. It is quite possible to use each of these forms of phosphoric acid without any reasonable probability of any benefit and a possibility of a depression in the resulting crop. For example: Basic Slag is frequently absolutely inoperative on calcareous soils, while superphosphate may result in detriment to the crop if applied to soils deficient in Carbonate of Lime. Again there are some soils, representing the lighter lands of our fertile alluvial tracts in Jamaica, where Basic Slag would be inoperative, superphosphate injurious and an intermediate or mixed phosphate be the form best adopted to the nature of the soil.

To use a "complete manure," containing in the majority of cases acid phosphates, indiscriminately on all our Jamaica soils is, to my mind, a chemical absurdity.

Before purchasing manures, planters would do well to consult the chemist and avoid paying too high a price and the possibility of getting an unsuitable mixture.

On many soils in Jamaica Phosphates are quite unnecessary. Analyses show that most of our good land is very rich indeed in this ingredient and that when exhaustion takes place in course of time, fertilisers supplying Nitrogen and Potash only should suffice to maintain the standard of fertility in these cases.

Appended are some data as to phosphatic fertilisers recently imported into Jamaica which may serve to guide planters as to a wise selection.

Phosphate Fertilisers.

—	1 Basic Slag. A.	2 Basic Slag. B.	3 Basic Superphosphate.	4 Mixed Phosphate.
	Per cent.	Per cent.	Per cent.	Per cent
Total Phosphoric Acid .	16.34	17.29	13.89	18.51
Equal to Phosphate of Lime .	35 67	37.74	30.32	40.41
Citrate Soluble				
Phosphoric Acid .	9 17	13.52	11.9	13.84
Equal to Phosphate of Lime .	20.01	29.50	25.97	30.22
Percentage soluble .	56.1	78.2	85.6	74.8
Water Soluble				
Phosphoric Acid .	nil	nil	minute trace	3.35
Equal to Phosphate of Lime .	nil	nil	do	7.31
Citrate Insoluble.				
Phosphoric Acid .	7.17	3.77	1.99	4 67
Equal to Phosphate of Lime .	18.66	8.24	4.35	10.19
Cost per Ton delivered in Kingston	£3 1 0	£3 3 0	£4 0 0	£4 0 0

Observations.

For clay soils deficient in Lime and all of the strong retentive lands which may need Phosphates—Basic Slag—is the best form. It is advisable to apply it alone and early. It must not be mixed with manure containing ammonia. Dose 2 to 20 cwt. per acre according to the crop and the object in view. Its action spreads over at least two years.

No. 1 is a Basic Slag purchased shrewdly as to price but really a dear or inferior article owing to low standard of phosphates and very poor solubility (56 o/o.) This was bought by a banana planter for use on a stiff soil deficient in available Phosphoric Acid. For 2s. per ton more he might have obtained No. 2 Slag as used by the Board of Agriculture.

This was Albert's Slag of high grade in fineness showing 2 per cent more Phosphate and a solubility nearly 50 per cent greater than that of No. 1. In buying Basic Slag a guarantee of "fineness" should be

obtained of at least 80 per cent. For Jamaica the highest grade is really the cheapest owing to the cost of freight (18s. per ton).

Basic Superphosphate.

This is a patented article which has just been placed on the market. It is by no means a novelty and the Patent rights must be doubtful since we happen to know of a firm who prepared the identical article some years ago and give it up as unsatisfactory in practice.

The name of the article is not in its favour since it is not 'Basic' and is not 'Superphosphate.' It is prepared by treating Superphosphate with Lime; thereby distroying the special value of the superphosphate—its solubility in water—and producing a product that we are convinced is of necessity more expensive than other forms of reverted phosphate and is by no means a Basic Phosphate with the special chemical advantages of Basic Slag. A large banana planter was induced to buy a large quantity of this article under the impression that it was similar to and better than Basic Slag. I estimate a loss to the purchaser of about £200 on this transaction and mention this case to convince planters that the opinion of the Chemist in such matters is freely available and may avoid the purchase of the wrong manure at the wrong price.

Superphosphate is undoubtedly the best phosphate for use on medium to light soils containing adequate Carbonate of Lime. A contract with a firm in Glasgow has just been made per the Crown Agents for a grade of 30 per cent. soluble phosphate f.o.b. Bristol in double bags at £2 10s. 0d. per ton This firm's quotations were the most favourable of a large number who were asked to quote prices for delivery in April of chemical manures for the Experiments of the Board.

Mixed Phosphate (No. 4) is an intimate mixture of 3 parts superphosphate and 2 parts steamed bone flour and is especially suitable for the majority of light, alluvial soils and those deficient in Carbonate of Lime.

Its value compared with Basic Superphosphate shows that, for the same price in Jamaica, we obtain $\frac{1}{3}$ more phosphate, $\frac{1}{5}$ more citrate soluble phosphate and over 7o/o of water soluble phosphate in addition, in 'mixed phosphate' as compared with the consignment of Basic Superphosphate quoted. Steamed Bone Flour to contain 65o/o of Phosphates and 2o/o Nitrogen was purchased for the Department at £4 f.o b. in 1901, at £4 10s. in 1902 and at £4 14s. for the current month.

I recomend the use of mixed Phosphate rather than Steamed Bone flour alone. Banana planters should find this mixture with $\frac{1}{5}$ part Sulphate of Ammonia a useful top dressing on soils in need of manurial assistance. In some cases the Ammonia should be supplemented with an equal quantity ef 95o/o Sulphate of Potash and the mixture applied at the rate of 4 to 8 cwt per acre.

JAMAICA CASSAVA.

Analysis of selected local varieties.

By H. H. Cousins M. A. (Oxon), F. C. S.
Government Analytical and Agricultural Chemist.

In view of the interest which is now being taken in cassava as a commercial source of starch and glucose, it appeared desirable to analyse some typical varieties of the cassava generally grown by the peasantry of the island. A collection of representative varieties was made by Mr. Cradwick of the Agricultural Department and planted at Hope in January, 1902. These represent the most valued sorts grown by the peasantry in the Alligator Pond district where Cassava is an important staple.

After fifteen months growth, samples were sent to the Laboratory for analysis and are here reported on.

The Hon. T. H. Sharp, who has taken an active part for some years in advancing the cassava industry, submitted a collection of seven varieties grown on his property 'Inverness' in the South East of Clarendon, and these have been analysed and the results are here recorded.

The tubers represented the entire produce of average hills and were truly extraordinary. The yield of cassava in this district must be enormous. The cost of production is also exceedingly low owing to the fact that the cassava has not to compete against weeds and the cultivation necessary to grow the crop of the simplest and easiest character.

Given a water supply, this district should produce cassava in enormous quantity at the lowest possible cost and the success of a starch factory be assured. Some of the varieties grown at Hope appear to be identical with the Inverness Bitter Cassava. It is to be noted that the 'Brown Stick' which leads in starch and sugar content in the Hope Series is also first in the Inverness Series, while the Clarendon tubers contain about 9 per cent. more starch than those grown in the Liguanea plain at Hope. This supports the statement of many practical men that cassava varies a good deal in quality in Jamaica dependent upon the soil and conditions under which it is grown.

The analyses were made on the entire tuber, unpeeled. The whole of each sample was first pass through a slicing machine, then carefully sampled and a smaller portion pulped from which the sample for analysis was prepared. In the analysis of cassava it is imperative to avoid keeping the tubers since decomposition rapidly sets in. It is clear that a cassava factory must be in close touch with the centre of production and that it would not be practicable to send cassava from long distances owing to this fact.

The tables of analyses of the two Series are here set out.

Creole Cassava Varieties. Hope Experiment Station 1903.

No.	Name.	Description of Tubers.	Moisture o/o	Glucose o/o	Sucrose o/o	Hydro-cyanic Acid o/o	Total Solids o/o	Starch o/o	Glucose Value o/o
1	Bobby Hanson ...	Large, long, rough dark skin.	62.8	0.125	0.500	0.014	37.2	31.9	35.2
2	Brown Stick ...	Short, thick, rough dark skin.	57.0	0.222	0.366	0.019	43.3	36.3	40.0
3	White Top ...	Small, rough dark skin.	61.5	0.250	0.673	0.019	38.5	30.7	34.2
4	Rodney ...	Large, Smooth white skin.	62.2	0.250	0.660	0.018	37.8	32.7	36.2
5	Black Bunch of Keys ...	Medium size, dark rough skin.	58.1	0.200	0.514	0.019	41.9	35.3	39.1
6	White Bunch of Keys...	Long, narrow, white smooth skin.	59.3	0.125	0.541	0.019	40.7	31.8	35.2
	Average ...	6 Creole Bitter Cassavas	60.2	0.195	0.532	0.0180	39.9	33.1	36.65
	Average ...	6 Colombian Sweet Cassavas	55.7	...	...	0.0013	44.3	34.8	37.9

Cassava from 'Inverness', Clarendon, Hon. T. H. Sharp, 1903, (in order of Starch content.)

No.	Name.	Description.	Hydro-cyanic Acid. per cent.	Moisture per cent.	Total Solids per cent.	Glucose per cent.	Sucrose per cent.	Starch.	Glucose Value.
5	White, Smooth (Bitter)	Long leaf, smooth long, very large white tubers	0.029	57.58	42.42	0.14	0.48	39.10	39.65
4	Brown Stick (Bitter) ...	Dark brown rough, long large tubers	.026	56.24	43.76	0.19	0.51	39.01	39. 5
3	Luana (Sweet) ...	Brown rough long medium tubers	.014	56.64	43.36	0.17	0.73	35.14	35.94
2	Cotton Tree Sweet ...	Pinkish, smooth long medium tubers	.013	58.79	41.21	0.14	0.62	34.15	34.85
1	Commander Sweet ...	Dark brown, rough hard small tubers	.017	60.99	39.01	0.09	0.91	32.58	33.50
6	Black Bitter ...	Long leaf, Blue Bud. Dark rough, very long and large tubers	.046	59.67	40.33	0.08	0.40	32.42	32.86
7	Silver Stick Bitter ...	Smooth, pinkish, medium length and size of tubers	.026	59.98	40.02	0.08	0.42	32.40	32.86

To indicate the relative starch value of Creole varieties and the new Colombian varieties recently reported on (Bull. Vol. I p. 37) the average of the six varieties grown at Hope is compared with that of the best six of the Colombian varieties.

Grown under very similar conditions of soil and climate there is a decided advantage in favour of the Colombian Cassavas, both as regards starch, glucose and total solids. The 'Brown Stick' is practically on an equality with 'Governor Hemming' (the best Colombian variety) as regards starch but contains ten times as much Prussic Acid.

We have not yet obtained data as to the agricultural yields of these varieties. Clearly the relative value of the sweet and the bitter as a source of starch lies entirely in the yield per acre and not in the intrinsic superiority of the best 'bitter' over the best 'sweet' in starch content.

As an article of food, of course, the Colombian non-poisonous Cassava is beyond all question of rivalry.

Hydrocyanic Acid in Cassavas grown at Hope.

No.	Name.	Cortex o/o	Peeled Tuber o/o	Hydrocyanic Acid.		
				Cortex o/o	Interior o/o	Total o/o
1	Bobby Hanson ...	19.0	81.0	0.026	0.010	0.014
2	Brown Stick ...	15.0	85.0	0.020	0.015	0.019
3	White Top ...	19.1	80.9	0.026	0.021	0.019
4	Rodney ...	11.4	88.6	0.026	0.017	0.018
5	Black Bunch of Keys	13.6	86.4	0.037	0.014	0.019
6	White Bunch of Keys	13.6	86.4	0.030	0.017	0.019
A	Average ...	15.3	84.7	0.028	0.016	0.018
Trinidad Average 13 Sweet Cassava		20.0	80.0	0.032	0.008	0.013
Trinidad Average 12 Bitter Cassava		...	...	0.021	0.023	...

All the varieties grown at Hope are Bitter, the variety "Bobby Hanson" having the lowest proportion of Prussic acid

The results of the estimation of the Prussic acid in the cortex and the inner portion of the tubers are given in the foregoing table.

For seven days a nearly uniform production of Prussic acid took place when the sliced tubers were placed in water. The water was

poured off every day, the prussic acid estimated, and a fresh supply of water was added. Finally Hydrochloric acid was used and this eliminated the whole of the prussic acid. We have now ascertained that the total Prussic acid can be estimated in one operation by treating the cassava with Hydrochloric acid and distilling in steam. This will greatly facilitate the operation of determining Prussic acid.

Our results, so far, appear to confirm Professor Carmody's statement that an analytical difference can be drawn between sweet and bitter cassava based on the fact that in the bitter the poison is uniformly distributed in the whole tuber, while in sweet cassava most of the poison is contained in the peel. Further experiments are in progress and we have been promised the assistance of Mr. J. T. Palache in obtaining further supplies of sweet cassavas for analysis and experiment. So far we have not examined a Jamaican sweet cassava that can be called 'sweet' or non-poisonous to the same degree as the Colombian varieties.

Hydrocyanic Acid from Cassavas. (Inverness.)

No.	Name.	Description.	Total Hydrocyanic Acid Per Cent.			Per Cent of Total Hydrocyanic Acid in Cortex.
			In Cortex.	In Interior.	Total.	
1	Commander	Sweet	0.004	0.013	0.017	24
2	Cotton Tree	Sweet	0.004	0.009	0.013	31
3	Luana	Sweet	0.004	0.010	0.014	29
4	Brown Stick	Bitter	0.005	0.021	0.026	19
5	Long Leaf White	Bitter	0.004	0.025	0.029	14
6	Long Leaf Brown	Bitter	0.008	0.038	0.046	17
7	Silver Stick	Bitter	0.004	0.022	0.026	15

This table shows that the amount of Prussic Acid in the cortex of both Bitter and Sweet Varieties varies but little. The Bitter Cassavas, however, contain a decidedly higher proportion of the poison in the inner portion. Carmody's rule would have enabled anyone to identify Nos. 1, 2 and 3 as Sweet Cassavas and to conclude that the remaining four varieties were Bitter. Some recent analyses, however, convince me that in Jamaica the gradation between 'sweet' and 'bitter' varieties is by no means marked, since varieties intermediate between the two types exist.

BOARD OF AGRICULTURE.

The ususal monthly meeting of the Board was held at Head Quarter House on Tuesday, 21st April at 9 o'clock. Present: The Hon. the Colonial Secretary, (Chairman), The Hon. the Director of Public Gardens the Government Chemist, Mr. C. E. DeMercado, Mr. J. Shore and Mr. C. A. Fursdon.

The Minutes of the last meeting were read and confirmed.

The following letters were dealt with :—

(1.) from Dr. Morris, enclosing copies of a pamphlet on Cassava-poisoning;

(2) from the British Museum, conveying thanks for the Bulletin;

(3) from Mr. Guy S. Ewen, suggesting that drain-tiles should be manufactured at the Penitentiary. It was pointed out that experience in Jamaica and other parts of the West Indies had shown that drain-tiles were unsuited to the climatic conditions on account of silting up in the heavy rains. The Secretary was instructed to reply that the matter would receive further consideration by the Board;

(4) from Mr. Johns of Mandeville School, making enquiries as to the Agricultural College. It was agreed to refer this letter to the Chemist.

In connection with the School Garden Scheme, it was decided to lay out such a garden at Hope and to improve on the plan as might be found necessary

Mr. Thompson's report for the week ending 11th April was considered. On the suggestion of Mr. deMercado it was agreed that the travelling Instructors should be directed to inquire into the matter of the supposed damage to cocoa by rat-bats.

The syllabus for the examination for Scholarships at the Agricultural College was returned by the Schools Commission with suggestions. These had been considered by Mr. Cousins who thought it would be necessary to hold the examination this Summer in order that Students could be admitted in October. It was decided to make arrangements and advertise accordingly.

The Secretary was directed to circulate among the members the report on the work of the College for the term.

A report by the Chemist on the Laboratory apprentices was approved.

The Board approved of the publication by the Chemist of the results of the manurial experiments 1902-03. It was agreed that the matter of the crop map should be further discussed by the Chairman and Mr. Cousins.

The Director of Public Gardens reported that a certain amount of the cotton seed presented to the Colony had been distributed but that a good deal still remained. It was agreed to advertise this.

The Board proceeded to discuss various schemes for the promotion of agriculture.

The meeting then terminated.

The usual monthly meeting of the Board was held at Head Quarter House on Tuesday, 12th May 1903, at 9 o'clock. Present: The Hon. the Colonial Secretary (Chairman), His Grace the Archbishop, the Hon. the Director of Public Gardens, the Government Chemist, the Hon. H. Cork, and Messrs. C. A. T. Fursdon, C. E. de Mercado, J. Shore and John Barclay, the Secretary.

The Minutes of last meeting were read and confirmed.

The Instructors' reports which had been circulated, were considered and approved

A letter from His Excellency the Governor was read asking the

Board to make an enquiry into the state of the Horse-breeding Industry with a view to improving it. The Board was in favour of some action being taken, and Mr. de Mercado and Mr. Cousins were asked to confer together on the subject, and make a draft report to come up before next meeting.

A memorandum from the Director of Public Gardens stated in reply to the Chairman's enquiry that the first crop of tobacco had been sold, last year's was still to sell, and the present crop was still in preparation. A tender for last year's crop was considered.

A letter from Dr. Neish on exhaustion of banana land, was directed to be circulated among the Board, and come up at next meeting with their remarks.

A letter from Mr. Cradwick stating that he had been asked by intending planters of banana and cocoa on a large scale in the western parts of the island, to visit their lands to give advice, and asking if he was at liberty to do so. He was authorised to do so if it did not interfere with his itinerary.

Mr. Hewitt, a pupil at the Chemical Laboratory, asked the Board to help him to get on to a banana plantation so as to utilize his vacation for getting some practical experience. Mr. Cork was requested to give him a trial.

Mr. Cousins said that Mr. T. H. Sharp was eager to try some experiments with cassava at his property "Inverness," to discover the best period from planting to taking up the roots, so as to get the maximum starch, and asked for a small grant of £10 to further this. It was decided that as tests for the same purpose were to be carried through at the Prison Farm they would endeavour to co-operate with Mr. Sharp there, and make the necessary tests for him.

A report on the Prison Farm from Mr. Palache showed satisfactory work being done, good practical results, and a profit on the working so far.

On the motion of Mr. Cork it was resolved to see if the blood at present wasted at the slaughter house could not be dried and utilized as a fertilizer, if the quantity was enough.

Mr. Olivier moved that the Board express their appreciation of Mr. Buttenshaw's services as Secretary for the period he had acted. Mr. de Mercado seconded and this was directed to be minuted.

FOUR RECENTLY DESCRIBED FERNS FROM JAMAICA.

By Lucien Marcus Underwood, Ph. D.
Professor of Botany, Columbia University, New York.

In preparing a monograph of the ferns of all North America, we have had occasion to compare various Jamaican ferns with the types of species to which they have been referred and have found that in several cases they differ specifically. For example, one of the moonworts which is quite widely distributed in the region just above Cinchona was referred by Mr. Jenman to *Botrychium ternatum*. *B. ternatum* was described in 1784 from Japan, and is a very different plant from the one growing in Jamaica and from the various species from other countries which have been referred to it. The Jamaican plant therefore

required a new name and we have called it *B. Jenmani.* In a similar way the Jamaican plant which Mr. Jenman referred to *B. Virginainum,* is very distinct from that species which is very common in the northern United States and appears occasionally in the southern States as far as Florida. It has a very marked biological character of retaining its leaf of one season (and sometimes an earlier leaf also) until the maturity of the sporophyll of the succeeding season. For this reason we have named it *B. dichronum.* Two species of *Danæa* also require new names as noted in our recent revision of that genus.

The original descriptions of these four species are quoted below:

Botrychium Jenmani, Underw. Fern Bull. 8: 59. 1900.

Root fleshy, from a short axis 1–2cm. long; sterile lamina separating at a height of 1–2cm. and usually at or below the surface of the ground; leaf stalf 2.5–4cm. long, flesh coloured or pinkish; lamina 3–12cm. wide, 2.5–9cm. high, composed of a central bipinnatifid portion, and two similar but smaller lateral ones which take their origin alternately at distances varying from 5–15mm.; lower lateral division, the larger with 4–6 lateral pinnules, each composed of 3–5 oval segments with finely crenate margins; venation indistinct except in younger laminae: sporophylls 12–22cm. long, including the rather compact mostly tripinnate panicle.

This species is comparatively common above Cinchona growing among bushes and along trails.

Botrychium dichronum, Underw. Bull. Torrey Club, 30: 45. 1903.

A moderately tall plant, allied to *B. Virginianum,* with sessile sterile lamina and presistent leaf of the preceding year. Roots fleshy: stem 15–20cm. long, smooth: sterile lamina broadly triangular, 20cm. wide, 15cm. long, tripinnatifid with about five pairs of nearly opposite gradually diminishing pinnae, the lowermost with longer pinnules on the outer side and inclined forward at an angle; pinnules 8–10 on each side of a winged rachis, alternate, cut nearly to the midrib into 6–10 segments set at an angle of 45° with the rachis, the lower ones slightly narrowed at the base, and 3–5 toothed at the apex, all gradually simpler towards the apex of the lamina: panicle triangular, spreading, 3cm. or more long on a slender stalk 4cm. or more long, 2–3 pinnate.

This plant is quite frequent in the region above Cinchona and Morce's Gap extending up on John Crow Peak and Blue Mountain.

A fine series of specimens is in the Herbarium of the Department of Public Gardens, Jamaica. Since seeing the plant in the field we find it attains a larger size than the original description indicates.

Danaea Jamaicensis, Underw. Bull. Torrey Club, 29: 675. 1902.

A low, coarse plant with acuminate sterile pinnae and narrow pointed pinnae on the sporophylls. Rootstock unknown; stipes pale, 18–24cm. long, with 2–4 nodes; sterile leaves with a terminal and 11–12 pairs of pinnae, about 2cm. apart except the lowest pair which is smaller, 10–14cm. long, 1.7–1.9cm. wide, tapering rather abruptly into a slender deeply serrate acuminate point; veins mostly forked, the intercostal spaces about 12–14 to 1 cm. (measured above the furcations); sporophylls with about 8–12 pairs of pinnae, about 2 cm apart, short-stalked, 5–7cm. long, 5–7mm. wide, obtuse at base and tapering at apex; rachis somewhat alate above.

This appears to be the species confused by Jenman with *D. ste-*

nophylla with which it has little in common, while both the Kew specimens enumerated above are placed under *D. Moritziana*. *D. Moritziana* is from Columbia and has the pinnae of the sterile leaf quite different in shape, tapering toward the cuneate base and much more gradually toward the apex; intercostal spaces 16–17 to 1 cm.

Danaea Jenmani, Underw. Bull. Torrey Club, 29: 677. 1902.

Rootstock (as far as known) horizontal, rather stout; stipes brown scurfy, those of sterile leaf 10–11cm, long, usually with one node; pinnae 7–9 pairs, opposite, 2–3cm. apart, obtuse at base with a short pedicel, 4.5–6cm. long by 1.8cm. wide, abruptly short-pointed, the margin more or less serrulate at the apex; rachis scurfy, more or less alate; veins mostly forked, the intercostal spaces about 12 to 1 cm above the furcations; basil and terminal pairs of pinnae shorter than the others; sporophylls with about 11 pairs of pinnae, 5–8mm. apart, 3 cm. long, 5mm. wide, mostly blunt and short-stalked.

This is the species called *D. alata* by Jenman, and although he calls it "frequent" in Jamaica it appears to be very rare in collections. We have found it to be frequent near Mabess River.

CUBAN USES OF THE ROYAL PALM.

By William Palmer.

The royal palm (*Oreodoxa regia*) is a widely distributed tree throughout Cuba, and it is truly the tropical feature of the landscape. In the former more highly cultivated areas they largely occupy the hedgerows, thus being arranged in double rows along the roadways, and in single rows along the dividing lines. This arrangement is largely accidental, cultivation compelling the absence of the young plants from the fields, and the hedgerows offering a secluded habitat until they are strong enough to need no shelter. In other places the frequent fires have destroyed the trees on the higher areas, so that one sees them oftenest along the banks of the watercourses. The tree is a noble one, and occurs everywhere except among the pines of the mountains. To the simple Cubans living remote from modern civilization, it furnishes many of his necessities, most of which perhaps are contained in the following list.

Posts.—Trees are felled and allowed to lie for a considerable time before they are cut into lengths and split.

Fences.—These are made of strips of the wood tied upright to cross-pieces and close together, so that chickens cannot get through.

Columns.—They are used as the main supports of a house, the upper portion of the trunk being used.

Boards.—When the interior of a felled tree is rotted, it can readily be split and the pieces trimmed to the required length and width, which is necessarily narrow.

Coffee mortars.—Most palms are somewhat swollen at about one-third of their length from the ground: this is cut out for about the height of a table, the wider end is hollowed out, and with a pestle of similar or different wood, forms a mortar and pestle which is used to crush the roasted coffee beans. When not in use, the hollow may hold the family supply of beans and it is always handy to support the family wash-tub a shallow broad article made often of the same wood.

House walls.—The basal part of the leaf stalk is a broad long woody portion which clasps the trunk for its whole length and whose lower end leaves a narrow horizontal scar where it was attached to the trunk. These fall with the leaf, and are dampened and flattened by weights. Bundles of these leaf bases are an article of sale in places where the palms are scarce, and they may be seen piled up in stores for sale. They are trimmed and tied to the framework of the house. They are placed in two rows, the side of one overlapping another and the lower ends of the upper row overlapping the lower row. They also serve to cover anything, and not unfrequently are used as tables.

Rain Coats.—One rainy afternoon several Cubans came to our camp dressed in coats made of the green (freshly fallen) stalk. A hole had been cut out of the centre through which the head was thrust, and the two halves bent so as to cover the front and back. A string torn off the edge of the same piece was used to tie it round the waist, the whole making a peculiar but efficient coat of mail.

Boxes and Baskets.—With a sharp knife which all Cubans carry, a few minutes suffices to make one of these leaf bases into a receptacle capable of holding water, vegetables, or similar things. Cuban tobacco is always bound up and shipped from the plantation in a large bundle wrapped in the bases of the leaf stalks.

Thatch.—All Cuban houses outside of the towns have their roofs covered thickly with thatch made from the long leaves of the palm. It is usually cut into two or three parts, and tied to the pole rafters with palm leaf string.

String and Rope.—Either split parts of the leaf base or the division of the leaf are used, either twisted or not. No nails are used in the construction of the houses—the poles, thatch and siding being tied on.

Canes.—A strip of the wood worked round and polished, makes a presentable cane.

Brooms.—The flower stalk and its divisions is a large affair. With the berries off, it is bound about its centre, and the numerous small twigs are ready for work. It is a common article of every Cuban house, and the earth, floors and surroundings are kept well swept.

Chicken and Pig Feed.—The bunches of berries are carefully cut off and lowered by a palm leaf rope to the ground, and then laid across the chicken or pig pen to be eaten as desired.

Paper.—The inside layer of the base of the leaf stalk is very fine and white, and is used for writing purposes.

Wine.—This is made from the berries when in a green state. A gun-shot fired into a bunch of fruit is sure to result in a shower of juice. Woodpeckers are fond of this and will tap the berries or the base of the fresh leaf stalk and sip the juice.

Nest of Woodpeckers.—The large Cuban woodpecker always excavates a large hole about two-thirds up the trunk of a live tree, and rears its young in the cavity.

Food.—When a tree is felled, the mass of embryo leaves are cut out forming a lump about 18 inches long by 6–8 inches in diameter, of beautiful creamy whiteness.

Without the royal palm the people of Cuba would be poor indeed. With the coco-nut, banana, sweet potato and palm, they are able to exist comfortably with a mild climate.—(*Plant World.*)

IRRIGATION.

By F. H. Newell*

While methods of conserving and conducting water have been improved under the stimulus of modern invention, the application of water to the soil has been left to experience gained largely by accident and through failure. There is great need of long-continued systematic study and acquisition of knowledge concerning the actual effect which the water has upon the soil and upon the plants. We can see the ultimate result, but have only a vague conception of the steps by which this result is produced.

Most of the farmers practising irrigation in the United States use quantities of water far in excess of those theoretically demanded or actually beneficial to the crops. This is in line with the general prodigality of pioneer life, and with the habits of shiftlessness so easily acquired where an abundant supply of water can be had. It is so much easier to open the ditches and let the water flow freely than it is to guard and guide each tiny rill, that for economy of time and labour, if not from actual indolence, the irrigator is apt to let the water go its own way.

It is sometimes stated that irrigation is a lazy man's way of cultivation. The reverse is the case wherever the best results are obtained. Irrigation, properly conducted, means intensive farming and application of water with great care, followed by thorough cultivation of the moistened soil.

Different plants require different amounts of water. Some are satisfied with a very little. Others require a great deal, and cannot do without it. Still others are relatively indifferent as to whether much or little water is applied; they have the habit of adjusting themselves to circumstances. Each crop therefore has different needs, and the practice of irrigation must vary accordingly.

It is not merely the character of the plant which has to be considered, but also the quality of the soil. Certain soils receive and transmit water with great rapidity,—such, for example, as sand and gravel. Others, like clay, take water slowly and hold it with great tenacity. Thus the manner and time of irrigating certain plants will vary according to the ability of the soil to hold and supply water as needed. If the moisture escapes rapidly, as from sand, the plant after a few days is not able to receive enough and begins to droop. On the other hand if the soil is very compact and the water is held from escaping, the soil may become water-logged, air cannot penetrate the interstices, and the plant suffers from drowning.

There is still another factor in the production of crops which must be considered besides sunshine, soil, and water. This is the low order of vegetable life known as nitrifying organisms. These, in the presence of air and moisture, manufacture food for the plant and are its servants in preparing material upon which it thrives. A certain amount of

*From "Irrigation in United States", by F. H. Newell, Hydraulic Engineer and Chief of the Division of Hydrography of the U. S. Geological Survey Department.

water is needed for these nitrifying organisms, but, on the other hand, too much water stagnates and destroys them. Thus it is that there is a very delicate adjustment to be preserved in respect to the amount of moisture in order to procure the best results. These conditions the successful irrigator learns by experiment and failure, and unconsciously follows certain rules which he is usually unable to put into words.

There has been very little progress in the practice of irrigation from the methods of ancient times. This is due largely to the fact that the men who are now bringing new lands under ditch have for the most part received their training as farmers in humid regions, and find it difficult to unlearn many of the facts which they regard as fundamental, and to reverse the habits of half a lifetime. They hesitate to adopt the methods of the Indians and Mexicans, despising these as crude or childish. Nevertheless these primitive peoples have, through the experience of generations, acquired certain ways which are worthy of study, particularly in the direction of using the smallest possible amount of water in oases on the desert. When they have plenty of water, the Mexicans use it wastefully; but where the amount is extremely limited, some of them, particularly the agricultural Indians of the South-west, have acquired the art of utilising every drop. Even the drippings from the family water jar are arranged to fall upon a growing plant, and the moist spots are carefully guarded for the growing of corn or beans.

The amount of water required for raising crops varies according to soil and other conditions. The plant itself needs a certain minimum supply in order to receive and assimilate its food and to keep up transpiration. A far larger quantity is required to saturate the surrounding soil to such a degree that the vitalising processes can continue. The soil is constantly losing water by evaporation and by seepage, so that the amount which the plant takes from it is relatively small. Nevertheless, the moisture must be maintained within narrow limits in order to produce the most favourable conditions of plant growth.

Experiments have been made to determine exactly how much water is needed in order to keep the soil in proper condition for plants of different character. Among the most important investigations are those by Professor F. H. King, who has found by direct measurement that from 300 to 500 pounds of water are required for each pound of dry matter produced; in other words, for each ton of hay raised upon an acre, 300 to 500 tons of water must be furnished either by rainfall or by artificial means.

Water covering an acre 1 inch in depth weighs about 113 tons, and to produce one ton of hay the depth of water required is approximately from 3 to 5 inches. It is necessary to furnish at least this amount, and sometimes several times as much, in order to produce a crop. The actual amount used in producing 5 tons of barley hay to the acre has been about 20 inches in depth. Much depends upon the permeability of the soil, and its ability to hold water.

The quantity of water used in irrigation is usually stated in one of two ways—either (1) in terms of depth of water on the surface, or (2) in quantities of flowing water through the irrigating season. The first method is preferable, since it is susceptible of more definite consideration, and is also more convenient for comparison with figures for

rainfall, which are given in inches of depth. In the humid regions rainfall is usually from 3 to 4 inches per month during the crop season. In the arid region. where the sunlight is more continuous and the evaporation greater, there should be, for the ordinary crops at least enough water during the growing season to cover the ground from 4 to 6 inches in depth each month. Carefully tilled orchards have been maintained on far less. In Arizona, where the crop season is longest, being practically continuous throughout the year, twice as much water is needed as in Montana, where the crop season is short and the evaporation is less.

The second method of stating the quantities necessary for irrigation is of convenience when considering a stream upon which there is no storage. It is frequently estimated that one cubic foot per second, or second-foot, flowing through an irrigating season of ninety days, will irrigate 100 acres. One second-foot will cover an acre nearly 2 feet deep during twenty-four hours, and in ninety days it will cover 180 acres 1 foot in depth, or 100 acres to a depth of 1·8 foot, or 21·6 inches. This is equivalent to a depth of water of a little over 7 inches per month. In several of the States, laws or regulations have been made to the effect that in apportioning water not less than 66⅔ acres shall be allowed to the second-foot of continuous flow. This is extremely liberal, and permits extravagant use of water.

When the ground is first irrigated, enormous quantities of water must sometimes be used in order to saturate the subsoil. It has frequently happened that, during the first year or two, a quantity of water which would cover the ground to a depth of 20 to 10 feet has been turned upon the surface. Frequently for several years an amount equal to a depth of 5 feet or more per annum is thus employed. Gradually, however, the dry soil is filled, and, as stated in another place, the water table is raised nearer the surface, less and less water being needed.

The farmers, being accustomed to the use of large quantities of water, often find it exceedingly difficult to get along with less, and continue to use excessive amounts, often to their own disadvantage. They are actuated in part by the consideration that, having paid for the use of the water, they are entitled to a certain quantity, and fear that if they do not take all of this, their claim to it may be disputed. Some of them actually waste water to their own detriment from the mistaken belief that in so doing they are establishing a perpetual right to certain quantities.

With the gradual development of the country, and the bringing of more and more land under ditches, the need for water increases, and equity demands that no irrigator shall take more than he can put to beneficial use. Flowing water must be considered as a common fund, subject to beneficial use by individuals according to orderly rules, each man taking only the amount he can employ to advantage. Under any other theory full development of arid regions is impossible.

It is instructive in this connection to know what is the least amount of water which has been used with success. To learn this, it is neccessary to go to south California, where the snpply of water is least, relative to the demand made upon it, and the economy is correspondingly greatest. Successive years of deficient rainfall in California

from 1897 to 1900, while working many hardships, served to prove that with careful cultivation, crops, orchards, and vineyards could be maintained on a very small amount of water. In some cases an amount not exceeding 6 inches in depth of irrigation water was applied during the year, this being conducted directly to the plants, and the ground kept carefully tilled and free from weeds.

During these times of drought some fruits, as, for example, grapes, apples, olives, peaches, and apricots, were raised without irrigation, but a most thorough cultivation was practised. Some fruitgrowers insist that, in the case of grapes, for example, the quality is better when raised without artificially applying water, although the quantity is less. It has been stated that in raisin-making there is less contrast than might be expected between the irrigated and non-irrigated vineyards, for although the yield of grapes raised by watering is far heavier yet after drying the difference is not so marked. Wheat and barley, also, according to some farmers, make a better hay when cultivated dry, but the weight is less Shade trees, such, for example, as the eucalyptus or Australian blue-gum, the catalpa, mulberry, and acacia, grow without water artificially applied, but do not reach the extraordinary development that they do when near irrigating ditches. It is almost useless to attempt to raise the citrus fruits without plenty of water.

The quantity of water necessary to irrigate an acre, as estimated by various water companies in southern California, ranges from 1 miner's inch to 5 acres, to 1 miner's inch to 10 acres, the miner's inch in this connection being defined as a quantity equalling 12,960 gallons in twenty-four hours, or almost exactly 0.02 second-foot, this being the amount which has been delivered under a 4-inch head measured from the centre of the opening. Under this assumption 1 second-foot should irrigate from 250 to 500 acres. This is on the basis of delivering the water in pipes or cemented channels in the immediate vicinity of the trees or vines to be irrigated.

If it is assumed that 1 miner's inch is allowed for 10 acres, or 1 second-foot for 500 acres, this quantity of water flowing from May to October inclusive, will cover the ground to a depth of a little over seven-tenths of a foot, or 8.8 inches, a quantity which, with the care and cultivation usually employed, has been found to be sufficient for some orchards. Mr. W. Irving, Chief Engineer of the Gage Canal, Riverside, California, states that for the year ending September 30, 1899, water ranging in depth from 1.78 to 2.48 feet was used in addition to the rainfall of 0 47 foot. This was less than the usual quantity economy being enforced by shortage of supply.

The method of applying water governs to a large extent the amount used. In the case of lucerne, flooding is usually practised; with small grains in most parts of the West the water is run in furrows; while in the case of orchards the water is sometimes applied directly to each tree. In this case a little earth basin, about 6 feet or more across and 6 inches deep, is formed around each tree and partially filled with water; The better way, however, is that of running water in furrows, four or five of these being ploughed between each two rows of trees. The water is applied very slowly, several days being

spent in watering 5 acres, and when dry the ground is thoroughly cultivated.

The annual charges for water by the acre in southern California, where this economy of water is practised, have been as low as $3, and from this rising to $6 or more per acre. In the case of the San Diego Flume Company, it is stated that water was sold for $600, per miner's inch, with an annual charge or rental of $60, 1 miner's inch being considered sufficient for from 10 to 20 acres. The annual charge for water, taking the arid region as a whole, has averaged by States from 50 cents to $2.00 per acre, or $1.25 (5s. 2½d.) per acre for the entire country.

The conditions in southern California, while they may be considered as exceptional, yet indicate the limiting or ideal conditions of economical use of water. For good farming in other parts of the arid region, 12 inches of water in depth during the crop season should be sufficient, except in the case of lucerne and other forms of forage which are cut a number of times, when at least from 4 inches to 6 inches should usually be given to a cutting. As previously stated the character of the soil, the temperature, and the wind movement introduce so many conditions that broad statements of this kind are merely suggestive and not to be followed as rules.

Irrigation is usually carried on during the daytime, and it is unusual for water to be applied during the night, other than to arrange the head gates and allow the water to flow to certain portions of the field. In times of scarcity, however, when water can be had only at certain hours, night irrigation must be carried on, and the water carefully applied, with as much skill as possible in the darkness. Night irrigation, although possessing disadvantages, has many advocates. The air being cooler, excessive evaporation is checked, there is less loss and consequently more economy in use and the plants are not so suddenly chilled as during the heat of the day when cold water is run upon the fields; and the proportional amount of water received during the night is often greater than during the daytime, and the charge of cost is correspondingly less; so that, for economy in various directions night irrigation is sometimes preferred.

LOCAL DEPOSITS OF BAT GUANO.

By H. H. Cousins, M.A., F.C.S., Government Analytical and Agricultural Chemist.

It has long been known that there are in Jamaica considerable accumulations of Bat Guano in caves and other sheltered places where these animals congregate. A good deal has been used in the past upon various estates in the island, and recently some commercial enquiry has arisen as to the possibility of an export trade in this material with the United States.

Some 35 different samples of 'Cave Earth' and 'Bat Guano' have been analysed at various times at the Government Laboratory by Messrs. Bowrey, Watts and the writer.

These results are here tabulated to indicate the great variations that occur in the manurial value of Bat Guano, dependent upon the conditions under which it has been produced.

Analyses of Jamaica Bat Guanos.

No.	Analyst.	Moisture.	Organic Matter.	Nitrogen.	Phosphoric Acid.	Potash.
1	Bowrey	30.9	12.8	2.3	0.7	...
2	"	23.0	29.8	3.5	0.8	...
3	"	33.6	39.9	5.3	0.5	...
4 to 8	"	..	...	...	0.9 to 7.4	...
9	"	17.4	57.1	5.5	4.4	...
10	"	42.8	28.2	2.1	8.5	1.3
11	"	19.9	72.3	9.3	2.8	1 3
12	"	19.6	57.9	10.5	5.7	1.7
13	"	20.1	43.3	7.6	10.1	1.5
14	"	8.6	38.9	2.6	13.8	0.9
15	"	41.0	18.6	2.3	11.2	...
16	"	45.9	39.6	7.6	3.5	...
17	"	37.3	15 6	...	9.8	...
18	"	48.9	35.0	...	4.8	...
19	"	45.2	30.2	...	7.7	...
20	"	45.2	21.9	...	8.0	...
21	"	33.3	21.0	...	9.6	...
22	"	48.3	46.6	8.9	2.2	0.8
23	"	35 6	48.7	5.2	2.8	1.9
24	"	26.0	42.9	2.6	7.7	1.6
25	"	61.9	27.3	1.4	1.9	0.3
26	Watts	28.4	43.9	4.9	5.6	4.7
27	"	27.3	28.7	2.9	4.8	2.1
28	"	18.6	20.6	1.2	7.5	1.1
29	Cousins	...	...	0.2	10.2	...
30	"	...	...	2.1	0.9	...
31	"	35.8	47.6	7.6	5.1	1.4
32	"	35.0	53.3	8.8	2.2	0.5
33	"	24.5	39.1	5.6	2.3	0 5
34	"	35.4	18.0	1.1	2.3	0.4
35	"	36.1	23.3	1.3	4.0	0.6
Average	...	30.9	33.4	4.5	5.3	1.3

Sample No. 11 represents the dried excrement of insectivorous bats of recent origin. This is marked by a high percentage of Nitrogen. Such a material should be worth about £6 per ton at current prices.

The commercial value of this product is chiefly based upon the con-

tent of nitrogen and this can only attain a high standard where the deposit is protected from the action of rain and of excessive moisture. Samples below 2 % of Nitrogen could scarcely be handled economically in Jamaica for local sale. For export a minimum of at least 6 % of Nitrogen would be necessary to cover expenses and make the sales remunerative to the owner of the deposit.

Sample 29 represents a deposit that has been freely washed by rain. It contains no more nitrogen than an average Jamaica soil, while the Phosphoric Acid is not sufficiently high to warrant its use as a source of Phosphates. No. 31 (from St. Thomas) represents a large deposit of high class Bat-guano that has been found to be an excellent fertiliser for sugar cane. This was valued at £4 per ton to the buyer allowing for 25 % latitude.

Samples 32-35 are the successive layers of a large cave deposit in St. Catherine of which No. 32 is the upper and richer layer. The amount of moisture in these deposits is, for export, excessive and should be reduced to 10 % by drying the material in the sun. A saving of 25 % in the bulk of the material could then be effected. Owners of caves are warned not to base their calculations upon the analysis of the top-layer only, since a gradational loss in nitrogenous materials is to be expected as the deeper layers of the deposit are drawn upon. In the case mentioned above the owner decided not to ship the deposit but to seek a local market for it.

Bat-Guano is, as the average figures show, a fairly well balanced manure. The better samples are principally nitrogenous in character. Considering the richness of many Jamaican soils in Phosphoric Acid, a good grade of Bat-Guano should prove an excellent fertiliser for Sugar Cane or Bananas ; on some soils it would be well to fortify it with Potash salts. In valuing a Bat Guano, I would suggest 9s. for each per cent. of Nitrogen per ton, 3s. for each per cent of Phosphoric Acid and 4s. for each per cent. of Potash per ton.

Thus sample 32 would be valued as follows :

Nitrogen 8·8 per cent at 9s.	=	79s. 0d
Phosphoric Acid 2·2 per cent at 3s.	=	6s. 6d.
Potash 0·5 per cent at 4s.	=	2s.
Total		87s. 6d

The "average" of all the samples gives the following valuation :

Nitrogen 4·5 per cent at 9s.	=	40s. 6d.
Phosphoric Acid 5·3 per cent at 3s.	=	16s.
Potash 1·3 per cent at 4s.	=	5s.
Value per Ton		61s. 6d

This estimate is based upon the current unit values of fertilisers delivered free at Kingston. I have deducted 25 per cent from the valuation of the Nitrogen to allow for 'latitude' or variability in the samples and for the inert properties of some of the nitrogenous constituents.

These values represent what, in my opinion, a planter would be justified in paying for a Bat-Guano for use on his estate.

SOME LOCAL REFUSE MANURES.

By H. H. Cousins, M.A., F.C.S.

In an agricultural community it behoves everyone to seek a useful application for any refuse materials capable of increasing the fertility of the soil. Some examples of such products that have been recently referred to the Government Laboratory for an opinion as to their value are here given :—

(1) *Pond Mud.*

This represents the mud cleared out of a pond on a sugar estate in Trelawny. On analysis it gave the following results :—

	Per Cent.
Moisture ...	5.81
Combined water and organic matter	15.72
Carbonate of Lime ...	1.18
Phosphoric Acid ...	1.60
Equal to Phosphate of Lime	3.49
Potash ...	0.09
Nitrogen ...	0.30

This mud is rich in Phosphates, deficient in Potash and fairly rich in Nitrogen. It should be of benefit to the soil on the estate if spread and worked in. The benefits arising from its use would be due as much to its mechanical properties as to its chemical composition.

(2) *Banana trash ash.*

Large quantities of Banana trash are collected at certain centres on the Railway where Bananas are unloaded. A sample of the ashes obtained by burning the accumulated heaps of this trash gave the following results on analysis :—

	Per cent.
Potash ...	6·86
Phosphoric Acid ...	3·23
equal to Phosphate of Lime ...	7 07

The estimated value of this is about £2 per ton. There are some soils in the island markedly deficient in Potash, to which this ash should be of the greatest benefit. As an illustration of such a soil, an analysis is here given of a property in Portland where Bananas have failed entirely.

The analysis indicates a soil of excellent quality in all respects except that of Potash which is decidely below the normal.

Soil Analysis.

Reference Number—64.
Source Details—Surface Soil from a property in Portland where Bananas have entirely failed.
Depth of Sample—9 inches.

Physical Analysis

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	2.21	Fine Earth
	Sand	...	5.15	
	Fine Sand	...	30.54	
	Silt	...	51.07	
Agricultural Clay.	Fine Silt	...	1.21 { 0.95	
	Clay	...	0.26	
	Moisture	...	9.82	
	Total	...	100.00	
			Per Cent.	
	Retentive Power for water	...	64.0***	

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble Matter	...	28 470
Soluble in Hydrochloric Acid	...	71.530***
Potash	...	0.175*
Lime	...	0.782**
Phosphoric Acid	...	1.138****
Carbonic Acid as Carbonate of Lime	...	1.250**
Combined Water and organic matter		19.710***
Humus (soluble in Ammonia)		5.290***
Nitrogen	...	0.369***
Hygroscopic Moisture	...	10.670***

Fertility Analysis.

Available Potash	...	0.006*
Available Phosphoric Acid	...	0.035****

Observations.

This soil consists almost entirely of silt and fine sand, with just a trace of clay. It is free-draining, and yet has a high absorptive power for water. In all these respects an excellent soil.

The Chemical Analysis shows an enormous proportion of *Phosphoric Acid,* of which a large amount is available for present use. The *Nitrogen* and *Humus* are both high, indicating a very rich condition of soil. The *Carbonate of Lime* is adequate. The *Potash* is rather low and the *Available Potash so low* that I conclude *that this factor limits the productive capacity of a soil that is otherwise in a state of exceedingly high potential fertility.*

I recommend a trial of

(1) Banana Trash Ash from Railway, 1 ton per acre.
(2) Wood ashes, 2 tons per acre.
(3) Sulphate of Potash, 2 cwt. per acre.

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(3) *Sheep Manure.*

In England Sheep manure is rarely collected in bulk, since the sheep are fed at large over grass lands or folded over the roots. In the

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*Below normal. **Normal. ***High. ****Very high.

tropics sheep are housed or sheltered and considerable accumulations of sheep manure are thus brought about.

If carefully managed, this manure is of high fertilising quality and is rightly appreciated by sugar-planters for use on exhausted soils.

An analysis of a sample from a pen in Westmoreland is given as an illustration of the relative value of this material.

Analysis and Report on a sample of Sheep Manure from Westmoreland.

"This sample contains.—

	Moisture	...	29.86 per cent.
	Organic matter	...	*56·58 "
	Sand and Clay	...	4·45 "
	Mineral Salts containing—	...	9·11 "
(1)	Phosphoric Acid	...	1·11 } "
equal to	Phosphate of Lime	...	2·41 }
(2)	Water soluble Potash	...	1·06 "
(3)	*containing Nitrogen	...	2.71 } "
equal to	Ammonia	...	3·29 }

Approximate weight per Bushel 36 lbs.

Mechanical condition—Fairly dry and friable.

I value it as follows:—

Nitrogen 2·71 % @ 12s.	...	32s. 4d.
Phosphoric Acid (soluable) 1·11 % @ 2/9		3s. 0d.
Potash 1·06 % @ 5s.	...	5s. 3d.
		40s. 7d.

This manure is therefore worth 40s. 7d. per English ton or roughly 8d. per bushel of 36 lbs. at current value for fertilizers. (1901)"

(4) *The Kingston City refuse.*

A large accumulation of the miscellaneous refuse of Kingston has been localised through the institution of a Deposit Ground.

An analysis was recently made at the request of His Worship the Mayor and a valuation at current fertiliser rates has been made. I estimate that it is worth about 12s. per ton f. o. r. Kingston. This leaves, of course, but a small margin for the cost of handling. This deposit could only be economically used within a limited range of Kingston, and would only be of commerial advantage upon an exhausted soil or a hungry soil under irrigation conditions.

Report on Analysis of Sample City Refuse from Deposit Ground.

The samples were taken with a soil-auger and mixed, 20 per cent. consisted of coarse stones and refuse of no manurial value. The residual 80 per cent. gave the following results:—

		Per cent.
Moisture	...	5.15
Volatile and organic matter		16.10*
Mineral matter	...	78.75**
Total	...	110.00

		Value per ton.
1. *Containing Nitrogen ...	0.735	7/6
Equal to Ammonia	0.893	
2. **Containing Phosphoric Acid	2.447	8/
Equal to Phosphate of Lime	5.351	
3. Potash ...	0.360	1/6
Lime ...	5.643	
Total value per ton of fine portions		17/

Estimated value F.O.R. Kingston = 12/ per ton.

HISTORICAL NOTES ON ECONOMIC PLANTS IN JAMAICA.

V. Tea.

The China Tea tree seems to have been first introduced into Jamaica in the year 1771 by a Mr. Baker under the name of the Bohea Tea Tree (Black Tea, *Thea Bohea*). At that time, and for long after, it was erroneously supposed that Green Tea was the product of another species, *Thea viridis*, and a plant of this was brought to the Island by the first Island Botanist, Dr. Thomas Clarke in 1775, and planted in the first Government Botanic Garden at Enfield, near the present Gordon Town. From these two plants, others were propagated for Mr. Wallen's garden at Cold Spring, and for Mr. Hinton East's garden adjoining Enfield. Both plants are mentioned by Dr. Broughton in his "Hortus Eastensis" as growing in Mr East's Garden in 1793.

Dr. James Macfadyen, in 1837, states in his flora of Jamaica that—

"The *tea plant* was introduced into the garden at Coldspring by the late M. Wallen, Esq. The house had for many years fallen into decay and the garden was neglected and allowed to grow up into weeds. Notwithstanding this, on clearing the land, for the purpose of planting it in coffee, about two years ago, the Tea trees were found to have survived, and young plants to have grown up. They are now in a very thriving condition, flowering and perfecting their seeds; and a supply of young plants may at any time be procured."

Mr. John MacLean, the late owner of Cold Spring showed the present Director of Public Gardens in the year 1887 Tea trees in Wallen's old garden, which after Dr. Macfadyen's time had again been overgrown and completely covered with bush, until disinterred by Mr. MacLean. Their condition showed that at that elevation they had come to stay, and were perfectly able to hold their own against native vegetation.

Kew Gardens, an establishment which has done so much for the Colonies in introducing new plants and affording scientific information on cultural products, sent out plants of Assam Tea as early as 1849-50 to Mr. Nathaniel Wilson, Island Botanist, at the Bath Garden.

Mr. Robt. Thomson in his Annual Report for 1868, says:

"A Ward case of Assam Tea, containing upward of six hundred plants arrived in excellent condition from India, via the Colonial Office."

Again in 1869, "Assam Tea.—Owing to the dry seasons in the early part of the year these plants were retained in pots, so that their

progress has been considerably delayed. Half an acre containing eight hundred plants, was planted out in August at a height of a little over four thousand feet at the Cinchona Plantation. The propagation of this plant from cuttings will be carried on during 1870 in order to increase the area cultivated to two acres."

Further, "The eight hundred plants of tea planted out in August 1869, at the Cinchona Plantation are in a vigorous state of health, indeed they are quite equal in this respect to the finest coffee plants of the same age I have witnessed anywhere.

"The plants now range from three to five feet in height, have recently blossomed freely, and have a good crop of seeds set, from which they can be propagated to a large extent in a few months. There are several distinct varieties among these plants, which like the Cinchona, may be turned to account by selecting and adapting them to the altered circumstances of climate. The necessary conditions of altitude, soil and continuous moisture for the successful cultivation of this great staple commodity, are obtainable over a vast extent of the hilly districts, and, considering the favourable geographical position of Jamaica together with the desirability of introducing new products, I would submit to the favourable consideration of the Government the advisability of establishing an experimental plantation of ten acres." (Report, 1870-1871.)

In 1872-73 experiments in making tea were made:

"The eight hundred plants of this valuable variety of Tea that were planted at the Cinchona Plantation four years ago have grown with great luxuriance, and have already become naturalized, consequently the plant can be increased to any extent. Samples of Tea of superior quality have been manipulated by a Coolie who had been employed in the Assam Plantations."

Again in 1873-74, we find: "Several lbs. of the Assam variety of this plant were prepared by a Coolie who had some knowledge of the process; these samples proved of fair quality. More skilled manipulation is, however, necessary to produce Tea of good quality. This plant could now be propagated to any extent, and it grows with the greatest luxuriance."

In 1874-75, "Fair samples of the Assam variety of Tea have been manipulated. No plant in the island grows with more luxuriance and facility than this, and I see no reason why it could not be extensively grown. For example, Jamaica has maintained her position in the markets of the world with regard to Coffee, notwithstanding the almost universal competition. Many thousands of acres of land on the slopes of the Blue Mountain Range are admirably adapted to this product, and this land is quite unsuited for Coffee culture owing to its being too humid. The value of the Tea exported from Calcutta to Europe has increased in ten years from a quarter of a million to two millions of pounds sterling."

In a "Report on the Jamaica Collection of Products at the International Exhibition at Philadelphia, 1876", Mr. Thomson writes:—"The Judges at the Exhibition considered the Tea of good quality and accordingly awarded a medal for same."

In December, 1883, Dr. Morris, at that time Director of Public

Gardens and Plantations. addressed a letter on this subject to Government, as follows :—

"The small plantation of Tea, established at an elevation of 5,300 feet near the Latimer fields of the Government Cinchona Plantations, is in a thriving state as regards the growth of the plants, many of which are from 9 feet to 12 feet high. With the exception of some small samples of Tea prepared for exhibition purposes—one of which obtained a Gold Medal at Philadelphia in 1876—no attempt has hitherto been made to utilize these Tea plants. Both in the Annual Reports and in other publications issued by this Department attention has been called to the existence of this experimental Tea plantation; and seed has been distributed from time to time amongst private planters in the hope of drawing their attention to the facilities which the Island offers for a Tea industry. So far, however, nothing has been done with Tea in Jamaica by private parties, beyond planting a few trees in gardens for ornamental purposes. But with the influx of planters from Ceylon, possessing practical acquaintance with the cultivation and curing of Tea, I am hopeful a start will soon be made to prepare Tea, if only, as in the early days in Ceylon, to supply local demand.

As mentioned in my late paper, read before the Royal Colonial Institute, I estimated that with indentured coolie labour and an experienced planter from Ceylon and India, Tea might be grown in the West Indies and placed in the market at a cost not exceeding 7½d or 8d. per pound. At the present time very inferior Chinese Tea is sold in Jamaica at 4s. 6d. to 5s. per pound. Hence there is here a very good opening for a Tea industry.

The plants at present in Jamaica were received through the Royal Gardens in 1868, and their existence here indicates with what foresight and intelligence these Gardens have contributed to the furtherance of colonial interests, and to laying the foundation of local industries."

To this letter Sir Joseph Hooker, Director of Kew Gardens, replied through the Colonial Office as follows :— "It appears from a letter of Sir Joseph Rogers that in 1868 Assam Tea plants were forwarded from Kew to Jamaica. The variety most in favour at present in India is what is called the Assam hybrid, and I think that the introduction of this into Jamaica is probably the best step to aim at. Tea seed is generally regarded as difficult of transmission, inasmuch as, like most oily seeds, it rapidly loses its vitality. In the course of last year, however, the Lebong Tea Company forwarded to the Royal Gardens a box of seed in excellent order which germinated freely. Application has, therefore, been made to this Company for its good offices in meeting the request of the Jamaica Government, and I now transmit copies of letters received from the Secretary showing what has been done in the matter. From these seeds, when they arrive, as a matter of precaution, a supply of plants will also be raised to be forwarded to Jamaica as well as the remainder of the seed."

In his Annual Report for 1883-84, Dr. Morris draws attention to its economic value as an industrial plant for Jamaica, and recommends it to the serious and thoughtful attention of planters. He continues as follows :—

"Several samples of an excellent Tea have lately been prepared at the

Government Cinchona Plantations, one of which was lately sent to the New Orleans Exhibition. The process of manufacturing Tea is certainly one that requires care and judgment; but men who can prepare and cure the celebrated Blue Mountain Coffee of Jamaica, should find little difficulty in learning the details of Tea curing. The advantages as regards Tea are that no sun is absolutely required and no water. The Tea plant is most hardy: it will grow in the old soils of abandoned coffee fields, as proved in Ceylon, and it will thrive in Jamaica at all elevations. from about 80 feet to nearly 6,000 feet. To secure the best results it is advisable to plant Tea in moist, warm and somewhat sheltered districts."

Two consignments of Hybrid Tea seeds were received from the Royal Gardens, Kew, in 1885, and some 3,000 plants were raised and planted out in two places.

Samples of Tea were forwarded in 1886 to the Indian and Colonial Exhibition.

From 1885 to 1888 seeds and plants were supplied from time to time for trial on an estate near Portland Gap; the plants grew and multiplied, but nothing was done on a commercial scale.

In the Reports on the Colonial and Indian Exhibition in London, 1886, Mr. A. G. Stanton, the Tea Expert, writes at considerable length on the exhibits of Tea, and speaks as follows of the exhibit from this island which was prepared under the direction of Mr Hart, now Superintendent of the Royal Botanical Gardens, Trinidad:—"The four samples exhibited in the Jamaica Court are from the Botanical Gardens. They are delicate in flavour, and of good quality, and show knowledge of manufacture and careful preparation, although the colour of the dry leaf is rather too grey. Pekoe Souchong is the only kind represented."

In 1887 the present Director sent samples to Kew to get the opinion of Tea Brokers and to test the merits of an evaporator for drying the Tea. The following was published in the Bulletin for March, 1888:—

"Tea.—The evaporator has been tried in the mannfacture of Tea at Cinchona. Three samples were sent to Kew with the view of testing whether the machine dried Tea was superior to that cured on iron over a fire. A sample of the latter was labeled No. 1, the samples of the machine Tea were called Nos. 2 & 3. These samples were sent to England, unfortunately, in mustard tins, which impaired their value considerably, and this is what the Brokers refer to in their letter and report subjoined:—

A. G. Stanton, Esq., to Royal Gardens, Kew.

3, Rood Lane London, E.C., 21st December, 1887.

I duly received your letter of the 29th instant, together with the three samples of Jamaica Tea.

As I have given in the enclosed Report a pretty full statement of the various characteristics of the samples, I will only here add that the liquors of all are very serviceable for the London Market; the samples are all slightly impared, No. 1 being especially so.

I shall always be happy to report upon any samples and to do what-

ever I may be able in the way of assisting intending Planters with any information or suggestions which they may require.

Believe me, &c.

(Signed) A. G. STANTON.

Messrs. Wilson and Stanton to Royal Gardens, Kew.

13 Rood Lane, London, E C., 31st December. 1887.

We beg to hand you our characters and valuations of Packages of Tea per mail from Jamaica :—

Sample.	Species and Character.	Value per lb.
No. 1	UNASSORTED TEA ... ... The dry leaf is well rolled but is much too grey in colour, and wanting in tip ; somewhat uneven and inclined to be dusty. The liquor is fairly dark and full with some flavour. The infused leaf is regular and of a fairly bright colour.	£0 1 1
No. 2	UNASSORTED TEA ... ... The dry leaf is good colour but is too crinkley, and has not been properly rolled. The liquor is dark and full, and of a nice flavour. The infused leaf is regular and of a fairly bright colour.	0 1 2
No. 3	BROKEN ORANGE PEKOE ... ... Dry leaf is good colour, and with a few tips ; but is rather open, ragged and too uneven. The liquor is dark, full, and of good flavour. The infused leaf is bright and regular.	0 1 8
General	The above Teas are chiefly valuable in the London Market on account of their liquors, the manipulation of the dry leaf being faulty. We prefer the samples marked Nos. 2 and 3, the leaf being better in colour ; and liquors of finer quality and flavour. No. 1 is too soft in liquor and resembles China Tea, Nos. 2 and 3 being more like Ceylon Tea. All the samples have a peculiar smell, and taste of some substance quite foreign to Tea ; for this defect we have made due allowance in our Report. The leaf of No. 1 is quite *limp* instead of being crisp, the sample has probably been damaged in transit. (Sgd.) GOW. WILSON AND STANTON."	

A few years ago seeds and plants were supplied to the Hon. H. Cox who has planted out about 60 acres at Ramble, St Ann. He has also obtained the latest Machinery, and has turned out Tea of excellent quality.

During last May, Mr. C. Royal Dawson, a well known Tea-planter from the Wynaad, India, visited Jamaica, and saw the Tea growing in St. Ann and also in the Blue Mountains. He writes to the Director as follows ;

"I have formed a very favourable impression of my visit. The Tea in the Blue Mountains, in spite of abandonment and neglect, proves beyond a doubt that it can hold its own. Both varieties, Assam and China, looked most luxuriant, but the latter, notwithstanding, is not the right sort for producing flushes. The Assam is decidedly the best for the island, and on the Blue Mountains at from 3,000 to 6,000 feet should pay well to cultivate. All valleys in the Blue Mountain range ought, in my opinion, to grow as good Tea as Coffee."

AN EARLY JAMAICA BOTANIST.

Arthur Broughton—a son of the Rev. Thomas Broughton (1704-1774), prebendary of Salisbury and vicar of Bedminster near Bristol, a miscellaneous writer of some merit - took the degree of doctor of medicine at Edinburgh in 1779. He was elected a physician to the Bristol Infirmary in May, 1780. He published anonymously a volume of brief diagnoses of British plants. In the December of 1783 he came to Jamaica, intending to return to Bristol, as he received formal leave of absence from the Infirmary. In 1786 his post was filled up, his successor being appointed for a year only on the understanding that if Broughton returned he would resume his office. He died at Kingston on May 29th 1796: the Dictionary of National Biography, misled by some remarks of Wiles, suggests 1803 as the year of his death.

His name is preserved in the genus of orchids named *Broughtonia* by Robert Brown.

Nothing is known of his life in Jamaica, Unfortunately there is not in the Library of the Institute any daily paper of the exact time of his death, which is, however, briefly recorded in the "Columbian Magazine."

He apparently practised medicine here, and devoted his leisure to botany. The garden, the plants of which he catalogued, at first the property of Hinton East, then of the public, is still known as Gardens House; it is situated just above Gordon Town. Broughton's name is not recorded amongst the members of the Kingston Medical Society, which (the Jamaica Almanac for 1795 tells us) was instituted on the 4th of September, 1794, by the medical members of the Jamaica Humane Society and other medical gentlemen in Kingston in consequence of a malignant fever which raged in 1793 and 1794 and baffled the power of medicine for many months.

The following is a list of Broughton's works:—

1. Dissertatio medica inauguralis de vermibus intestinorum. *Edinburgii*, 1779. 8vo.

2. Enchiridion botanicum, complectens characteres genericos et specificos plantarum per insulas Britannicas sponte nascentium, ex Linnæo aliisque desumptos. *Londini*, 1782. 8vo.

3. Hortus Eastensis or a catalogue of exotic plants in the garden of Hinton East Esq., in the mountains of Liguanea in the island of Jamaica. * * To which are added their English names, &c. *Kingston, Jamaica*, 1792, 4to.

The same. A Catalogue of the more valuable and rare plants in the Botanic Garden in the mountains of Liguanea in Jamaica. *St. Jago de la Vega*, 1794. 4to.

The same. New ed. [by James Wiles]. *Jamaica*, 1806. 4to.

The "Hortus Eastensis" was reprinted by Bryan Edwards in his "History of the West Indies." With the exception of this reprint, none of Broughton's works is in the Library of the Institute of Jamaica.

F. C.

METHODS OF CORN BREEDING.

At the Association of American Agricultural Colleges and Experiment Stations last October, Dr. Hopkins of the Illinois Experiment Station read a paper on this subject which was of special interest.

Some experiments have been made in Jamaica by Mr. Palache, one of the Instructors of the Agricultural Society, and by Mr. Barclay, the Secretary, in the selection for seed of the finest ears and the largest grains, but nothing has been done on the lines indicated by Dr. Hopkins,—selection by examination of the grain.

He points out a grain of corn is not uniform all through, that there are three distinct parts which may be readily observed by cutting the grain across with a penknife, and that these parts differ in their chemical composition and their value as food for either man or stock.

These three parts are :

(1) The dark coloured and rather hard and horny layer lying next the hull principally in the edges and towards the tip end of the grain.

(2) The white starchy-looking part near the crown end of the grain.

(3) The germ which occupies the central part of the grain toward the tip end.

The illustration* shows two grains cut across :

A has more of the horny part in proportion to starch and also a larger germ than B.

The horny layer which usually constitutes about 65 per cent. of the corn grain contains a large proportion of the total protein in the grain.

The white, starchy part constitutes about 20 per cent. of the whole grain, and contains a small proportion of the total protein. The germ constitutes only about 10 per cent. of the corn grain ; but, while it is rich in protein, it also contains more than 85 per cent. of the total oil content of the whole grain, the remainder of the oil being distributed in all of the other parts.

By keeping in mind that the horny layer is large in proportion and also quite rich in protein, and that the germ, although rather small in proportion is very rich in protein, so that these two parts contain a very large proportion of the total protein in the corn grain, it will be readily seen that by selecting ears whose grains contain more than the average proportion of germ and horny layer we are really selecting ears which are above the average in their protein content. As a matter of fact, the method is even more simple than this, because the white starchy part is approximately the complement of, and varies inversely as, the sum of the other constituents; and to pick out seed corn of high protein content it is only necessary to select those ears

*Cliché lent by Dr. Morris, Commissioner Imperial Department of Agriculture.

whose grains show a relatively small proportion of the white, starchy part surrounding the germ.

All the grains of corn in any one ear are almost identical in their chemical composition, so that the whole ear may be judged by one grain.

There is a wide variation in the chemical composition of different ears even in the same patch of corn, so that it is quite possible to alter the character of the crop year by year, by selecting on simple inspection so as to increase, as may be desired, either the starch or the protein.

For a satisfactory breeding plot, about 20 to 40 selected seed ears are required. If the breeder desires to make only physical improvement then he should select, say 40 of the most nearly perfect ears which it is possible to pick out. If it is desired to improve the composition or quality of the corn as well as the physical properties, then at least 200 perfect ears should be selected, and from these 200 ears the 40 ears which are most suitable as seed for the particular kind of corn which it is desired to breed should be selected.

The 40 selected seed ears are planted in 40 separate parallel rows, one ear to a row, consequently the breeding plot should be at least 40 corn rows wide and long enough to require about three-fourths of an ear to plant a row. It is well to shell the remainder of the corn from all of the 40 ears, mix it together, and use it to plant a border several rows wide entirely around the breeding plot, to protect it, especially from foreign pollen.

The very best ears of seed corn are planted in the centre rows of the breeding plot, the remainder of the ears being planted in approximately uniform gradation to either side, so that the least desirable ears among the 40 are planted in the outside rows; and in the final selection of the best field rows from which the next year's seed ears are to be taken, some preference is given to the rows near the centre of the plot.

Dr. Hopkins recommends that every alternate row of corn in the breeding plot be completely detasseled before the pollen matures and that all the seed corn to be taken from the plot be selected from these 20 detasseled rows. This method absolutely prohibits self-pollination or close-pollination of the future seed. By self-pollination is meant the transfer of pollen from the male flower of a given plant to the female flower of the same plant; and by close pollination is meant the transfer of pollen from the male flower of one plant to the female flower of another plant in the same row, both of which grew from kernels from the same seed ear.

The transfer of pollen from one plant to another plant which grew from kernels from a different seed ear, is termed cross pollination.

It is also recomended that in the 20 rows of corn which are not detasseled, no plant which appear imperfect, dwarfed, immature, barren, or otherwise undesirable, should be allowed to mature pollen. Detasseling is accomplished by going over the rows two or three times and carefully pulling out the tassels as they appear.

Occasionally an entire row is detasseled because of the general inferiority of the row as a whole.

As the corn approaches maturity it is time to begin at the real beginning in the selection of seed corn; that is with the whole corn crop and the whole corn plant, as it stands in the field.

The first selection is then made of seed corn from the field rows (each of which is the progeny of a separate single ear) on the basis of performance record. Each of the twenty detasseled rows is carefully examined. Some of them are discarded for seed purposes by simple inspection, and with some rows this decision may be made early in the growing season; because, when each field row is planted from a separate individual ear, that row has an individuality which in many cases is very marked. It may show very imperfect germination (in the most careful work the germinating power of each ear is ascertained before planting), it may be of slow growth, produce small weak plants, or numerous barren stalks. The plants may be tall and slender or very thick and short. In one row the ears may be borne high on the stalks, while in the adjoining row they may average one or two feet nearer the ground. One row may yield more than twice as much corn as an adjoining row on the same kind of soil. As a matter of fact when one begins to breed corn by the row system (one seed ear to each row), he is usually surprised to find that the plants in some rows are so very different from those in others.

No seed corn is taken from a row which produces a large proportion of imperfect plants, barren stalks, small ear or a low yield, even though a few apparently good seed ears might be found in the crop which that row yields.

The points to be considered in the selection of the field rows, and finally in the individual plants from which seed ears may be taken should include the per cent. of "stand" of plants, the height and physical proportions of the plant, the character and amount of foliage, the position of the ear on the stalk, the length and size of the ear shank, the per cent of ear-bearing plants, the time of maturity, the total yield of the row, the average weight of the ears, and the number of good seed ears which the row produces.

Some of these points can be determined by inspection, some require actual counts and measurements or weights.

The corn from each of the detasseled rows which have not been rejected by inspection is now harvested. First, all of the ears on a row which appear to be good ears and which are borne on ood plants in a good position and with good ear shanks and husks are harvested, placed in a bag with the number of the row, and finally weighed together with the remainder of the crop from the same row. The total weight of ear corn which the row yields is the primary factor in determining the 10 best rows from which all of the 200 ears for the next year's selection must be taken; and yet no corn breeder should follow even this rule absolutely or blindly. If it should happen that one of these ten best yielding rows, although slightly higher in yield, is nevertheless plainly inferior to some other row in the number of good ears produced, the row selection should be changed accordingly. Yield is of first importance, but it should not exclude all other points. It is more practical and profitable to produce 99 pounds of good ears than 100 pounds of nubbins, Other things being equal, or nearly so, preference is also given to the rows nearest the centre of the field.

In the final selection of the 40 seed ears as many as possible of the ten best field rows should be represented, slight advantages in chemical composition are frequently sacrificed for the sake of having such a

large representation, because of the possible future evil effects of too close in-breeding.

Each lot of 20 ears (more or less) from each of the ten best rows and finally each single ear of the 40 seed ears ultimately selected is kept labeled, and permanent records are made of the number and the description of the ear, the composition of the grain, performance record of the row, &c., so that as the breeding is continued an absolute pedigree is established, on the female side, for every ear of corn which may be produced from this seed so long as the records are made and preserved. It is known also that there is good breeding on the male side although the exact individual pedigrees of the males cannot be known and recorded.

CINCHONA CULTURE IN INDIA AND JAVA.

Professor Verne, who was sent by the French Minister of Instruction to investigate the cinchona culture, mentions the following interesting facts in his report: The Indian plantations are found about 27° north latitude, 3,600 feet high, in a territory having temperature ranging between 28° and 85° F. The mechanical labour is performed by the natives, who receive from $1 to $1.70 per month, without food according to age and sex. The favorite species of cinchona is the C. ledgeriana. The plants are raised on mossy ground, sheltered from the winds one side by a hill and on the other side by thickets of bamboo, the young shoots being particularly susceptible to sudden changes of temperature By the third year after planting, the tree is sufficiently grown to permit the removal of bark, which grows on again within three years without recourse to mossing operation. The same system is in vogue in Java, where, however, the variety of cinchona is not the English C. ledgeriana (Howard's), but the C. ledgeriana of Moen, the latter being found to yield 9 per cent. of quinine; or, if only the trunk bark about a metre above the ground is chosen, it yields 14 per cent. of quinine. On the other hand, the English C. ledgeriana assays on an average 4 per cent. In Java the cultivation of the latter variety is abandoned; while C. succirubra planting is diminishing. In both the English and Javanese plantation a very large source of profit is the manufacture of quinine on the spot from small and defective pieces of bark, unfit for shipment. Particularly striking is the method of quinine extraction as practised in Java, it simply consisting of treating the powdered bark with a 5 per cent. solution of caustic soda, heated to 50° C., throwing this mechanically agitated mass into a reservoir containing Java petroleum of specific gravity ·999, removing the petrolic solution of alkaloids by mechanical devices into a warm reservoir, into which is poured water acidulated with sulphuric acid. This watery layer is removed, evaporated and from the concentrated solution the quinine sulphate separates by crystallization, which it is not necessary to recrystallize, since it contains only one-half of 1 per cent. of cinchonine. Of such quinine 50,000 kilogrammes are exported annually to the United States. The special reason of the success of this quinine manufacture is due to the exceedingly clever mechanical devices used in the extraction.—*(Am. Journ. Pharm.)*

BOARD OF AGRICULTURE.

The monthly meeting of the Board of Agriculture was held at Headquarter House on 16th June last at 9 o'clock. The members present were Hon. W. Fawcett (Chairman), Hon. T. H. Sharp, Messrs C. A. T. Fursdon, H. H. Cousins, J. W. Middleton and J. Barclay (Secretary).

The Secretary read letters from His Excellency the Governer appointing (1) Hon. W. Fawcett to act as Chairman of the Board in the room of the Colonial Secretary, Hon. Sydney Olivier, (2) Hon. T. H. Sharp to act as a member of the Board during the leave of absence granted to the Archbishop of the West Indies, (3) Mr. J. W. Middleton, to act as a member of the Board during the absence from the colony of Mr. C. E. deMercado, (4) Mr. T. L. Roxburgh, Acting Colonial Secretary, to act as a member of the Board in the absence on leave of Hon. S. Olivier.

A letter was read from the Hon. J. V. Calder, stating that he could not attend the meetings so early as 9 a.m.

Horse-Breeding.—Mr. Cousins submitted a minute with regard to the horse-breeding industry, in which he stated that he had sent out circulars to 70 gentlemen whose opinions and views were desirable to obtain. Only a portion of the replies had yet been received, but he hoped to be able to present a report at the next meeting of the Board.

Educational.—The question of a successor to Mr. Buttenshaw was discussed and Mr. Cousins was asked to report on the matter.

Mr. Cousins submitted a minute relative to agriculture in the elementary schools, asking if the Board would consider the possibility of improving the standard of school gardens throughout the Island.

A Committee consisting of the Acting Chairman and Messrs. Middleton and Cousins was appointed to consider and report.

Experiment Station.—A minute from Mr. Fawcett on the tobacco crop at Hope was submitted, giving an account of income and expenditure which was considered satisfactory.

Travelling Instructors.—Three reports and an itinerary from Mr. W. J. Thompson, Travelling Instructor, were submitted. These reported meetings at Above Rocks, Mount Fletcher (Port Royal Mountains) Water Mount, Old House, and Point Hill districts in the St. Dorothy district of St. Catherine. He had also visited Somerset, Cedar Valley, Dallas Castle and Linstead, the visit to the last-named place being to report on orange trees in the district.

Two reports from Mr. Cradwick were submitted giving particulars of the spraying of coco-nuts for disease in the Content district of Hanover, and of visits to Montego Bay, John's Hall, Lotten, Chatham, Adelphi, Western Favel, Maiden, Springfield, Ginger Hill, Miles Town, Balaclava, (where he started a local Agricultural Society), Hopewell, Jericho, Green Island, Lances Bay, St. Simons, Richmond, Kendal Grains, Flamstead, Guerney Mount, Pondside, Brownsville, Cascade, Maryland, and Askenish. He reported favourably on districts of Malden and Springfield in St. James, as containing splendid land for cocoa, but none was growing, and the large district of Ginger

Hill, in St. Elizabeth. as a splendid district for bananas and cocoa, but neither was grown there so far.

Banana Lands.—A memorandum on the exhaustion of potash on banana lands was submitted, with a minute from Mr. Cousins on the subject, which was offered for publication in the Agricultural Society's *Journal.*

Woodpeckers.—A letter from the Acting Colonial Secretary with regard to Woodpeckers was read, in which it was stated that His Excellency the Governor in Privy Council had considered the question of removing these birds from the list of protected birds, and decided that they should not be removed.

Prison Farm.—A letter from Mr. J. T. Palache was read asking if he could be permitted to take representatives of the Branch Agricultural Societies in Manchester, to see the cultivation at the Prison Farm, and if these could get free passes on the Railway.

It was decided to consider the matter of offering reduced fares to approved parties of six members of branch societies generally for the purpose named.

Bees Wax.—A minute from Mr. Cousins was read reporting that he had analyzed samples of bees wax taken by the Constabulary all over the Island, and these were all found to be genuine.

The meeting adjourned to 14th July.

CITRUS FRUIT CULTURE.

By J. W. Mills. *

Working-over old Orchards.

In every fruit district the introduction of inferior varieties necessarily causes much loss to growers, as it is expensive to replant or to work over old orchards. This is the price that horticulturists willingly pay for new and improved varieties. The orange-growers of southern California have experimented with almost every known variety, and have been compelled to abandon a number that once were popular. The heaviest loss incurred was because of the inferior Australian Navel which preceeded the Washington Navel and sufficiently resembles it in growth to have been sold in numbers of cases for that far better variety. In recent years many trees of Australian Navel, Mediterranean Sweet, and seedlings have been rebudded to the Washington Navel and its improved types.

While it is easy to perform the operation of budding, it requires special knowledge and skill to get the new tree-top rightly started and through the first season. Even an old orange tree will take buds in the main branches or trunk, and will produce a luxuriant growth from the buds the first year, if properly managed. But if such trees lose their tops after the first summer's growth, they are usually worthless or are not profitable for years. In such cases it is better to take out the trees and plant young budded trees from the nursery.

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* University of California, Agricultural Experiment Station, Bulletin No. 138.

The Method of Re-budding Trees.—Old Mediterranean Sweets are among the most difficult of citrus trees to re-bud, and very poor results will be obtained if they are handled by ordinary methods. Mr. E. L. Koethen and Mr. O. D. Wilheit, of Riverside, have been very successful in budding-over all kinds of old citrus trees, including Mediterranean Sweets. They trim out all branches that are not used to insert buds into, and then thin out the remaining branches above where the buds are inserted. This is done early in the spring, and at the time of budding. The removal of surplus limbs directs the entire flow of sap into the branches containing the buds, which results in their healing-over quickly and becoming well united. Upon the removal of the tops of the trees, the buds start at once. All saw cuts are covered with some material that will exclude the air, usually grafting wax, though Mr. Koethen has experimented with thin putty and finds it much cheaper, more durable, and not injurious to the tree. After the tops are removed, the trees should be whitewashed to prevent sunburn.

Value of "Cured" Buds.—The best success comes from using "cured" buds these are buds that have been cut from the tree and kept in damp sand or moss for a few weeks before using. When treated in this way they become tougher, and when inserted into a tree that has freely-flowing sap they absorb it more readily. When buds are well cured, and not allowed to become either too wet or too dry, they are not easily injured in handling. The delicate germ is very brittle when the scion is first cut from the tree, and the slightest touch will sometimes destroy it.

Placing the Bud.—The incision which is to receive the bud is made by running the knife down the side of the branch or trunk of the tree. The cross cut is made at the lower end of the incision instead of at the top, as is the usual method, and slants upward. By giving the knife a slight twist before removing it from the last cut, the two corners are turned out, which, with the upward slant, forms an opening, into which the bud slips easily. Narrow strips of waxed cloth are then wrapped around the limb, completely covering the inserted bud and the incisions. The insertion of the buds from below gives better protection from rain and dew.

When to remove the Bands.—These waxed bands are allowed to remain on the buds for from four to six weeks, according to the weather. During such a season as the spring of 1901, which was cool and damp, citrus trees make very little growth. Under these circumstances the waxed bands should remain a longer time. The bands were removed from the buds after four weeks (the usual period) in a number of cases in the Pomona Valley in 1901, and they generally died, but in the same year when the bands were allowed to remain on the buds for six weeks the result was satisfactory.

Removal of the Tops.—There are three usual mothods of removing the tops after budding: (1) the removal of the entire top at the time of taking the bands from the buds; (2) the removal of all branches but one, which is left to draw sap: and (3) the girdling of the limbs above the buds while still retaining the entire top for one year.

When the first method is practised and proper protection is given to the buds and young top during the first year, better results seem to be obtained than by any other way. The new top receives the entire

nourishment afforded by the tree; with frequent pinching-back of the new branches, the wood can be hardened and better matured before winter, and the leaves become thick and heavy, affording much frost-protection . .

The second practice of *leaving a side branch on the tree* to "draw sap" is a safe method, and will sometimes save a tree if the buds fail to grow; but when budding is skillfully done there is no need of leaving side branches.

Girdling the branches above the buds after they have healed over and the bands have been removed, while leaving the tops on until after the first winter, is not practised widely, but has some ardent advocates. The top when thus left continues to draw enough sap to keep alive, and to ripen a crop of early and poor fruit. The removal of such a top after the buds have made one year's growth is sometimes difficult without injuring the new head The chief advantage for this method is that the old top forms a covering for the new head, obviating the necessity of wrapping it for protection against frost. Trees handled in this way have made a better record than adjoining trees that had the tops cut off at the time when the bands were removed from the buds and were left unprotected during the first winter. . .

The old-time method of cutting off the entire top of a tree so as to bud upon suckers is now considered a poor way, as a year of time is thereby lost.

Pruning and Shaping trees.

The tendency of young trees of Washington Navel and some other varieties to assume a drooping habit when making a vigorous growth is due to the fact that the soft shoots are unable to support the weight of the large, heavy leaves. Mr. Reed writes: "It cannot be expected that the soft, succulent shoots will grow upright when they are weighed down with the great fat leaves that vigorous young Navel trees always produce, but if they are pinched back they will soon begin to straighten up. If this method is followed, a Washington Navel tree can be made symmetrical and upright. I make it a point to visit every one of my young trees several times during the season and pinch back shoots."

Even trees that have been long in bearing will be benefited by pinching back every branch that takes too vigorous an upward growth. This pinching process is especially necessary with trees from one to five years old.

Pruning Bearing Trees.—The advantage of an upright tree over a drooping one is considerable when it becomes loaded with fruit. The crop is borne with less breakage of limbs, and not so much fruit is injured with the winds. After they are in full bearing, there seems to be no pruning that will promote the health of the trees or improve the crop, other than cutting out limbs that project abruptly from the side, or those that make a sudden skyward growth, and the constant trimming out of dead or stunted wood that is found on the inside of the trees.

If too close, the branches of a tree should be thinned out from the inside until the sunlight has had free access. This does not make any noticeable difference in the appearance of the tree, but makes it bear fruit on the inside. Such fruit is safe from sunburn and frost, and

packs as "fancy" grade. By early attention to pruning, the trees need never be allowed to grow too close in the centre.

Renewal of Tops.—There are some groves of old orange trees that do not respond to the best treatment that the owners can give them. Under such circumstances, the most effective way to stimulate new life and vigour is sometimes to remove the entire top, leaving enough of each of the main limbs to distribute equally the suckers that will afterward make the new top of the tree. If the tops are only thinned out and but partially cut back, there will be a proportionate amount of feeble growth and a corresponding lack of productiveness. An old orange tree will rapidly produce a new top, even when cut back to a mere stump. It is soon in a condition to bear again at its full capacity. When the roots are healthy and the soil is properly cultivated and fertilized, the orange tree appears able so produce several generations of tops on one stock. But it will generally be found that the trouble with old, non-productive trees lies in the root-system, or in the management of soil, or in both. Thorough investigation of roots and soil should be made before any severe cutting or pruning of the top is resorted to.

Except as noted in preceding paragraphs, all trees should be trained low for protection against frost, heat, and wind, and to aid the gathering of fruit. Heavily-laden branches are generally propped to prevent breaking down, as the loss from dropping and splitting is so great that the trees cannot be safely lightened by thinning of fruit when small.

CULTIVATION AND IRRIGATION.

During the past seven years the substation grove has been ploughed deeply at least twice north and south one year, and twice east and west the next. Every year the plough turns up masses of fibrous roots that grow just below the reach of the cultivator teeth, in the strip of land between the trees in the rows running in the direction of the last ploughing. These roots grow from five to twelve inches below the surface during the winter and spring when the soil is kept moist by rains. Their presence shows the upward tendency of the feeding roots of orange trees when left to grow naturally under favourable conditions.

The extent to which the root-systems of orange trees can be influenced by orchard treatment seems to be very limited.

The deep-rooting tendency of the sour orange is observable in both light and heavy soils, while the roots of the sweet orange, and in a lesser degree those of the pomelo grow near the surface in all kinds of soil during the seasons of their most rapid growth, and the only way in which they can be forced to a lower depth is to plough deeply and apply irrigation water as low as practicable. As orchardists cannot with present facilities afford to plough deeper than ten or twelve inches, the fibrous roots will mostly be found just below that depth. Even after trees become old and well established their fibrous roots continually seek the surface soil, unless deep ploughing and deep irrigation are persistently practised. One orchard near Pomona, which has been ploughed deeply from the time it was planted and irrigated in deep furrows, bore four and a half boxes of fruit per tree at the age of eleven years. An adjoining orchard that was never ploughed, but was cultivated frequently and irrigated in furrows made with a "bull-tongue" attach-

ment, produced but three and a half boxes of poorer oranges at the same age. The former orchard is budded on sour stock, which, as heretofore shown, roots deeply, and it received a liberal amount of fertilizers; while the latter orchard is budded on the shallow-rooting sweet-stock, and received but a moderate amount of fertilizers. The more productive of these two orchards evidently has the better root-system; it has also been ploughed deeply and irrigated in deep furrows —therefore it never shows the need of water before the regular irrigation date comes around. On the other hand, the less productive orchard, which is on surface-rooting stock and has received much shallower culture and watering, shows signs of drought before each irrigation date. In the case of orchards on the same stock, the value of deep ploughing and deep irrigation is also very marked.

The So-Called "Hardpan."—The orange tree is a native of tropical forests, where it obtains warm soil and abundant moisture within easy reach. Its successful culture in countries like California, which lack summer rains and moisture-laden atmosphere, is necessarily to some degree artificial and a notable triumph of modern horticulture. In order to achieve the highest results, it becomes more and more essential that the grower shall keep the soil in the most perfect condition, shall apply all needed water and plant-food in sufficient but not in excessive amounts, and shall pay especial attention to keeping the feeding roots as low as practicable and to preventing the formation of what is called "hard-pan," but is only the well-known "plough-sole," aggravated by shallow irrigation.

"Hardpan," some growers say, appears now where it was never before known. The fibrous roots of orange trees run along its surface, and thus are subject to every vicissitude. It often happens that what orchardists call "hardpan" is only the firm layer of soil caused by uniform cultivation, or ploughing, whether deep or shallow. The depth to which soil is stirred should vary from year to year; eight inches, twelve inches, ten inches, fourteen inches, and then eight inches again, would put an end to much of the present outcry against "hardpan." Cultivator teeth should also be kept sharp and should be "set down" to various depths so as to prevent the formation of "plough-sole" of any description, and to assist in breaking up that which former neglect has caused.

Very few orange groves have been planted upon true "hardpan," and if so planted have seldom succeeded. Only a few trees, such as our native oaks, are capable of thrusting roots through the iron-like layer of natural subsoil that is properly termed "hardpan." When found to exist, it should be deemed sufficient to debar citrus culture, unless so thin that, by boring or blasting, the root-system can be established in good soil below the "hardpan," or when it is so constituted that when kept irrigated the roots will penetrate it.

An instance of the latter occurred at Riverside, where Mr. Reed planted a few trees on a terrace bordering on an arroyo, and found what was reported as true "hardpan" near the surface. The trees received "an abundance of water over the whole area for a year," and it was then found that the roots had penetrated it to a considerable distance.

The term "irrigation hardpan" is quite generally used in the orange-growing district to describe the condition of some small areas in orchards where irrigation and subsequent culture have been careless, or where sufficient attention has not been paid to the difference of treatment required by lighter and heavier soils.

Of course very sandy soils can be handled sooner after irrigation than can heavier soils and when a sandy piece of land containing areas of heavy soil is cultivated as soon after irrigation as the sandiest part will permit, trouble may be expected with the so-called "irrigation hardpan," by the puddling of the subsoil, partly directly by the plough, partly by the soaking in of claywater.

Value of proper Cultivation.—It is usual for orchardists to put in a subsoil plough to help in breaking up the heavy spots of what is called "irrigation hardpan." But this difficulty can easily be overcome without using a subsoil plough, as was shown by the experience of Mr. W. J. Cox, of Glendora, Los Angeles County, who found that "irrigation hardpan" was forming in a part of his orange grove. He irrigated a few trees that were within reach of the domestic water-supply and followed this up at the proper time with thorough cultivation. After each irrigation he cultivated a little deeper. As a result of deep irrigation and cultivation, the soil took in water as readily as ever and the trees regained their vigorous appearance. He simply used a chisel-tooth cultivator and plenty of water.

A somewhat different case was that of Mrs. McKenzie of Riverside, whose orange grove failed to be profitable, though apparently well irrigated. This orchard had been cultivated to the same depth until a hard, clay "plough-sole" had been formed. The stratum of hard subsoil was several inches thick and contained a number of large surface roots. She wrote to the Californian Experiment Station, sending samples of soil for examination. It was found that the plough-sole prevented the irrigation water from reaching the deeper roots, and she was advised to plough the entire orchard, roots and all, as deep as the plough would go. This was done, much to the alarm of many growers, and great numbers of orange roots of all sizes were turned to the surface. Following further advice, she irrigated and cultivated the ground deeply, and the following season she harvested the largest crop ever taken from this grove.

The Glondora grove, to which allusion has been made, had had deep cultivation from the beginning, and the roots were mainly below the so-called hardpan. The McKenzie grove had many roots in the hard "plough-sole" so that the only remedy was to destroy these useless roots and force the growth of new and deeper ones, at the same time giving the irrigation water a chance to penetrate. This rather drastic root-pruning was necessary, and if the Glendora grove had been cultivated to a uniform depth a few more seasons, deeper ploughing and the destruction of the surface roots would have become inevitable there also. The breaking-up of all hard layers of soil caused by improper cultivation or careless use of water is of the first importance to the health and profit of an orchard.

Reckless Deep Cultivation.—After Mrs. McKenzie's experiment at Riverside, previously mentioned, subsoilers of different forms were used, and the idea soon became common among growers that the

deeper a plough could be run, the better would be the results that would follow. The injurious results of such practice can not be estimated without careful study of the root-systems of orange trees on various stocks and soils. A number of bearing citrus groves were so much injured by the reckless use of subsoil ploughs that the leaves of the trees actually wilted down immediately after the operation. In these cases, the sharp-cutting plough was run close to and on all sides of the trees. When trees over ten years of age, which have been subjected to uniform shallow ploughing and irrigation, are submitted to such treatment, they probably lose at one blow not less than seventy-five per cent. of their active roots. The shock is such that it would take several years of careful treatment to restore the trees.

Practical Notes on Deep Cultivation and Irrigation.—It is almost always more economical to use a sub soiler or plough where "irrigation hard pan" has been formed than it is to use the large amount of water necessary to soften it, but according to the best practice the deepening of cultivation should be gradual, and the implement should never run deeper than fifteen inches. One must remember that the really serious loss in sudden deep cultivation comes from the destruction of thousands of fibrous roots that grow from the hundreds of laterals branching from the large main roots.

If a plough is run to a depth of one foot, in three furrows, between the rows, and water percolates slowly for a long time through these furrows, no need can arise for a subsoiler. "Irrigation hardpan" within reach of the plough simply shows, as has been said, that too shallow and too uniform cultivation has been practiced. In that case the entire surface should be thoroughly broken up, and irrigation in deep furrows after this will restore the proper conditions.

Experience also shows that when the water is slowly run in deep furrows for a long time and the greater part of the surface is kept dry and is deeply cultivated, better results are obtained than when the basin or block method, or even the shallow-furrow plan is used, even though they are followed by deep cultivation. When the water is applied below the first foot of soil, and the soil above is kept comparatively dry, there is nothing to attract the roots to the surface; and when the water is thus applied, a team can be driven along the dry strips of of land between the furrows, and with a harrow or other appliance the dry soil can be dragged into the wet furrows, to lessen the evaporation, immediately after the irrigation water is turned off. By any other system, it is absolutely necessary to wait at least twelve hours, and sometimes much longer, before a team can be driven over the ground. Then, too, when a soil irrigated by these more wasteful methods has been cultivated, it is still moist near the top, and is soon filled with a mass of new roots so close to the surface that they must be destroyed.

Waste from Evaporation of Water.—Water applied to the soil sinks and spreads. Some of it is being taken up by the still dry soil underneath and at the sides long after the last drop is visible. Some of it too, is being drawn back to the surface, and thence evaporated into the warm air. Irrigation after sundown has some distinct advantages if the water can be handled. Sub-irrigation upon soils adapted to its use is the ideal system of applying water, and greatly lessens waste. Orange roots will not enter a pipe-line unless it is full of water all the

time. If the pipe is on a grade and open at bottom and top so that air passes through it, there will never be trouble from orange roots. Valves, once thought necessary, are not now used. The high cost of the present sub-irrigation systems places them beyond the reach of most orange-growers.

Spread of Water from Deep Furrows.—The diagrams show the extent to which water from fairly deep furrows penetrates the sandy soil and the heavy loam of the substation. A moment's study of them will convince any one that the only way in which to lessen waste in surface irrigation is to let the water flow slowly through as deep and narrow furrows as practicable, thus making a larger cross-section of wet soil, even narrower at the surface than in the chart, and checking the evaporation by filling the furrow with dry earth and by cultivation at the earliest moment.

Examining these suggestive diagrams of soil saturation, let us first call attention to the three showing the spread and descent of water on the heavier soil. Here it has spread much more slowly and to a less extent than in the case of the adjacent sandy land. Even after two days run of water (of twelve hours each) and seventy-two hours further delay, the total sectional area of saturation is hardly more than half as great, covering about sixteen square feet, as against about thirty square feet on the lighter, more porous soil. A still deeper and narrower water channel is highly desirable on this heavier soil. Instead of eight inches, it might well be sixteen or eighteen, which would make the cross-section No. 3 nearly a foot deeper, and narrower on the surface.

The cross-section on the sandy soil show that the eight-inch furrow is practically sufficient to carry the water well down into the soil. A deeper, narrower channel even here will result in economy in the use of water, a smaller flow producing as large an area of saturation with less surface. These two sets of illustrations of the results of irrigation in furrows on different soils, under conditions otherwise practically identical, explain and enforce the entire argument respecting deep irrigation set forth in this bulletin, and long and earnestly recommended by Professor Hilgard.

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OF THE

DEPARTMENT OF AGRICULTURE.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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COCOA III.

NOTES FROM DR. PAUL PREUSS

COCOA IN VENEZUELA*

The characteristic mark of Criollo cocoa is found in the bean, which in the fresh state looks round and swollen. The transverse section therefore is elliptical or nearly circular. The tint of the bean is much paler than in Trinitario and varies even to pure white. The taste is not, even in fresh grains, of a disagreable bitterness, it is still less so in the dry beans.

The fermentation of the Criollo beans is accomplished in one day. At Guigue, the beans are allowed to ferment for two days, they are then exposed for some hours to the sun and finally they are submitted to a new fermentation lasting one day. The tint of the dry bean is a light brown. The aroma and the taste are excellent. The break is extremely friable. When a few dry beans are squeezed in the hand they give out a particular sharp rattling sound, not heard in the Trinitaro which produces rather a strong cracking sound.

The Criollo of Venezuela preserves its characters well; at any rate it is the case in the variety with red fruits. It does not show any tendency to deteriorate from proximity to the Trinitario. In places where these two varieties grow together, it is stated that the fruits of certain classes of Trinitario acquire a resemblance to those of the Criollo, but the Criollo, according to Dr. Pruess's observations, never appropriate the characters of the Trinitario.

Plantations of pure Criollo cocoa are not very extensive anywhere. As a general rule all the varieties are planted anyhow together. Plantations of pure Carupano are equally rare. Well-informed planters have long since ascertained that the Carupano diminishes the

Continued from Bulletin for June and July, page 121—124.

value of their plantations, and they make an effort to get rid of it, but it is difficult on account of the delicacy and the feeble growth of the Criollo. When, for example, a tree dies in a plantation, whether from old age or from some malady, it is extremely difficult, if not impossible, in a plantation of pure Criollo, and absolutely impossible in a plantation of pure Carupano, to raise a young tree of Criollo in place of that which has perished. The young tree is stifled by the large trees that surround it. On the contrary, a young Carupano will develop well, thanks to its greater vital force. So that if planters do not wish to have empty spaces in their plantations, they are obliged to fill them with Trinitario the value of which is less. In this way they are continually depreciating the old plantations (Chuao). This is the reason for the lowering of the quality of Caracas cocoa of which there is frequent complaint.

New plantations of Criollo call for much more careful shading, more thorough maintenance, and a more abundant irrigation than those of Trinitario. It is calculated that it takes 3 years longer to get a full crop of Criollo than of Trinitario. On the other hand, the product obtained in the first case is much more precious, and fetches as much as double the price of the other, the preparation of which latter, besides, is longer and more difficult; add to this, that the Trinitario requires more space than the feebly developed Criollo, and therefore less trees are planted to the acre of Trinitario than of Criollo. All these considerations ought to be weighed when enquiries are made as to what variety should be planted by preference.

Trinitario or Carupano is distinguished from Criollo by a more pronounced development, its trunk is shorter, its foliage is thicker, its leaves are larger and it yields more and sooner.

A certain number of varieties are distinguished of which the names have been given before, according to the size, the form and the colour of the fruits, according to the form and taste of the beans, as well as according to the tint of the inside of the beans. At the head of all the varieties is the Angoleta, of which the fruits are regular, generally deeply furrowed and very rough, terminating in a somewhat long point. The shell of the fruit is thick. The beans are large and plump. This variety is considered very good. In the second place comes the Cundeamor, of which the fruits are red or yellow with deep and long furrows, very rough, terminating in a long point, often curved and narrowed at the base. The tint of the fresh bean is, in the two varieties, bright violet but still much darker than in Criollo. The beans of the Cundeamor are as large and plump, scarcely bitter, and fermentation takes place relatively quickly. The denomination Cundeamor comes from the name given a wild fruit called "Cerasee" in Jamaica (Momordica) of which the form offers some resemblance to this variety of cocoa.

Then come in order of quality the numerous varieties called simply "Carupano," of which some have their shells and relatively large grains (carupano grande mejor), and the others with thick shell and flatter beans. Their form approaches rather that of an egg, but they have however a visible point. The colour of the bean is bright violet. The Sambito of which the fruits are very large, massive, rather smooth

and terminated by only a short point, has only rarely large plump beans; they are bitter and of a bright violet colour. The worst is a variety of which the fruits are deep red, bright, smooth, with thick shell, rounded at the two ends and massive, of which the beans are very flat, of a deep violet colour and very bitter. It is called "Trinitario Amergo" or "Cojon de Toro," fermentation for this variety ought to last 8 days, and even then its taste is still bitter and acrid.

SOIL TEMPERATURE.

Reference was made in last bulletin (page 126) to the temperature of the soil. Prof. F. H King in his "Text Book of the Physics of Agriculture," which everyone interested in agriculture should possess, has a chapter on the subject, from which the following notes are taken.

Importance. In temperate climates subject to frost, growth will not begin, with most cultivated crops, until the soil has attained a temperature of 45° to 48° F. and it does not take place most vigorously until after it has reached 68° to 70° F. Neither do the nitre germs begin the formation of nitric acid from humus until a temperature above 41° F. has been reached and its greatest activity is not attained until the soil temperature has risen to 98° F.

Germination. The soil temperatures at which the seeds of most cultivated crops germinate best, lie between 70° and 100° F. with an average of about 85° F. The best soil temperature for germination of corn (maize) and squash is 93°, for melon 99°. The more quickly seeds are permitted to germinate after they are placed in the soil the higher will be the per cent. of seeds growing, and, as a rule, the more vigorous will the plants be. Indeed seeds of low vitality placed in too cold a soil often fail to germinate at all. It is found that. when corn germinates in 3 days at a temperature of 65 3° F., it requires 11 days when the soil was as low as 51° F.

Root Pressure. The power which sends the soil moisture into the roots of plants and up into the leaves is osmotic pressure, developed by the warmth of the soil, and unless the soil temperature is sufficiently high, plants may wilt. Pumpkin and tobacco plants wilt badly, even at night with an abundance of moisture, as soon as the soil temperature falls much below 55° F., the moisture not rising fast enough to compensate for even the slow evaporation during the night.

Formation of Nitrates. The nitrates in the soil do not develop until the temperature has risen above 41° F.; the action of the germs is extremely feeble at 54° and they do not attain their maximum activity until a soil temperature of 98° has been reached; but if the earth becomes as warm as 113° F. then the action is nearly stopped, it being as weak as at 54°.

Influence of colour. The colour of a soil, especially when dry, so that the rate of evaporation from its surface is small, has a marked influence on the temperature, even at considerable depths. The darkest

soil, whether black or brown, was more than a degree warmer than the light soil at four inches deep.

Influence of Topography. The degree of inclination of the land surface and the direction of the slope, whether facing east, west, north or south, may exert a marked influence upon the temperature of the soil and particularly upon its diurnal range. The temperature of a stiff red clay soil, upon a level plateau, and upon a south exposure sloping about 18°, was found in the surface three feet to make a difference in temperature of from a little more than 3° F., in the surface foot, to a little less in the second and third feet.

Influence of chemical changes. When heavy dressings of farmyard manure are ploughed in, and when heavy crops are turned under for green manure, the fermentation which is set up in these materials results in a measure of heat which warms the soil in the same way that a manure heap heats when fermenting. Indeed all the steps in the formation of nitrates in the soil result in the evolution of some heat.

Influence of rains. Heavy rains which fall upon a field and penetrate the soil may exert very marked effects upon its temperature on account of the relatively high specific heat of the water as compared with that of the soil.

If the atmosphere is warmer than the deeper soil, and if rains fall which result in heavy percolation, a large amount of heat is conveyed rapidly and deeply into the soil with the water and the temperature of the ground, two to four feet below the surface, may thus be very materially raised.

Influence of evaporation. There is no factor, except the direct sunshine and the direct radiation of heat away from the earth into space, which exerts so strong an influence on the temperature of the soil as the evaporation of moisture from its surface; and the chief reason why an undrained clay soil is colder than one well drained is the cooling effect associated with the larger evaporation of soil moisture.

To evaporate a pound of water from the surface of a square foot of soil, by means of the heat contained in the soil, makes it imperative that 966.6 heat units be expended to do the work and this, if withdrawn from a cubit foot of saturated clay soil, would lower its temperature some 10.3° F.

The difference in temperature shown by the wet and dry bulb thermometers measures, in one way, the cooling effect of evaporation; the wet bulb often reading as much as 15 or even 20 degrees lower than the dry one, under otherwise identical conditions.

Table showing the influence of rapid evaporation upon the temperature of the soil.

Date.	Time.	Condition of weather.	Temp. of air.	Temp. of drained soil.	Temp. of undrained soil.	Difference.
April 24	3.30 to 4.p.m.	Cloudy, with brisk east wind	60.5° F.	66.5° F.	54.00° F.	12.50°F.
April 25	3. to 3.30 p.m.	Cloudy, with brisk east wind	64.0	70.0	58.00	12.00
April 26	1.30 to 2p.m.	Cloudy, rain all the fore-noon	45.0	50.0	44.00	6.00
April 27	1.30 to 2p.m.	Cloudy and sunshine, wind S.W. brisk	53.0	55.0	50.75	4.25
April 28	7 to 8.30 a.m.	Cloudy and sunshine, wind N.W. brisk.	45.0	47.0	44.50	2.50

In the table above are given the observed differences in temperature of a well drained sandy loam and an adjacent black marsh soil, not well drained, the observations being taken simultaneously and the differences in temperature being due largely to differences in the rate of evaporation in the two cases.

Influence of thorough preparation of the seed-bed. It follows from what has been said in previous paragraphs, that the practice of thoroughly preparing the seed-bed before sowing or planting must have the effect of decreasing the capillary rise of cold water from below and its loss by evaporation from the soil. This then would tend to concentrate the sun's heat in the seed-bed itself, first by lessening its rate of conduction downward, and second by diminishing its loss, by lessening the evaporation. In the spring, then, early and thorough preparation of the seed-bed tends to make the seed-bed warmer: it diminishes the loss of soil moisture; it increases the formation of nitrates, thus making the soil richer; it hastens and makes stronger the germination and it enables one or more crops of weeds to be destroyed before the crop is up in the way of cultivation. Hence there is much to gain and little to lose in the thorough preparation of the seed-bed before planting.

Control by underdraining. When land naturally too wet for tillage early in the spring has been thoroughly underdrained, the soil is brought into fit condition for seeding much earlier than would be pos-

sible without this improvement, and one of the great points gained is the warming of the soil to a greater depth, on account of the removal of the water and the lessening of the loss of heat by evaporation.

CANE VARIETIES AT CINNAMON HILL.

ST. JAMES.

Mr. Shore has recorded the yields of cane from the Cane Varieties grown at Cinnamon Hill as ratoons, the canes were irrigated and gave five times the average yield of the non-irrigable lands of the estate which suffered severely from the unprecedented drought. D. 116, D. 51 and D. 102 have done well as ratoons. These experiments indicate that some of the seedlings are decidedly superior to the estate canes under irrigation conditions.

It is hoped that the proposed central factory project may be carried through and an extension of the irrigable lands be made possible.

H. H. COUSINS.

REPORT ON EXPERIMENT CANES AT CINNAMON HILL, AS FIRST RATOONS.

Name.	Tons per acre 1902.	Tons per acre 1903.
D. 51	62.	55.9
D.116	62.	49.
D.102	42.5	47.1
Otaheite	41.	43.5
Canaan	70.5	43.4
D.275	43.5	43.2
D.103	32.3	42.
D.343	49.3	37.3
C. Queen	42.3	35.8
D.119	52.	34.
D. 80	25.8	31.
D. 95	37.	30.5
D 115	47.2	29.5
D.128	33.	29.1
D.117	35.6	28.1
D.109	45.	24.
B.147	34.	22.6
Red Rose R.	32.5	21.7

These canes were cut as plants on 21st August, 1902, and again as first ratoons on 15th June, 1903, only ten months old.

This could not be helped as the estate's crop was finished and some alterations were to be made in the works later.

The juice stood only 6.6 Baume average; owing largely to a fall of 16.25 inches of rain in May—an exceptional fall for this district. The rainfall for the ten months was 47.53 ins. but was unequally distributed, the first four months of 1903 being very dry. Irrigation was used during that time, so that the growth was kept up.

The extraction of juice by mill was 67o/o, against 65o/o last

year; and the average extraction from estate's canes for the crop was 57o/o, by the same mill.

The return from the small area of ordinary canes that could be spared water was 25 tons per acre. This shows the value of irrigation in a dry year such as 1902-03 was, when the average return per acre from non-irrigated canes was 9 tons.

D.102, 103, 80 and Otaheite have done better as First Ratoons than as Plants.

JOSEPH SHORE.

18/6/03.

AN INSECT PEST OF SWEET POTATOES.

Grub. Mr. Cradwick, Travelling Instructor, sent to the Director of Public Gardens for identification and remedy a sweet potato, which was destroyed for purposes of food by the holes made through it by a small maggot-like whitish grub, about a quarter of an inch long. The grub has no feet but is able to bore its way through the potato. The portions of the potato next the borings become black and discoloured, and even the untouched parts are said to be without taste and to be refused by pigs.

Perfect Insect. The potato was kept for some time until the grubs had passed through the quiescent or pupal stage, and developed into the perfect insect, the sweet potato weevil. It is one of the snout-beetles, about a quarter of an inch long, of a bluish-black colour, brownish in the middle, with long, blackish snout or beak. It is known to entomologists as *Cylas formicarius.*

Remedy. As the infested potatoes are useless as food, there need be no hesitatation about burning them at once, as well as all the rubbish on the ground which may harbour more of the insects. Destruction by fire prevents the multiplication of the insects, and future attacks may be less severe.

In order to give no opportunity for later development of these pests, it is well to plant the ground with some other crop, such as corn or cane, which are not affected by the maggot.

CULTIVATION OF RICE IN THE UNITED STATES.*

By LESLIE HARRISON.

It can be stated that rice cannot be grown without irrigation, and for all practical purposes that statement will hold true; for while it is true that "Providence" rice has been grown in the past, and is grown yet, it is also true that rice grown without the artificial application of water has comparatively small commercial value in the rice industry of the southern States.

The methods of cultivation and irrigation are widely different in the two great rice districts of the country; for excepting the fact that the resultant crop is the same, and that both are grown by means of irrigation, there are few points of likeness. For example, Carolina rice-growing is historically the oldest in the country, and its present

* Forestry and Irrigation, July, 1903.

methods show almost the same primitive conditions which have characterized rice cultivation from its first Asiatic beginnings. Louisiana and Texas, on the other hand, whose industry has more than taken the place that was once occupied by South Carolina and Georgia, make use of the most improved methods, with expensive modern machinery for harvesting and threshing, and are now engaged in irrigation works of great magnitude.

Rice growing is not by any means a new venture in this country. In 1694 a storm-tossed Spanish vessel put into Charleston harbor, where it lay for some time to undergo necessary repairs. During this stay the captain of the vessel gave to one of the citizens of the town a handful of rough rice. From this one handful, through careful seeding and cultivation, developed the notable Carolina rice, now world famous. For a long time Georgia and the Carolinas furnished the principal part of the rice crop of the country, and for a number of years preceding the civil war these states produced 105,000,000 pounds of cleaned rice annually. At the present time the annual yield is about 50,000,000 pounds.

Louisiana now produces more than half of the rice raised in this country, the annual output amounting to some 200,000,000 pounds. The history of her rice industry dates back to the exiled Acadians—French settlers from Nova Scotia—who in the last half of the eighteenth century began the raising of "Providence" rice: but providential rain was not to be depended on, and fat years were invariably followed by lean ones, so that irrigation came to be more and more desirable, until now the systems of Louisiana are among the most elaborate and valuable in the country.

Irrigation of Rice in the Carolinas and Georgia.

The rice industry of the Atlantic coast is confined to tidewater areas from Cape Fear to the Florida boundary of Georgia. In this area there are about 80,000 acres on which rice might be grown, but as a matter of fact, only about half of this is cultivated. The water supply is entirely from coastal rivers, and the plantations must lie far enough above salt water to avoid its bad effects on the fields. This limits the cultivation to a strip lying not more than 30 miles from the coast, and seldom less than 15. In a few cases where the river water is brackish at certain seasons, storage reservoirs are provided to offset these conditions; and where the water is always too salt or the lands are above tidewater, the planter must depend on water taken from inland streams, lakes or reservoirs.

Almost all the irrigation in the Carolinas and Georgia is of a simple nature. When reservoirs are required a small stream is dammed, so that the water backs up to form a reservoir, while the land below is irrigated by direct flow from the dam through suitable ditches or canals.

In the case of irrigation from tide water banks or levees are thrown up, and these are pierced by "trunks," or long boxes made of heavy timber and closed by a sort of gate at each end. These trunks are placed at an approximately mean distance between the limits of high and low tides, so that the water of high tide will flow through them on to the fields to be flooded, or so that the flood water may be turned

off at the time of low tide. The gate at either end of the trunk is so arranged as to act as a valve, the pressure of the water against it serving to keep it shut unless it is held open by a lever provided for that purpose and worked from the top of the retaining bank or levee. Water flowing in at a time of high tide can be retained on the field for as long a time as is desirable, for when the tide drops, the water inside of the levee is held by the automatic closing of the inner gate. In the same manner, when it is desired to drain the field, the inner gate is held permanently open, while the outer one closes when the tide is up, thus preventing any inflow.

Drainage forms an essential part of rice culture, being absolutely necessary at the time of harvesting. Undertiling is of advantage in the Atlantic coastal fields only when the water is supplied from reservoirs or lakes. The rivers carry too much sediment during the freshet season to make a system of under-drainage successful, as the tiles would soon become clogged; yet the slopes are for the most part fit for good drainage with but little grading. A system of low dikes and small ditches through the field accomplishes the desired results of equable application and depth of water, with rapid run-off when a draining of the field is desired.

Rice is a shallow feeder. Its mass of roots spreads out just below the surface, and none of them strike down to any great depth. On this account all ploughing is shallow, generally not more than 3 or 4 inches deep, though a greater depth might be advantageous as giving more plant food. In some places the ground is so stiff that it is flooded before ploughing. Afterwards it is put in condition by disc harrow and roller.

On lands flooded by rivers which carry rich sediment fertility is easily assured, but in many instances, and particularly in the growing of upland rice, fertilizer is needed, and this should be of a high grade to give best results, as cheap fertilizer is a false economy. Naturally the fertilizer varies in different localities; but cotton-seed meal, blood and bone, and other well known mixtures are used, most of them containing a good percentage of potash.

In planting great care must be exercised in the selection of the seed rice, in order that it may be free from the volunteer "red" rice and from weed seeds. Uniform kernels are also desirable, as a uniform crop will permit of a higher polish than kernels that vary. The seed is sown in March and April, and early sowing has many advantages, though some crops are put in as late as June, with varieties which mature quickly. The time of sowing also differs in different sections, and is affected by the weather and to some degree by the migrations of birds, which work havoc on the crop, either when planted or in the fall when the grain is in the "milk" stage. The grain is planted either in drills or in hoed trenches and dropped by hand. The drilled method insures an even stand, which is a matter of some importance. It may be even planted broadcast and harrowed in or it may be planted in hills. Some planters recommend the latter method, as it ensures easy cultivation and a more effective campaign against weeds.

After planting, the next important step is flooding, and this is done soon after the seed is sown, sometimes on the same day. Seed that is

not to be covered is clayed before planting by stirring it in clayed water, so that the flooding will not float it. Flooding serves several purposes. It protects the grain from the birds and causes quick germination. This water is left on the field several days, or until the seed is well sprouted. It is then drained off and no more water is applied until the plants are well up and the fields show considerable green. Then a "stretch" flow is turned on for a few more days, until the plants are about six inches high, affording nourishment to the rice and impeding or destroying weed growths. When the plants have attained a sufficient growth under the stretch flow the water is gradually lowered to an average depth of a few inches, and remains on the field for a period of from two weeks to a month, the duration depending on local soil conditions. Then the dry growth follows for about a month and a half, and during this time the crop is cultivated with horse or hand hoes; weeds and volunteer rice are removed, and in some cases an intermediate flooding is made to protect the plants from grubs. When the plants begin to joint the harvest flow is turned on and this is kept almost touching the rice heads until their bending tells that the grain is ripe. The field is then drained for harvest

The quantity of water required for irrigation is not looked into, but it is probable that here, as in many other places, the fault of over-irrigation is a common one. The supply from tidal streams is almost unlimited, and the whole question of water rights is never brought up as there are none.

Harvesting machinery is not used, the grain being cut with hand hook or sickle. The beds in the field are narrow and usually small, to permit of complete drainage, and this would entail much breaking down of the grain and subsequent waste if a harvester were used. The grain is cut before it is dead ripe, or while the lower eighth of the head is still "in the milk," for if cutting is delayed until the head is quite ripe, there is much loss from the shelling out in handling. A high stubble is left, on which the grain cures for a day or two, when it is placed in shocks after being put up in straw-bound sheaves. As soon as possible, in order to avoid loss from storms, the grain is taken to the threshing-houses. These are permanent structures, one on each plantation, built on the bank of a stream or tidal canal, where tugs and lighters can get the rice to take it to market. The milling is a complicated process for, after threshing, the rice or "paddy" still has two coverings - a coarse outer husk and a thin close skin. These are taken off by special processes, and the different products—bran, flour, grain, and chaff—separated. In addition to this, the commercial article is always polished to give the grain the smooth, pearly appearance, which artificially enhances its market value, but detracts from the real food value.

Irrigation of Rice in Louisiana and Texas.

The rice of the Gulf States is now grown mainly on the uplands, and does not depend on tidal irrigation. With the use of modern methods and machinery, the industry has developed into a leading one in these two states, while it has declined in the Carolinas and Georgia.

During the last fifty years, however, rice production in the United

States has grown but little, and only the present time sees any great advance in production over the crop in 1850, for the decline in the Atlantic States has offset the advance in the Gulf States. It is possible that the former may adopt some of the methods of use in the latter and thus regain the prestige held before the civil war, but until they do so they cannot easily compete with improved machinery at home or cheap labour abroad. The production could and should be doubled, as we now produce less than half of the rice consumed in this country, and the use of rice as a staple article of food is constantly increasing.

Acadian success with Providence rice, intermittent as crops were, showed that, with proper methods of cultivation and irrigation, Louisiana was particularly fitted for this crop. At first, the only attempt at irrigation was the raising of levees above the rice fields to reserve some of the heavy rainfall, instead of allowing it to waste into the bayous. When water was needed to flood the fields, the levees were cut and the water allowed to flow on the plants, but in dry seasons this method of irrigation was worthless, and something more dependable had to be devised. Later it was discovered that upland soil was especially suited to the growing of rice, good crops being obtained in wet seasons, and it became only a matter of getting water to them when large areas could be cultivated and the industry could furnish a profitable commercial venture, worthy of the enlistment of capital.

The introduction of the steam-pump furnished the impetus which was needed. After some failures with pumps of wrong type or limited capacity, large centrifugal pumps were introduced to raise the water from bayous to canals From these canals the water was pumped directly on the fields, and the problem was practically solved.

Yet there were a number of local conditions which made irrigation very different from what it was elsewhere. For example, it might be said that the only point of similarity between the Louisiana rice canal and the irrigation canal of the western States is that both are filled with water for the purpose of irrigation. Beyond that the comparisons are contrasts, to use a Hibernianism. For instance, water flows in the western ditch and stands at a level in the rice canal; the source of supply in the west is above the fields to be irrigated, and below it in Louisiana; the canal of the west is dug below the surface of the land through which it passes, while the rice canal is built up on the surface of the ground, and on the highest ground to be had; the western canal holds water poorly, losing much through seepage through the soil, and the levees of the rice canal are impervious.

The proper construction of these levees, however, is of prime importance. The surface of the ground upon which the levees are to rest must be absolutely clear of all vegetation, and must then be ploughed and pulverized, so that the earth embankment placed above will make a good "joint." To aid in this, deep furrows are ploughed in the foundation earth, and the levee banks are built up firmly and of good material. This has to be done to prevent devastating breaks, as some of the canals are so large that they appear to be rivers of no inconsiderable size. Indeed, it is proposed to navigate some of them with lighters and barges for the transportation of "paddy" from the threshers to the mills which turn out the finished product. For

examples of the great size of these canals, we have the Eagle Lake Rice Irrigation canal, 17 miles long and 200 feet wide; The Trespalacios canal, 4½ miles long and 200 feet wide, and the Treadway canal, 25 miles long and 220 feet wide. Another canal, now under construction, will be 56 miles long and 175 feet wide.

Owing to the fact that these canals are practically on a level and have no current in many cases, they are subject to obstruction through the growth of water weeds, and these constitute a serious menace to the usefulness of the smaller ditches, unless the growths are removed.

The water in these canals all has to be pumped, and in most cases from bayous which are below the sea-level, on to lands which lie as high as 70 feet above. For such a raise it is necessary in most places to have several lifts, the first one being from the bayou or stream, and the others at intermediate points along the canal. The pumps are of two types only, both suction pumps, however—the centrifugal and rotary. The former is the more popular, as it does not need direct connection with the propelling machinery, being run by belt or rope transmission. The rotary pumps, when properly established, should be more efficient than the centrifugal, and as they are run much more slowly, there is less wear and tear; but the increased cost of installation, owing to the necessity for permanent and strong foundations, limits their use. Boilers and engines are of varied patterns, but any that are good will serve the purpose.

Fuel is of three kinds— coal, wood and oil. Of these, coal is the most expensive and oil the cheapest and most convenient to handle. Wood can be had near at hand, as most of the bayous are in heavily wooded districts; but the cost of labour brings the price above that of fuel oil, which is delivered from the nearby Texas oil fields at a low rate. In Texas particularly, where much of the irrigation is from artesian wells, crude oil is the most important factor in the fuel and power question.

From the canals the water is distributed over the fields through measuring flumes, and is held at different levels in the sloping field by means of low levees, over which the water may flow until all the levels are flooded. Planters are now making these levees in the fields very flat and with gradual slopes, so that they interfere but little with the cultivable surface of the ground and allow the passage of the reaper and binder for harvesting. Since the water rises to the tops of these field levees, almost an average crop of rice is raised on them, and the fact that they can be cultivated and harvested makes it possible to keep out the weeds and red rice.

The application of water to the crop differs in some particulars from irrigation on the Atlantic coast. In the first place, the Louisiana farmers depend on early rains to start the crop, and need no flooding to protect the grain from birds, since the reed-bird or bob-o-link is not the pest in Louisiana and Texas that it is in the Carolinas and Georgia. The first growth of the crop, or until the plants are from six to ten inches high, is made without artificial application of water, but after that the fields are kept flooded until within ten days of harvest time, when the levees are cut, and the water drains off rapidly by means of ditches provided for that purpose, leaving the ground dry enough to permit the use of the reaper and binder. As the harvesting machinery

is similar to that used elsewhere for wheat, so also is the threshing outfit. Mills are large and form an industry by themselves, not being in any way connected with the separate plantations, as is the case in the Carolinas.

Several things will have to be done before the rice industry of Louisiana and Texas will be placed on as good a basis as that of the Atlantic seaboard in the matter of water supply. At present magnificent operations are going on, and great ventures are being pushed forward under state and national sanction. At present in many localities the bayou supplies are being overdrawn, that many acres have had to be abandoned on account of lack of water, and in some instances brackish water has backed up from the sea because the bayou supplies have been so depleted. There seems to be no recognition of water rights on some of these supply streams and bayous, and as a consequence there are too many pumping plants on some, all of them being supplied in dry seasons. In Texas where artesian irrigation is used to a greater extent, the flow can be readily measured, the duty of water calculated, and only enough ground planted to be sufficiently irrigated; but development for the present threatens to be too rapid for present institutions to keep pace with it, and some radical departures will have to be made to secure all water needed and to protect users in their rights to that water.

THE STORY OF THE PAPAW.

By F. B. Kilmer.*

"The slim papaya ripens its yellow fruit for thee."—*Bryant.*

Grant Allen tells us that no plant can be properly understood apart from its native place. Therefore we begin our study of the *Carica Papaya* in its tropical home.

The *Carica Papaya* is accredited as indigenous in Central America. Observations and correspondence lead me to conclude that it has become acclimated in the hot regions of three continents. The zone of most abundant growth seems to lie between the isothermal lines of 77° wherever soil and rainfall are favourable. It is grown by cultivation north and south of these lines. (The papaw is seen as far north as Jacksonville, Fla., and in Southern California).

In these tropical lands, where every tree or plant has its peculiar legends and myths, the views of the natives upon plant life are considered unscientific and valueless, but I have found that, when stripped of the terms of superstition, some of their observations, compared with our scientific knowledge, are not far apart. Their apparent veneration for trees and plants is based upon intimate association wherein they have come to a knowledge that plants eat, drink, marry, propagate, care for their offspring, and bestow blessings or curses upon all living things, including man. This is about all that anybody can know about them.

Many trees are famous in these lands, none more so than the papaw. Conflicting stories as to its powers and properties are due somewhat

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*Reprinted from the "American Journal of Pharmacy."

largely to the fact that different species or variations in species possessing varying characteristics, are found in these localities.

Quite universal is the knowledge of the unique property that has given to this tree its world-wide fame, viz.: the power of its milky juice to soften and dissolve tough meat. The statement has passed current in our journals that the emanations from this tree will dissolve and digest albumin, and that it is the custom of natives to hang meat and chickens in the branches of a tree to render them tender and edible. The natives often go further than this: they state that if male animals browse under the papaw tree; they thereby become emasculated. If we compare this statement with the alleged property of the roots as a generative tonic, we shall have a marvellous combination of an aphrodisiac and an anaphrodisiac in the same plant.

It is needless to urge that such stories are exaggerations of the pepsin-like properties of the fruit.

The native uses of the papaw are numerous and varied. The bark is used in the manufacture of ropes; the fruit is edible, and according to local conditions, may be sweet, refreshing and agreeable, or in other localities it is sickly, sweet and insipid. The fruits find a large consumption by the natives, and are considered very nutritious.

At the corner of a sugar-cane field where the ragged canes bend over in a wild green, brown and yellow tangle. there will be standing a papaw tree, and if the time of the papaw tree has quite come, beneath the tree will be assembled a half dozen negroes.

The ripe fruit is eaten as we eat melons. Salt enhances the flavour and some users add sugar. The melons must be perfectly ripe when eaten raw, as the green fruit contains a strongly marked acrid principle. The colour of the ripe fruit is more or less that of our very yellow musk-melon. The sweetness of its resinous, pulpy, juice clings to the tongue and remains prevalent for some hours.

The natives enjoy the flavour, while the stranger has to acquire the liking. Excellent preserves are made of the ripe fruit, which, for this purpose, is boiled down in sugar and candied (like citron).

At the sugar-houses slices of the papaw are often seen seething in hot syrup. The slices of melon combined with some acid fruit is made into native tarts, which articles correspond more or less to what we call "pies." The fruit is also stewed and served on the table. The green fruit is made into plain and spiced pickles, which are highly esteemed.

The fruit, just before ripening, is peeled and sliced, macerated in cold water, with frequent changes of water for some hours; the then macerated fruit is dropped into boiling water, boiled sharply and then served as a vegetable.

In every tropical village one will find a market-place set apart where the native products are bought and sold, and in such a place by the roadside, under the shade, are the market women; in their quaint baskets or bowls, the traveller finds an astonishing and puzzling variety of green and yellow coloured fruits and vegetables. The papaw is always there in abundance, and a most frequent cry of the sellers is "Aqui estan las Mameo," or "Ca qui ulè papay ca qui ule"

As an article of food one finds the papaw prepared in a score of ways making a variety of edible dishes, which, from the native stand-

point, would be expressed in our language, as "wondrous and nutritious delicacies."

A plant so universally distributed and possessed with such varied properties, naturally takes an important place in the native materia medica. In the native parlance "it makes him much well."

The seeds are reputed as anthelmintic[1] and emmenagogue, they are also used as a thirst quencher, form component parts of a drink used in fevers, as well as being used as a carminative. Syrups, wines and elixirs made from the ripe fruit are expectorant, sedative and tonic.

A malady which the natives call the "cocoa bag," is a troublesome tropical disease, reputed to be hereditary and contagious; at all events it seems to lurk in the blood of persons of otherwise apparently good health and habits. Suddenly the victim becomes a mass of offensive sores, debilitated, etc. The native doctors add the papaw fruit to the diet drinks used in this disease, and succeed in moderating its violence, at least. To the sores a paste made with the papaw milk as one of the constituents is also applied.

The slight pimples accompanying the first stages of the yaws soon spread into ulcerous sores that cover the entire body. Here, too, the claim is made that a slice of the papaw rubbed over the pimples will abort them. It is also claimed that the ulcers may be cleaned in a similar fashion.

I witnessed a most striking cleansing of a black foot in which the chiga had bored and laid its eggs, producing a mass of foulness beyond description. Here a paste of the papaw milk was pushed into the seething mass and kept there for forty-eight hours. It was then flushed, curetted, and antiseptics were applied. A clean wound which readily healed resulted.

The green leaves or slices of the green fruit of the papaw are rubbed over soiled and spotted clothes, and by its power of dissolving stains papaw has acquired the name of "melon bleach." The leaves or a portion of the fruit are steeped in water and the treated water is used in washing coloured clothing, especially black, the colors are cleaned up and held fast.

The seeds are eaten as a delicacy. They have quite an agreeable taste, something of the order of the water-cress and a piquancy slightly suggestive of the mustard family. Macerated in vinegar they are served as a condiment.[2]

The strange and beautiful races of the Antilles astonish the eyes of the traveller who sees them for the first time. It has been said that they have taken their black, brown and olive and yellow skin tints from the satiny and bright hued rinds of the fruit which surround them. If they are to be believed, the mystery of their clear, clean complexions and exquisite pulp-like flesh arises from the use of the papaw fruit as a cosmetic. A slice of the ripe fruit is rubbed over the

[1]The anthelmintic properties residing in both the seed and juice have been noted by various authorities.

[2]The seeds are encased in a slimy coating and advantage is taken of this by the younger generation, who spread them out on a board, and by this means form a "slide," which corresponds with the frozen gutters so agreeable to our northern urchins.

skin and is said to dissolve spare flesh and remove every blemish. It is a toilet requisite in use by the young and old, producing, according to the words of a French writer, " the most beautiful specimens of the human race."

The papaw has been brought to America as a cure for the national disease, dyspepsia. In its tropical home there are no dyspeptics, but its use along similar lines is by no means unknown.

The meat in these countries is tough and tasteless, beef, mutton, pork, or fowl have the same flavour, and are as tough as hickory wood; boiling until they fall to pieces does not render them any more tender, they simply change from solid wood to fine tough splinters.

One reason for this is that in this climate meat must be eaten immediately after slaughter. (It often reaches the pot in an hour after killing.) The papaw helps to overcome this. Rubbed over tough meat it will render it soft and change a piece of apparent leather to a tender, juicy steak. It is put into the pot with meat, enters into cereals, soups, stews, and other dishes, and they are made at least more edible and digestible.

Most of the half-breeds of Indian extraction upon the South American Continent and adjacent islands are particularly given to meat diet; many of them eat it raw,[3] sometimes in a state of partial decay, and here the papaw is brought into use, being eaten with the flesh or rubbed over it before it is eaten.

Some of these people are great gluttons; they gorge themselves until the skin on their distended stomach is stretched to its utmost. It is certain that no human being could digest the kind of food and the enormous amounts they consume without the kindly aid of the papaw fruit to assist digestion.

NAMES AND CHARACTERISTICS.

The botanical characteristics of this family having been more or less completely described by various authors, need not here be repeated. Of the many species the following are edible: *Carica cauliflora, C. pyriformis, C microcarpa, C. integrifolia, C. Papaya* and *C. quercifolia.*

The *Carica digitata* is credited with poisonous emanations, and its juice is actively poisonous, causing pustulation when applied to the flesh.

The *Carica Papaya* is designated by different names in the various localities where found. For instance, in Mexico "lechoso," in Brazil "papai," "maneo" and "mamerio"; in Paraguay, "mamon."[4]

Here, too, the term "jacarata" (chakarateca) is applied to the *Carica Papaya,* as well as to several trees of the same natural order. In Yucatan the native uncultivated variety is designated as "chich put," or little papaya, while the cultivated is simply "put." The Spaniards designated the original species as "papaya los pajaros" or "bird pa-

[3]In Bolivia and Paraguay it is a very common sight at the railway stations to see raw meat peddled out in chunks to passengers.

4 In Brazil the uncultivated plant is designated as "mameo-femeo". the cultivated form of the same as "mameo-meleo;" the hermaphrodite plant "meneco-macho."—(Rusby.)

paya." The term "papaw," though sometimes applied to several species, almost universally means the Carica Papaya.

Among the names by which botanists have designated this plant are the following: Papaya fructu melopeponis, Tournefort; Papaya Carica, Gaertn; P. lyatira, Tuss; P. vulgaris, A. D. C.; P. Orientales Col.; Carica Papaya, L.: C. Maniaya, Vell.

The *Carica Papaya* may, in brief, be described as follows:

A single, supple, slim, straight stalk, terminating in a group of large leaves which are arranged in the form of an umbrella, branching only when its growth is interfered with. Cultivated plants attain the height of from 10 to 30 feet; wild varieties push up to 60 or even to 100 feet. Near the base of mature trees the diameter ranges from 6 inches to 1 foot. In a young plant the stalks consist of a cellular pith filled with water; in a matured tree that portion of the trunk immediately under the bark is fibrous for a few inches, followed by a soft inner layer of an inch or more, terminating in the central portion which is hollow. At intervals through the hollow centre are seen membranous tissues dividing the cavities into sections, and in the rainy season, for a considerable height up the trunk, this central cavity is filled with water. The wood of the papaw is soft, white and spongy; cuts easier than a potato; is full of water, decays rapidly, and is not useful for any purpose. The trunk is covered with a gray (green at the top) smooth, tough bark laid on in folds, which at intervals form ringes.

A large turnip-shaped tap root reaches down to seek nourishment and to give stability to the tree. These roots are similiar in structure to the trunk, except for a white bark, and possess an odour of cabbage and a peculiar taste suggesting radishes. The leaf stems are large and hollow, cylindrical toward the leaf and flattened at the point where they join with the stalk. The leaves are large palm-lobed, with somewhat deep indentations, dark green on the upper and light green on the under side They are short-lived and, as the tree shoots upwárd, they drop off, leaving scarry marks in the bark of the tree trunk.

The locality where grown, as well as the effects of cultivation, modify the character of this plant, hence we find on record varying descriptions and statements. Among the notable varieties of the Carica Papaya are the green and violet. The latter species which has had considerable attention paid to it, is the one most highly esteemed for cultivation, but does not attain great height. The stalk and limb portion of the leaves are violet colour. The fruit is large, often weighing as high as 20 pounds, and when ripe is very sweet. While young the trees are kept shady, and pruned to prevent their growing tall. To encourage fruit, portions of the flowers are picked off; the smaller fruits are removed when green, so that the remainder will grow larger and stronger. By cultivation a dwarf variety ("lechoso enana") is produced. The green Carica grows to greater height than the purple; its fruits are smaller and possess a less agreeable flavour.

The three forms of flower present in the papaw are, according to the native description, classified as varieties. The so-called female trees bear only fruiting flowers and produce the largest fruit and the greatest numbers. These flowers are single, with a yellow (or purple)

corolla with five sessile petals, growing in considerable numbers at the apex of the stalk, which rapidly pushes upward and puts out new leaf stems. The fruit development is so rapid that buds, flowers, green and ripe fruit are often seen at the same time. The male flowers are born on hanging stems, ranging from 6 inches to 1 foot or more in length (hence the "hanging papaw"), and may be white, bright yellow, sometimes tinged with purple, often developing considerable fragrance. The hanging stems in older trees bear fruiting flowers and present a somewhat curious sight. The fruit of the hanging papaw is not large, but is very sweet. The fruits vary considerably in form as well as in size. They are orange shaped, squash-like or quite resembling the cocoa pod; again, they resemble musk-melons, and in the highly cultivated variety water melon shapes are seen. The fruits are green (or purplish cast) turning yellow when ripe.

The skin of the melon is smooth and thin. Before ripening the greater bulk of the latex lies just under this skin. The flesh of the green fruit is white, tough and watery. As the fruit ripens it turns to a musk-melon yellow, with a thickness of about 1½ inches ending in a central cavity which is filled with seeds attached to and held together with a delicate membrane, which constitutes the inner skin of the fruit.

The seeds when fresh are dark brown, changing to black on drying. Before dessication their outer membranous coating is transparent and slippery; the inner coating is hard, horny and wrinkled, and between these two coatings lies a mucilaginous substance containing myrosin. Within the inner shell lies the leaf-like cotyledons, veined at the base with an albuminous homotropal embryo with a roundish radicle easily distinguished when slightly magnified.

The seeds when dried resemble pepper. They are aromatic, pungent piquant but not as sharp as mustard, their taste slightly suggesting water cress.

Cultivavion and Growth.

It is quite common for numerous papaw plants to spring up from seeds scattered by the birds over a portion of land which, according to tropical custom, has been cleared by burning away the trees and undergrowth. There are no forests of papaws because the plants need sun and room. They are seldom seen among dense growths. They do not propagate in clusters. For the most part they are the product of cultivation, and near every hut are carefully guarded groups from two to six in number.[5]

They present a striking appearance with their straight slim, shiny stalk; their bright green umbrella tops towering above a wilderness of flower-sprinkled verdure. Most beautiful specimens are seen in such a place, their base covered with a tangled undergrowth of trailing, climbing vines. Their roots are kept moist by fallen leaves; and enriched by nuts and fruits that fall and rot among the masses of forage and litter so abundant in tropical gardens.

(5) This has particular reference to the habits of the *Carica Papaya*. Certain varieties such as the *Carica quercifolia*, *C. microcarpa*, etc., are sometimes found in the dense forests.

The only cultivation they can possibly receive must come from a little house waste promiscuously thrown from the hut, the browsing of the ever present dogs, asses and goats. But under these conditions fruiting is generally abundant. They exhibit somewhat the characteristics of the melon tribe. The young plants are exceedingly sensitive and tender; under slight adverse conditions they succumb and die.[6]

A place where it never rains but always pours seems best suited to the papaw. My records show the most thrifty trees in spots where it rains nearly every day in the year; pouring, soaking rains with a fierce, bright sun shining all through the downpour. After the rain come the insects, lizards, centipedes and other creeping things that delve among the roots and climb up the stalk of the papaw and do the real cultivation The plant will not flourish in swampy nor sandy soil, and seems to be at its best in the rich humus of the hillside.[7]

It grows at the edge of the sea with the waves washing the roots, luxuriates in the high mountain plateaus in all of the windward and leeward islands; it flourishes but does not attain to any great height on the bare coral rocks of Yucatan. In parts of Peru it grows prolifically without much cultivation or care and it is reported that in the Transandine regions it reaches a height of over one hundred feet.[8]

In some localities the plant begins to grow fruit in seven months; in others eighteen to twenty months from the seed. Usually its life is rather short, two to three years being the maximum fruit-bearing period. (A rare specimen was observed which was eighteen years old, and was bearing one to two fruits each year.) The fruiting of the papaw is abundant From two to three hundred have been gathered in a season from a wild tree, in size varying from an inch in diameter

(6) Professor Rusby (" Carica Papaya," *Druggists' Bulletin*) has stated that this tree " can be propagated and grown with great readiness; that its vitality is so great that it is with difficulty destroyed until its natural course has been run." Six years' observation has convinced me that it is exceedingly difficult of cultivation, and that the cultivated trees are most easily destroyed by adverse conditions.

(7) The following is an incomplete analysis of a plot in Jamaica on which were several fine specimens of the papaw:

Water (in air-dry sample)	5.02
Volatile matter	20.12
Silica	32.72
Lime (as oxide)	10.62
Magnesia, (oxide)	1.00
Potash (oxide)	.52
Sodium, trace	
Magnesia, trace	
Aluminum (and iron)	8.64
Carbonates (CO)2	5.81
Phosphoric acid	10.20
Sulphates, trace	

(8) In Venezuela thrifty specimens are cultivated in the sandy soil of the ravines. There is here, however, a rainfall averaging one metre per annum and the climate is very equable.

to that of a base-ball. The cultivated plants yield from twelve to sixty fruits, weighing from five to twenty pounds each.[9]

It is reported that in Brazil, in the French Colonies in Algiers, and in the Island of Réunion, successful and extensive cultivations have been carried on. In the Island of Montserrat a large acreage under cultivation was some three years ago, destroyed by a tornado . . . The wild plants do not seem to be attacked by disease except after injury, but the cultivated plants seem very susceptible to every sort of malady. Insects attack the tender leaves of the young plants, and they wither. Fungi and bacteria find here a suitable soil.

After fruiting, and especially if the fruits are bled, the tree will take on a general debility and become the prey of every adverse circumstance. One large field was entirely eradicated by a disease or diseases which the natives attributed to attacks of the "macaca worm,"[10] In my opinion, the trouble arose from the inherent weakness of the cultivated plant in its altererred environment, which rendered it susceptible to attacks of beetles and insects of various kinds

In another series of plantings conducted with still more careful preparation of the ground and selection of seeds, coupled with care for the young plants, there was a record of a small proportion of plants coming to maturity, and of these only a meagre part bore fruit. None of the plants or their fruits were as large as those of the parent stock. All of these efforts were accompanied by phases which were puzzling and embarrassing.

The variations in plant life which one sees and hears of in these regions are somewhat interesting. It is stated that the shaddock contains thirty-two seeds, only two of which will produce shaddocks; the remaining thirty will yield sweet oranges, bitter oranges, forbidden-fruit, good oranges and bad oranges, and until the trees are in full bearing no one can guess what the harvest will be. The seeds of the mango selected from the finest fruit and cultivated with care, will rarely produce anything approaching the parent stock. In fact no two trees of the mango seem te resemble each other. The papaw is likewise very prone to variation. Seeds selected with extreme care from flourishing trees, the fruit of which would weigh fifteen pounds, upon being planted would in part follow the parent stock, other portions would revert to the wild prototype and yield fruit the size of a hen's egg.

9The best method of planting papaws is to raise the young plants in beds and as soon as they are three inches high transplant them into bamboo joints, in which they can be kept until they are 9 inches high, when they can be transplanted to the open ground. In dry districts they will require abundant watering, irrigation twice or thrice a week being absoluetly necessary. In wet places they can be grown with little or no water. Papaws require good, rich, deep soil, and good cultivation, even then, many of the plants, just as they should commence to bear, suddenly fail, the plants cease to grow, the young leaves turn yellow and fall off.—(Wm. Fawcett, Bulletin Botanical Department, Jamaica.)

10 The term "macaca worm" in the tropics is applied to the larvæ of various beetles which feed upan plants that are undergoing decay. I supposed that plants already diseased were the only ones affected, and that the ravages of these larvæ hastened decay. At the present writing these larvæ are reported as doing great injury to the logwood trees.

In some of the fruits of the papaw the seeds number five, in others prodigal nature supplies over five hundred, apparently only a few of these seeds are fertile. When a native desires a single tree, he buries two or three such fruits in the ground, and at most two or three plants are the result After continued experiment it was found that seeds taken from the central portion of the largest and finest fruits were the most likely to be fertile, and would give more encouraging results The proper adjustment of the sexes in tropical soil is difficult and exasperating.

The papaw is much like the nutmeg in its vagaries of sex relation. It is generally agreed that for fertilization one male to ten female plants is the proper ratio, but until the trees arrive at the blossoming stage (five years in the case of the nutmeg) the male cannot be distinguished from the female. One can imagine the dismay of the cultivator who finds at the end of all his toil and waiting that he has a plantation of male non-fruit-bearing instead of the coveted female, or fruit-bearing plants. I have records of numerous instances where acres of ground were planted with thousands of papaw plants in which the males were in the majority of over fifteen to one.

This constantly recurring disproportion of the sexes suggests that in cultivation we were so changing environment as to cause a perversion of the sexes, resulting in a race of non-fruit bearers.

Methods of artificial fertilization and budding, such as is followed in the propagation of melons and oranges, are now in the experimental stage.

CONTAGIOUS SKIN DISEASES OF THE HORSE.*

By Dr. Theiler.

Prevalence of Skin Diseases.

One of the most striking results of the importation of a large number of horses from foreign countries has been the appearance of skin diseases, hardly ever met with in this country previous to the war.

Skin diseases have spread in an alarming way, and are now very common. They are very troublesome and sometimes hard to cure, and have caused the death of many valuable animals, losses which can only be attributed to a weakening of the system and the emaciation of the subjects.

Mange.

These diseases are commonly known by the common name of Mange; they are not always the actual Mange, but at the present time it is certainly the most prevalent disease.

The expression "mange" includes all skin diseases caused by a small parasite, belonging to the class of Arachnoidea related very closely to the tick family, one well known to every inhabitant of South Africa.

* From the Transvaal Agricultural Journal, Vol. I. No. 3. April 1903.

Parasites of Mange.

The mange parasites belong to the genus Acarina, and are known to exist on the horses in three species, namely :—

(1) Sarcoptes.
(2) Dermatocoptes.
(3) Dermatophagus.

They are very minute creatures, and can only be properly recognized by the microscope; by the naked eye they are just seen as a very small speck. Under the microscope the male can be distinguished from the female.

In the abdomen of the latter, eggs of a relatively large size may be seen—a female can deposit from 15 to 25 of these.

The hatching period lasts from three to seven days. The young acarinae, called larvae, then leave the egg.

They move about on three pairs of legs; on reaching the state of nymphae they have four pairs of legs; and from that stage in a fortnight's time they become mature.

Rate of Increase.

The following calculation may show in what an alarming proportion the descendants of a single Sarcoptes female can increase. Let us suppose that one mature female produces ten young females and five young males, these produce a fortnight later the same number, viz., a Sarcoptes grandmother has after a lapse of 30 days fully 150 offsprings. These will produce after 30 days some 10,000 descendants, and in three months we arrive, following the same proportion, at the enormous number of over one million Acarinae.

This may sufficiently explain how quickly the disease can spread, and, when neglected, how soon a number of animals can be found in a very short time to be affected by the disease.

Difficult to Destroy.

These Acarinae are very tough parasites, and not always easily destroyed. In moist places, amongst manure, for instance, they can live as long as eight weeks; in dry surroundings from two to six weeks. Eggs of Acarinae in similar conditions live respectively two to four weeks and four to six days.

This shows that any place occupied by a horse suffering from mange may remain infected for a considerable time.

The three different species of Acarinae above mentioned do not exist at all in the same conditions, but their results are practically the same.

According to the seat of the disease, the mange can sometimes be recognised without the help of the microscope.

Sarcoptes Mange.

The Sarcoptes dig real tunnels in the skin, and lay their eggs there; these, as they develop, go on with the digging process, and in so doing cause a severe inflammation of the skin.

This is especially noticeable on the head, neck, and shoulders of the animal, which are the first to be affected, but the disease may start on any part of the body.

The first symptoms are small spots devoid of hair; these increase in circumference, and very soon join each other. In these spots can

be seen small nodules or vesicles, which change into scab; the skin then becomes thickened, wrinkled, and drawn into folds, which gives it the appearance of a rhinoceros hide.

The affected parts become itchy, especially when the animal feels the heat and in trying to relieve this itching by rubbing or biting the sore parts, raw places very soon appear on the skin, and the inflammation becomes general. At this stage mange is very easily recognised, but at the very start of the disease and when there are only a few hairless spots, it is not readily detected.

All doubt can, however, be removed when the itching begins; the Sarcoptes are then sure to be present.

All horses suffering from mange are very fond of being scratched, and show their appreciation of such an act by moving their lips.

From these notes it is evident that if neglected, mange caused by Sarcoptes, easily becomes an obstinate disease, since the Acarinae, being so deep in the skin, are not always easy to reach. Thus the sooner treatment is started the better will be the chance of success.

This disease may be transmitted to human beings.

Dermatocoptes Mange.

This parasite differs from the Sarcoptes, in that it lives on the surface of the skin, and derives its nourishment from the blood and lymph.

It generally begins by attacking the base of the mane, the tail, the throat, or the sheath, udder, and the soft parts in the inside of the legs. This kind of mange does not, as a rule, spread over a large surface, but remains on circumscribed spots.

The bite of the Dermatocoptes causes a local irritation, producing a nodule, out of which oozes a sticky liquid, which in drying forms a scab; at the same time a desquamation (forming scales) of the skin and a falling out of the hair takes place, producing a well-defined spot whereby the disease can be located.

These scales and scabs remain and stick together, forming a bark-like surface under which the skin is thickened, assuming the appearance of tanned leather. The irritation thus caused induces the animal to rub itself whenever it can, and very soon the skin becomes very much inflamed and breaks into sores.

Whenever the Sarcoptes or Dermatocoptes mange spreads over the body, it will become very difficult to recognise the one from the other. It is only as long as the different forms keep to the seat of their predilection that it is possible to diagnose whether the disease is caused by Sarcoptes or by Dermatocoptes.

It is evident from the superficial seat of the Dermatocoptes that this parasite is much easier to destroy than the deeper seated Sarcoptes.

Dermatophagus Mange.

This parasite is mostly observed on a horse's legs usually about the fetlock, where the symptoms are very much the same as what has been described as being caused on the body by the other two Acarinae.

This form of the mange very seldom reaches the body, and generally remains on the limbs, sometimes reaching the elbow joint on the forelegs or the hock on the hind legs.

It usually takes months to develop and to be seen; when a horse starts pawing the ground, kicking or biting the limbs without any apparent reason, then it will be well to investigate closely into the cause.

Treatment.

The object of the treatment is to kill the Acarinae and their eggs. Without Acarinae no mange is possible; for this purpose many remedies are used; and cheap and effective ones are found within easy reach:

Carbolic acid, creolin, lozal, benzine, paraffin, tar, tobacco, sulphur, soft soap, and caustic soda are all to be recommended.

The treatment at the beginning should aim at the softening of the scabs with either soft soap, caustic soda, oil or fat. Soft soap can be simply rubbed into the skin and allowed to remain there for 24 hours. Caustic soda and carbonate of soda should be used in solution in the proportion 1–50 to 100 water (1 part of caustic soda to 50 or 100 parts of water.)

The oils and fats should be well rubbed in, and a second application given next day if possible. It will be found advantageous to mix the oil with paraffin or with carbolic acid, creosote or creoline, in the proportion 1–20 to 30.

After 24 hours the whole body should be well washed with warm water and soap, and the parasiticid mixture should then be well rubbed in, and allowed to act for at least six days; then the process should be repeated.

Parasite Destroyer.

The parasiticid mixture consists of either paraffin and oil in the proportions as above, tar and sulphur, one part of each, mixed with soft soap and spirits of wine—two parts of each. The different ingredients to be well mixed.

Another mixture is: Carbolic acid or creosote in oil 1–20. Also sulphur mixed with fat, allowing 1–5 fat. Benzine mixed with oil 1–3. Creoline with soft soap in equal parts and dissolved in spirits of wine four times its weight. Tar ointment 1–10. Tobacco decoction not stronger than 5 per cent.

When the disease has reached a chronic state, and is not inclined to yield to these treatments, then it is advisable to use different medicines alternatively.

When strong solutions of the above medicines are used, it is advisable not to treat the whole body at once, but to use them on certain parts first, and continue the treatment by degrees until the whole body has been submitted to it.

It will be necessary to disinfect stalls, and all articles which have been in contact with a mangy horse before using them either on healthy horses or on the horses already cured.

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BULLETIN

THE

DEPARTMENT OF AGRICULTURE.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Sixpence.

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JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. I. SEPT. & OCT., 1903. Parts 9 & 10.

THE IMPROVEMENT OF HORSE-BREEDING IN JAMAICA.

REPORT OF THE COMMITTEE OF ENQUIRY TO THE BOARD OF AGRICULTURE.

His Excellency the Governor in a letter to the Board of Agriculture, expressed his desire that the Board should formulate practical proposals for improving the horses of the island. A committee consisting of Messrs. C. E. DeMercado and H. A. Cousins was appointed to enquire into the matter and report to the Board.

A circular letter was drawn up and sent to all the chief breeders and authorities on horseflesh in the island. Thirty-five detailed replies were received. Extracts from which are given below.

They are arranged seriatim in the order of the terms of reference in the circular and after each is given a summary by Mr. Cousins upon whom in the absence of Mr. DeMercado the duties of the Committee devolved.

Circular re Encouragement of Horse-Breeding in Jamaica

Sir,

In accordance with the special desire of His Excellency the Governor, the Board of Agriculture proposes to formulate practical suggestions for the improvement of Horse Breeding in Jamaica. We have been appointed to investigate and report thereon to the Board and have the honour to request your valued assistance and advice

We submit the following points of reference for your observations.

1. Should stallions be imported ? If so, of what type or types ?
2. Is it desirable to import mares ? If so, what are your practical recommendations ?
3. What are your opinions as to the present standard of horseflesh producible in Jamaica ?

4. In what direction is it desirable to encourage the aims of horse-breeders ?
5. What conclusions can be drawn from the results of the sires imported by the Agricultural Society ?
6. What practical suggestions do you offer for the consideration of the Governmont—
   (1) for promoting better returns from our present stock of horseflesh :
   (2) for infusing fresh blood by judicious importations?
7. What prospects are there for an export trade in horseflesh—
   (1) to other West Indian Islands :
   (2) Polo Ponies :
   (3) Mounted Infantry Remounts.
8. What are your views as to the secondary advantages of producing larger stock for breeding draft mules ?

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1. Should Stallions be imported ? If so, of what type or types ?

Hon. J. V. Calder : I think a stout thoroughbred stallion should be imported, he should be sound with plenty of bone and not less than 16 hands high. There are so few mares in Jamaica worth looking at that I think at present only one stallion is required. There are several horses (imported) now here but they are mostly on the small side. The premier Blue Rock, who has always beaten any shown against him, is now getting old.

The stallion should serve at a nominal fee, mares of not less than 14.2 and the preference should be given to *thoroughbred mares* of 15 hands and over.

W. G. Clark, Esq. : Yes. 1st. ; "Cleveland Bay," an average 15.3 or 16—horse with plenty of everything that Jamaica horses lack Progeny of Cleveland Bay sires should be what we ought to build up our remount stock from.

2nd. A thick thoroughbred.

W. Cradwick, Esq. : Yes, most decidedly.

Robert Craig, Esq : There is little use in importing stallions of any type now seeing there are so very few mares of type and substance to put them to in the Island. Thorough breds of good bone and substance, (not of the racing class), short legged, from 15 to 16 hands high, and not from fancy studs, would, in my view, give the best results, if suitable mares were available. The Highland Horse — (North of Scotland), from 14·2 to 15 hands would, with suitable mates, give fine weight carrying stock for hill work and draft.

James Daly, Esq. : Yes. Thoroughbreds 15 hands and over.

H. G. T. Drew, Esq. : Yes. Thoroughbred race horse of about 15·2 with plenty of bone, round ribbed, and standing well on his feet, (somewhat after the build of the "Cleveland Bay.")

The thoroughbred (race horse) crossed with almost any stamp of horse, produces a useful animal.

Dr. C. R. Edwards. : Stallions should be imported
   (a.) Thoroughbreds of the heavy hunting type.
   (b.) Cobs of the Welsh Pony type.

C. A. T. Fursdon, Esq.: A moderate number of stallions should be imported, great care being taken over their selection—they should be kept at a Government Stock Farm and in the season visit different districts where arrangements might be made for them to stand for service under the care of a resident in the district in some such way as is being done with the Welsh Pony. The fee to be reasonable but *only* mares up to a certain standard to be accepted, and premiums to be given for the best three colts produced at 12 months old to encourage early maturity. Irish Hunter type—to give fair amount of quality and substance but not too heavy about 15 to 15·1 hands and able to do a good hard day's work whenever called upon.

J. M. Gibb, Esq. V.S.: Yes. Cleveland Bay and light hackney.

B. S. Gosset, Esq.: I think it is desirable that stallions should be imported. I consider that the best type of horse to improve our draft horses is the Norman Trotting breed of coach stallion

I am attaching a photo of one now used in England. I have seen many of them at an international horse show in Paris and was much struck with them. Normandy is a noted district for breeding London carriage horses, they cost about £90 each at 5 years old, nearly all the London carriage horses are imported not bred in England.

H. W. Griffith, Esq.: Yes. Most certainly.

Of two types: *Thoroughbred Stallions*, for those portion of the breeders, and public, who still hold to *Racing*.

Hackney Cob Stallions, (from 14·2 h.h.: 15 h.h.) for breeders, who are looking to useful, all round animals (riding and draft.)

Colonel H. E. C. Kitchener: Yes. Stout Canadian high action horses.

A. P. Lockwood Wingate, Esq.: I think stallions should be imported regularly and continuously. We are told that years ago on "Pepper" and "Goshen" respectively there were at one time five and seven imported stallions serving at the same time, and no doubt on many other Pens there were a like number which goes to prove how the high standard of horses in those days was reached and maintained.

The thoroughbred, I think, is the best type to import, but of the thoroughbred hunter kind. The sort of horse which is found in Ireland in the hunting fields—thoroughbred, but with plenty of bone and substance and up to any weight over a hard country after hounds.

Hon. G. McGrath: I think the importation of thoroughbred stallions would be decidedly advantageous, and the only description of sires which would prove satisfactory in the end and conduce to the improvement of horse-breeding in Jamaica The services of sires should be available in the different districts of the Island and thus prevent the necessity of sending mares to any great distance.

A. C. L. Martin, Esq.: The type of thoroughbred stallion best suited to get serviceable animals in the Island and to mate with fillies by Sir Gerald or other mares 14 hands and 14.2 should be an animal 15.2 with short legs, deep girth, about 6 ft. 2 in. good hind quarter plenty of bone below the knee, free from any disease that would be

transmitted to his offspring, From my own experience in horse-breeding and basing my theory on actual experiments that I have tried, I have been able to produce several serviceable animals by mating 14 hands mares with an animal such as described above. But the sire must be thoroughbred as no mongrel or half-bred animal will improve the breed by crossing.

E. W. Muirhead, Esq.: I am rather of opinion that stallions are not so much needed, but a few thorougbred ones of great size and quality will always be of value. I rather lean to a good stylish hunter (which generally is as well bred as possible). A Hackney of the type of Courtier (who died early after importation) should tend to do good.

J. T. Palache, Esq.: The type should be 1st thoroughbred stallions. These are the only ones likely to do any good. After 40 years of intimate connection with horse breeding, and holding in my possession the largest collection of records relating to the horse and horse-breeding in Jamaica, I unhesitatingly say that any attempt to introduce any of the other large breeds of the Northern climes will result in utter failure.

A. C. Paton, Esq.: Stallions should be imported and the type I consider the most advantageous to breed from is a stallion standing from 14·3 h. h. to 15 h. h. of the weight carrying hunter type. My reasons for proposing this height and type are these. The weight carrying hunter type would correct most of the faults which our mares possess such as lack of bone and general want of substance at the same time being a horse with say about seven eights of thoroughbred blood in him he would not perceptibly impair the good qualities which our mares possess.

A 14·3 h. h. or 15 h. h stallion would be a very little bigger than the average of our native mares and as nature determines the size most suited to the locality, if we breed to about the size of horse now in the island we will get the size most suited to the island. Apart from that there is a very limited demand for big horses in the island and I doubt if we could even breed them good enough to export, and if we could the price we would get would never cover the cost of feeding.

Hon. Dr. Pringle.: Yes. Pony Stallions Hackney Stallions at first put to our best mares to produce bone and quarter This progeny could be then treated with stallions that produce the hunter class and the racing class at home.

A. Roxburgh, Esq.: The importation of fresh blood at intervals is absolutely necessary and I am of opinion that this should be one of the duties of the Government. There is not, at present sufficient inducement to encourage private enterprise in this direction. Racing having come down to a very low standard.

The thoroughbred is, without doubt, the horse for Jamaica, but it is difficult to get the right stamp. Bone and substance are essential. The class of thoroughbreds usually imported being very fifth rate, do not possess these qualities. Hence the degeneration of our horse flesh into " weeds.

Three-quarter bred Hunter-Stallions of the short legged type would I think answer the purpose when put to our well bred mares.

Hon. T. H. Sharp.: The importation of stallions from time to time is necessary, but should be left to private enterprise.

Joseph Shore, Esq.: Certainly, but not of the English Type so commonly imported hitherto. The Arabian breed seems best suited to Jamaica (or some similar strain from a warm country.) From personal experience, some 20 years ago horses with the Arabian strain were procurable from some of the north-side pens, and they did well; being good journey makers and hardy, in both saddle and draught. This strain is now out.

Bernard Toole, Esq.: It is highly desirable to import stallions. A high class hunting stallion calculated at home to produce twelve to thirteen stone hunters. This animal usually stands from 15·2 to 16 hands, and while not at all a "heavy" horse possesses plenty of bone and substance, has fine actions, short legs and good body. A cross with a horse of this kind and our small sturdy Jamaica mares would I think produce a good class of ride and drive horses of a useful size. This cross would also have the advantage of improving size and substance without loss of the thoroughbred strain.

I do not know any other type so suitable for importation as the above.

United Fruit Co: We are of the opinion that if the standard of our working horsekind is to be improved and maintained, it will be necessary not only to import stallions but to import them at regular intervals of from 8 to 10 years, to avoid the evils of in-breeding, etc., and we are of the opinion that the stallions imported should be of a class to produce good roadsters, saddle and draft, of the pony standard. The stallions, we think should be in point of size range from 15·2 hands and upwards, and consideration should be given chiefly to bone and compactness.

A. Byron Ventresse, Esq.: A few stallions might be imported to advantage but they should be of the Hunter class.

Hon. C. B. Vickers: I think high bred stallions should be imported to get saddle and draft animals. Coarse bred stallions are not in my opinion desirable for their progeny could never compete with mules for heavy work in this climate.

R. A. Walcott, Esq.: I think stallions should be imported from time to time. The type must depend upon the kind of horse the breeders desire to produce. Hitherto nearly all the importations have been made in the interest of racing, and the result has been to produce a class of horses possessing remarkable endurance, speed and soundness but very deficient in weight and bone for heavy draught.

C. L. Walker, Esq.: A thoroughbred stallion about 15½ to 16 hands should be imported and if possibe to get them, with large carcases, standing on short legs.

Hon. W. Watson.: Yes. As horses in Jamaica are not likely to be used for heavy draft purposes, but simply as roadsters, it is desirable to stick to the English thoroughbreds for this class of horse.

Bearing in mind that bone is essential and that horses deteriorate rapidly in the tropics, sires of 15·2 and 16 hands with bone, should be resorted to, seeing that at present our mares are extremely small. The Welsh pony, "Sir Gerald", is in my opinion a success, and that type of horse is the best for the mountain districts.

J. R. Williams, Esq.: In order to benefit the classes unable to import or to purchase the better bred stock, stallions should I think be imported. I do not think there can be any doubt about this: the difficulty is, rather, how are such stallions to be kept so as to render their services available to the largest number?

I think stallions of the Irish Hunter type would be not generally useful.

If there is a stock farm, the importation of a thoroughbred occasionally, or now and then a Welsh pony for less general requirements, would be useful, for with the fuller equipment of a stock farm, all the interests of the island, and not merely, and not chiefly, the smaller and less independent interests should I think receive consideration.

R. L. Young, Esq.: Certainly stallions should be imported, but not the cheap, third rate, broken down class, that have been imported as a rule into this country, with nothing to recommend them but an immense pedigree and a lot of hereditary blemishes—which have done very little, if anything to improve our present strain.

We want a couple of new stallions every alternate year, but they should be of the very best strains, sound in wind and limb, and above all something showy to catch the eye. Either thoroughbred or of the hunter class and not under 16 hands in height.

Summary by H. H. Cousins.

There is a strong general opinion that stallions should be imported. There is a great variation of opinion as to the type most desirable. After careful consideration of all the data available and consultation with breeders of long experience I recommend as follows:

1. A stout up-standing thoroughbred of at least 16 hands of the "Blue Rock" type for getting draft stock, remounts and increasing the size of mares for mule-breeding.

A hunter-breeding thoroughbred of the type of the King's Premier sires in England if obtainable for a sum not exceeding £200 would do as well. A ¾ bred sire would not be satisfactory. Pure blood is essential for prepotency.

2. To satisfy the section of the public who desire Hackney or coarser blood to increase bone and substance (although I do not consider it likely to do what is expected) we should import a Cleveland Bay, if obtainable for £120. These are clean-legged and the most likely large breed to give us size without lack of quality. The progeny would require feeding.

2. Is it desirable to import Mares? If so, what are your practical recommendations?

Hon. J. V. Calder: I think it would be desirable to import mares and I believe there would be plenty of army drafts to be got that would be of great benefit. *At present,* however, I dont think it would

be wise to import any mares as their cost of keep would be heavy and probably beyond our means and possibly wreck any attempt to resuscitate breeding. We must go slowly at first.

W. G. Clark, Esq.: Yes, certainly, *but* only if the Government start a stock farm and import a quantity, say at least 20—or, the Agricultural Society to import a certain quantity every year selling them at public auction on their arrival.

W. Cradwick, Esq.: No, the mares in the country are good enough being usually much better cared than the geldings.

R. Craig, Esq.: It is clearly *most* desirable to import mares—without good dams it is impossible to raise good quadrupeds of any kind. Just where these can, or can *best* be procured, is a difficult question—price, including cost of importation, is perhaps the most important factor—for merely local use, and sale, a high price could not be given—with a subsidy, or the guarantee of a certain price at a certain age, for stock produced, the position would be raised.

I am not prepared to say from what country mares could be obtained—possibly Canada or the United States—but I have not seen, from either of these countries, the type of mare I would choose. They may however, be obtainable. Those I have seen, are heavy footed as a rule in fact heavy all over, and not sufficiently compact and active. If the matter of importing mares was taken up by the Government, as I think it should be, and the type of mare most desirable decided on, it would be necessary, I think, to send say, two experienced persons abroad to ascertain where supplies could be drawn from yearly The mares should be half or three quarters bred by this description I mean what are called in England light horses, as against heavy draft.

James Daley, Esq.: No.

H. G. T. Drew, Esq.: Yes, in order to maintain the high standard of breeding recommended (the thoroughbred)

Import say 3 mares of same stamp as the stallions, keep them under skilled supervision. for say 3 months, have them served by the stallions imported, then sold at auction. Offer at your agricultural, or horse show, a good premium for the best colt produced from these mares.

Dr. C. R. Edwards: It is desirable to import mares. For preference Flemish mares, to give us bone and quarters which our own mares lack.

C. A T. Fursdon, Esq.: Yes, in order to get early results this is very important, the island is exceptionally deficient in good bodied mares. Given a stock farm, there should be at least 20 there, and their progeny disposed of at an annual sale. A premium should be offered for mares of a stated quality imported for breeding purposes and payable on birth of first colt.

J. M. Gibb, Esq., V.S.: Yes. Mares of the Hackney stamp, about 8 mares. Probably these could be got from the War Department. Cast off mares, sound for breeding purposes.

B. S. Gosset, Esq.: I don't think imported mares are of much use for breeding in Jamaica. I have known a good many, most are either barren, miscarry their foals or do not raise them.

The change of climate seems to affect mares more than stallions.

H. W. Griffith, Esq.: Most certainly, even more so than stallions. Mares of Hunter class, not necessarily thoroughbreds, but well bred with plenty of bone.

Colonel A. E. C. Kitchener: No.

A. P. Lockwood Wingate, Esq.: Desirable, yes: A few, but hardly necessary if the importation of stallions is regular and continuous, as we should then very soon be able to produce mares hard to be beaten by imported ones.

Hon. G. McGrath: In Yorkshire good hardy stock for coaching and other purposes have been bred by crossing the thoroughbred sire with Cleveland mares and Yorkshire coaching mares. I think the importation of a few Cleveland mares would be desirable. The importation of mares would be more expensive than the importation of sires owing to the number of foals produced by the one as compared with the other. I am afraid the importation of mares must be left to private enterprise as affecting individual interest.

E. W. Muirhead, Esq.: I lay more importance upon the importation of mares than any other means of improving horse breeding and should suggest that mares accidentally* blemished of good strain be imported (in foal) but particular attention should be paid to shape and size, as also to mating.

J. T. Palache: I am of opinion that it is far more desirable, or at any rate just as desirable, to import mares and in much larger numbers than stallions for reasons which I will touch on later.

The number of really first class mares fit for breeding is very much diminished in Jamaica to day and requires to be replenished and strengthened in many directions—

1. Type thoroughbred mares so as to be able to breed on the spot first class acclimatised stallions and mares for distribution throughout the Island at cheaper rates and at less risk than importing.
2. Type thoroughbred pony mares registered in the Polo Pony Stud Book for the like reasons and purpose as above.
3. Type sound good half or three-quarter bred mares such as are bred in Ireland and many parts of England to cross with thoroughbred sires to produce Hunters and in Kentucky and Ohio, for producing mules. These mares could be put to thoroughbred stallions here and their fillies used for breeding mules and thus import size and substance to our mules.

It must be kept in view that the horse required for general utility in Jamaica is the light active muscular horse for our light vehicles and hill roads, and there is positively no work for the heavy cart horse of northern climes—plough and other agricultural work being performed by mules and oxen.

A. C. Paton, Esq.: If it is decided to increase the size of the horskind then mares will have to be imported. Our small mares even if "put to" a large stallion would not necessarily give large foals, in

* Accidentally on account of the difference in price for which they may be bought.

fact as a rule however large the stallion may be if "put to" a small mare, the progeny will nearly always be small as the mare has not sufficient room to develop a large foal. An instance of this is found in mule breeding. However big the stallion is if "put to" a jenny the progeny is generally small. I believe however, that by judiciously mating the mares we have got in the island with the right type of stallion a good class pony can be bred.

A. Roxburgh, Esq. : I don't think so. We have a good supply of mares well bred, and only requiring careful selection, to breed from. They may want shape and bone, but good strong sires will supply those qualities. The mares have the blood—which probably the imported mares would not possess.

Messrs. T. H. Sharp & Son : It is not desirable to import mares, the stock should be improved by sires.

J. Shore, Esq. : I think so—but this could only be done by private persons, not by societies—the progeny from a mare being limited.

The mares got by English stallions now in the country could be put to Arabian imported stallions.

Perhaps a few mares could be imported of the Arabian breed also, to start a stock from acclimatized.

Bernard Toole, Esq. : While the results from mares brought into the island must be necessarily slow I am of opinion that the importation of a few good ones would be advantageous. Strong well bred animals of fair size between fifteen and sixteen hands—and from three to five years old would suit. The selected male produce of these mares might be good enough to keep for stallions and thus render the importation of fresh blood (at least for some time) unnecessary. I take it that both mares and stallions would be kept at a suitable place by the Government or Agricultural Society or some such body under intelligent management and that their services would as far as possible be available to the whole island at a reasonable cost. The stallions should I think be distributed during the season at suitable centres and return to their head quarters when the season expires In no case should the imported mares be intrusted to private individuals.

United Fruit Co. : The importation of mares should, we think, be left to private individuals who may be so minded, as it would be a more difficult task and too costly to raise our standard in that way.

A. B. Ventresse, Esq. : If suggestion 1 is not carried out then I should like to see some mares imported, and they should be of the Hunter or Hackney class, because our standard of good serviceable stallions at present are much greater in proportion to the number of good mares, and the above named class of mares with our own stallions should produce good serviceable horses for our own uses, as well as for remounts, at the same time I am well aware that this would not produce any standard breed, but I think our object should be utility and not the cultivation of special breeds.

Hon. C. B. Vickers : Mares might be imported with advantage if the expense be not an obstacle.

Hon. W. Watson : No. As the question of acclimatising is one of

great difficulty and risk, seeing that we must turn brood mares into open fields, and degeneration sets in at a rapid pace; but, if Stallions are imported largely, and stabled and cared, this will eventually improve the breed.

C. L. WALKER, ESQ: Mares same size as the stallions and as many as can be purchased in England, that are injured and unfit for hunting; this class of mares are sold yearly in great numbers and can be purchased for about £13 to £14 per head.

J. R. WILLIAMS, ESQ.: The importation of mares at the public expense will only be justifiable and expedient, I think, if there is a Stock Farm, where imported mares of the same type as may be approved of for imported stallions can be kept, to supply pure bred stock of such approved types for public sale and public benefit.

R. L. YOUNG, ESQ.: I do not think it is absolutely necessary to import mares. Really good mares can be got in Jamaica if pains are taken to select them. But the general idea is that an animal that is unfit for anything else must be put to breed. Hence the reason that the large proportion of colts bred by imported sires are failures. If the Government intended having a stud farm I would certainly suggest that they import a few well-bred and shapely mares from which could be bred serviceable sires from the imported stallions. In this way the influence of these imported sires would be most quickly felt throughout the island.

SUMMARY BY H. H. COUSINS.

After considering the opinions given, I recommend as follows:—

1. When the stock farm is established, some mares should be imported for breeding. These should be well-bred, cheap and of various types.
2. Enquiry should be made as to the cost of landing (a) cast Army mares of light cavalry type (b) cast Hunter mares. If obtainable at a low price a trial importation should be made and the mares sold by auction.

3. What are your opinions as to the present standards of horseflesh producible in Jamaica.

S. C. BURKE, ESQ.: After fifteen years experience of horses in Jamaica, I have no hesitation in expressing the opinion, that I have never seen a *big* horse bred in Jamaica that would be worth £50 in England. We certainly have never produced a race horse in Jamaica which would fetch that price in England as a race horse, and I very much doubt if I could call to mind a dozen which would have been worth that price as hunters. When we do breed a fair sized horse it is seldom that he is up to weight. We have been trying for nearly two centuries, using the best blood in the English Stud Book, and we have not succeeded so far in producing a single race horse with any pretentions to high class. This fact has been amply demonstrated during the last ten years, by the repeated successes of horses (chiefly in my own stable) imported from England to race in Jamaica. Formerly we were contented to import horses and mares for breeding purposes only, but latterly horses have been imported for racing—

chiefly animals that were too bad to keep in training in England, and these have proved quite good enough to "clean out" our native bred ones.

But although we have been trying and have failed to breed good *big* horses, we have, on the other hand, without special effort on our part, succeeded in producing some very excellent *small* horses or ponies and these from the same stock that we have been trying to breed big ones from. This process the breeders of big horses call degeneration, but I am inclined to regard it more as a natural evolution, and a "throwing back" in size to the parent stock of the thorough-bred-horse, the Arab.

It must always be remembered that every horse in Jamaica, however mean and weedy looking he may be, is thorough-bred or very near it. The horse is not indigenous to Jamaica, and the first horses brought here were the chargers of the Spanish invaders in the 16th century. These horses were probably Barbs or Andalalusians, breeds closely allied to the Arabs, which in their turn were the foundation stock of the English thorough-bred. The decendants of these Spanish importations were crossed with English thorough-breds, as far back as 1760, and there has been a constant stream of thorough-bred blood flowing into the island from that time up to the present day, from which our present stock of horses is sprung. (It is curious that all importations of blood other than thorough-bred have been failures and have died out, a true instance of the survival of the fittes .) Thus it will be seen that our present Jamaica horses are very nearly thorough-bred, for, the present stock of our horses being the original Spaniards, which were themselves closely allied to the Barbs and Arabs (from which the English thorough-bred is descended) and these Spanish horses being in their turn crossed with English thorough-breds the results must be as near thorough-bred as possible This supplies an explanation for what is sometimes a very puzzling fact in Jamaica We often see an exceptionally smart pony produced by the union of a good thorough-bred horse and a common little "bush" mare, and we wonder at the result. But if we would only recollect that this common little mare is probably as well bred as the horse she was matched with, we would no longer be surprised.

From the foregoing remarks it will be gathered that it is my opinion that although we cannot produce a good class *big* horse, we can and do produce from the stock which we now have a very high class pony. The excellence of the ponies which we do now produce, (which be it noted we are not trying to produce, but which are only the misfits of our efforts to breed big horses) is entirely out of proportion to the mediocrity of our big horses. To be logical one would imagine that if we breed bad or mediocre big horses, we should breed moderate ponies. But the very opposite of this is the fact, and I have no hesitation in asserting that our best Jamaica bred racing ponies can hold their own in any part of the world.

The excellence of our Jamaica ponies can be best judged by their performances. Dewey, our champion pony, a 14.2 thorough-bred, has run a mile with light weights in 1.50, and 6 furlongs in 1.18, while with weller weights I myself have had the pleasure of riding him in a 6 furlong race in which he carried 13st. 4lbs. and won in the fast

time of 1.21. My own pony Dinna Forget, won many races carrying over 13st. and all in fast times, his best performance perhaps being when he carried me in two consecutive races of one mile and six furlongs respectively carrying 14st 7lbs. in the former and 12st· 7lbs in the latter and won both with consummate ease, covering the mile in 1.58 and the 6 furlongs in 1.28. Both Dewey and Dinna Forget compare favourably with English ponies as regards make and shape, being of the short legged, weight carrying type, and there is no reason why we should not produce more like them.

We have had an opportunity of comparing the "form" of our Jamaica ponies with the "form" of American ponies, which are admittedly smart. The well-known winners in America Little Monarch, Louise and Doubtful ran in Jamaica and won races There was little to chose between them and Dewey and Dinna Forget. The latter pony and Doubtful were in my stable at the same time and there was nothing to choose between them. Racegoers will remember the dead heat between them at Cumberland pen when carrying level weights.

From the foregoing facts I submit that it behove us in Jamaica to give up the attempt to breed *big* horses, and to turn our attention to the careful and systematic breeding of small thorough-breds or ponies. For if we can get such good ones from chance breeding, how much better ones will we produce when we use discrimination and selection in breeding.

Hon. J. V Calder : If there was a demand for horses at £25 or £30 of 15 hands and over, some would be bred, but whilst there is a ready sale for mules at £18 to £23, there is no demand for horses. At the Hope Show most of the working horses exhibited were imported. I think, however, if a supply of good horses were encouraged a demand would be created. The way to produce this in the first instance is to have some thoroughbreds produced, as I suggest, by means of encouraging races. I am sorry to say the races held now have only two objects: 1st of making money for the owners of the stand. 2nd To enable a few gamblers to get some money out of the French Pool.

W. G. Clark, Esq. : Run too fine and small, apparently there is little choice of good stallions at a reasonable figure within most small breeders' reach and in breeding results.

W. Cradwick, Esq. : The horse flesh produced is nothing like so good as it was ten or fifteen years ago. We produce a few good little ones, but we ought to produce a lot, which would be very valuable.

R. Craig, Esq. : The question is not clear.

If it means the standard of horseflesh *now* being produced—my opinion is that it is deplorable.

If, on the other hand, it means what standard *could* be produced—I have no hesitation in saying that a first-class horse for saddle and draft, can be raised in many parts of Jamaica No attempt should, in my opinion, be made to breed heavy horses for agricultural work—or heavy draft.

In this connection I may be perhaps permitted to say that the deterioration in the breeding of horsekind within the past 25 years has been

lamentable—it was possible even 20 years ago to purchase without difficulty, say a handsome pair of well matched carriage horses 16 hands high—an excellent saddle horse or any number of well shaped useful ponies up to carrying 16 stone. Today it is practically impossible.

In October 1889 I got the Government to introduce, and the Governor's promise of full support to a bill dealing with entire horses—the object being to prevent the indiscriminate crossing of mares by utterly worthless "runts" or entire horses and ponies, a former Law on the subject having lapsed, by effluxion of time. This Bill however was allowed to be wrecked, and nothing has been done since to check the rapid degeneration of the breed. Had the Bill obtained the support to which the Governor was pledged, it would have become Law and it is not too much to say that to-day a much better class of horses would have been in existence.

J. Daly, Esq.: Good, but could be greatly improved by new blood being imported and at a cost to meet the mares of small settlers. More feeding and care.

H. G T. Drew, Esq.; Owing to the scarcity of good young stallions and mares the standard is poor.

The few thoroughbred stallions in the Island, with perhaps one or two exceptions, are old and in themselves defectively built.

Breeding from *old parents* is in my humble opinion, the principal cause of their offspring being so "weedy" and deficient in bone.

C. A. T. Fursdon, Esq.: Very good workers but lacking generally in size and quality, hence only fit for local needs, if that.

J. M. Gibb, Esq., V.S.: Horse breeding has been dying out in Jamaica for more than 12 years, there being no demand for scarcely any class. Within the past 3 or 4 years however there have been signs of a likely demand.

The present standard of horse flesh is below the mark and that producible is better by judicious selection and more attention to youngsters.

B. S. Gosset, Esq.; The ticks are the great drawback to raising horses, but where Zebu cattle are raised ticks are decreasing. The decline in horse racing seems to have had a bad influence on the size of horses, pony races are not the same thing.

At present it does not pay to corn feed a foal unless for the turf.

H. W. Griffith, Esq.: There are two points with regard to the present standard, which I have noticed.

(a.) Though there are several very fine (good size) and well bred mares in the island, on making inquiries of their owners I find they do not have such good foals, as in past days; and that year by year their foals are smaller; though served by large stallions, in some instances mares of 16 h. h. producing animals, that grow to hardly 14 h. h. This in my opinion is partly due to climatic influences, and partly to want of proper feeding from time of weaning.

(b.) Almost all the mares and some of the stallions are too fine bred (light) and also inbred: wanting in substance, and the former wanting in size—this I fancy has a great deal to do

with the diminution in size, and quality, which is so noticeable throughout the island.

N.B. Some hold that ticks are the only cause, I do not think so; for if animals are properly attended to, the ticks cannot make such a great change—it is only when Brood Mares are allowed to run practically wild, and neglected, that ticks do a great amount of harm.

Colonel E. C. KITCHENER: They are exceptionally sound.

A. P. LOCKWOOD WINGATE, ESQ.: The present standard of horseflesh here, I think, is still good; but rapidly degenerating owing to the falling off of importations, many breeders giving up horse-breeding altogether owing to the poor profit got from the business and general lack of interest in the industry from the same cause.

HON. G. MCGRATH: The present standard of horseflesh producible in Jamaica is inferior to what it was in former years owing undoubtedly to the want of proper feeding. The guinea grass upon which the horses are principally fed has deteriorated considerably, for want of manuring and few persons will undertake the expense of feeding foals as they would soon "eat their heads off" owing to the small price now obtainable for good stock. The ticks also contribute their share of trouble in the rearing of horses.

E. W. MUIRHEAD, ESQ.: The present standard of horseflesh is no doubt affected by the poor quality of the grazing in the island, caused by the want of seasons. Consequently they run small and can only be raised up by better feeding; they should then fetch better prices to pay.

J. T. PALACHE: Deficient in numbers but excellent as a foundation on which to build by means of careful selection, judicious importations of the correct type of stallions and mares for crossing. More attention to caring and feeding in the early stages of the life of the yearling stock.

A. C. PATON, ESQ.: The present standard of horsekind in Jamaica is I think bad if compared with most other countries, although, as is generally the case, it is admirably suited for the purposes of the country. If, however, exportation was to be aimed at our horses would have to be very much improved.

HON. DR. PRINGLE: It lacks bone and quarter, suffering all the time from want of selection, being poorly fed when young or worked too early.

A. ROXBURGH, ESQ.: Jamaica horses as now produced are a wonderfully hardy long suffering breed. The standard as far as *appearance* goes is low. This, to a great extent, is owing to *poor feeding when young.* Feed a foal well till he is 2 year old and you can do what you like with him after that. If he drops to pieces from hard work or feed he can be always be recovered by improved conditions, but starve him when he is young and he can never be made into a good horse afterwards.

So far however as blood goes we have a good foundation upon which to build in our mares, and judicious selection of sires will soon result in a good class of working horse.

Messrs. T. H. Sharp & Son.: I consider the standard of the present horseflesh obtainable in Jamaica to be of a high order, it is chiefly descended from Arab blood, and has been kept up by the infusion of English thoroughbreds. With proper feeding of the foals a first class all round horse can be produced.

J. Shore, Esq.: For honest up-and-down-hill work I find the best horses are obtainable from the settlers, chiefly from the upland districts.

The progeny of imported animals within the first two generations from thoroughbred, are fine showy animals, but no use for hard collar or road work unless carefully watched and only a limited amount of work given (far less than the amount obtainable from the hardy mountain horses.)

I have had considerable experience in hilly districts and have been very much disappointed in the want of "wind" or staying power in so called well bred horses of good size. The settlers' animals seem to be brought up on the Roman principle—only the hardiest surviving—and they are as a rule fed on corn to a great extent from 15 months old, with hard, common feeding in addition.

These horses are generally descended from good sires, but many removes back

B. Toole, Esq.: The present standard of horseflesh producible in Jamaica is low, and this condition has been brought about by natural deterioration, in breeding, bad selection, and last but not least, by bad feeding, especially during the first three years. New blood, good selection, and a proper regard to feeding will improve present conditions.

United Fruit Co.: We are of the opinion that much can be said both in favour of and against our present standard of working horses. Many give satisfaction at the work they are put to do, and many prove miserable failures And here we think our system of rearing stock is largely responsible. Sufficient care is not bestowed on our colts, and the right sort of feeding to produce stamina, bone and muscle, is seldom or never given until the colts are actually put to do hard work, and the result naturally enough is, they accomplish less and break down earlier than they should.

A. B. Ventresse, Esq: From my experience of over 13 years in the tropics, which includes not only Jamaica but all the other West Indian Islands, and the main-land of America, there are types and standards in Jamaica equal to anything else anywhere for hard work and durability. I frequently drive my own horses over 50 miles in a day, and many weeks they do over 200 miles for me, but unfortunately the stock of this class is not large enough to draw from.

Hon. C. B. Vickers: I think there is a deterioration in the standard of horseflesh in Jamaica in past 20 years or so.

C. L. Walker, Esq.: Our Jamaica horses are not to be beaten for durability, but since gentlemen who used to race have given up the sport they have ceased to import thoroughbred stallions, our mares being small and being crossed with small stallions, our horses are rapidly degenerating to ponies. A scheme to import stock as above

will place Jamaica among the foremost places for breeding the best class of stock for racing, remounts, carriage and saddle.

Hon. W. Watson: The present animal is very durable and hardy but there is an entire lack of bone.

J. R. Williams, Esq.: The system of horse breeding in Jamaica varies greatly in different dis ricts, and the standard of horses bred. Again, there is the broad difference between the horse breeding of the larger Pens and the horse breeding of the small settler, and while a good many Pens breed a few horses just to keep up the supply of decent mares for their mule breeding, and as a sort of minor industry, a few Pens (very few in this neighbourhood) breed horses with an eye mainly to the horse market.

If we have a Stock Farm, we should consider the interests and requirements of the larger establishments.

If we are merely to import as hitherto a few horses, and to distribute these over the Island so as to benefit chiefly the smaller men, who most particularly need help, the consideration is somewhat different. The larger establishments are, I take it, well able to judge as to what type of horse they can successfully produce. And at present we have to consider what type would suit the smaller men best. The commonest deficiency in the small settlers' stock in these parts is in *frame*; they need the services of stallions calculated to get *stout* stock of 14 to 15 hands. And not only by the small settler but over the greater part of the island, I think the moderate sized horse is the one to be more suitably aimed at. It is only in exceptional situations that the breeding of large horses, I think, has much chance of success—and these require more care and feeding than the smaller are usually able or willing to afford.

I think therefore that the horse now produced with most success, in the largest number of places by the largest number of people, is a moderate sized horse of between 14 and 15 hands—generally nearer 14 than 15—and the horses of this type now produced need improvement specially in stoutness and frame.

R. L. Young, Esq.: Excellent colts are now to be picked up in Jamaica, especially in the Parishes of Manchester and St. Elizabeth, and if they are bought young and fed up are as fine animals as can be seen in any country. I attribute this to the larger proprietors in those Parishes being in a position to keep good stud horses. I see dealers passing through our way often with colts and fillies from two to three-year old. Most of them with a little extra care and attention would be really first class.

Some few years back it was a sight to see the fine colts ridden by our Peasant Proprietors to market on Saturday in this parish. But since these depressed times they can not afford to pay the high fees, and the larger proprietors have given up breeding horses, and do not keep studs.

Summary by H. H. Cousins.

It has been brought out that

(1) Horses have deteriorated greatly during the past 12 years.

(2) This has been associated with a decline of racing whereby sires have ceased to be regularly imported.
(3) The present horses are greatly inbred. Most of the mares are served by poor stallions.
(4) Good horses can be produced, but fresh blood and care in selection and feeding are necessary.
(5) A demand exists for a better class of horse.

I recommend:—
(1) Importation of sires for general use in island.
(2) Breeding stock for distribution at stud farm.
(3) Distribution of 2 King's purses of £100 each from December 1906 for 3 yr. old maiden native horses and fillies. Distance 1½ miles. Nominations as yearlings at £1 per annum.

4. In what direction is it desirable to encourage the aims of Horse Breeders?

Hon. J. V. Calder: In considering the best means to resuscitate horsebreeding it might be useful to consider what has led to its decay. Thirty years ago horses were produced in Jamaica that would not have been discredited in an English show yard. Any one requiring a pair would apply to Messrs. Maxwell, Morgan, Sawers or Wheatle and he would get what he wanted. Subsequently this demand was supplied by itinerant dealers who offered at cheap rates young and ill-fed animals, but buyers were satisfied so long as the horses were cheap and endeavoured to hide broken knees and sprung sinews with a display of gaudily plated harness.

The market has always been limited and was destroyed by the importation of a lot of cripples, I believe, from Prince Edwards Island. Penkeepers have given up horse-breeding and to-day it is almost impossible to buy a pair of carriage horses. Horse-racing is considered by a few persons as a terrible vice that should be put down, but it has been the means of bringing up the horses in England to their present standard and is, I think, the best available means of improving the Jamaica horse, and will, if encouraged, place on the market yearly a limited number of well fed horses too slow to race.

Unfortunately the promoters of racing in Kingston were intimately connected with the owners of the stand, whose only object was to make 6 o/o on their investment and pile up a large reserve fund, thus naturally adding to the value of their shares and hoodwinking the public by proclaiming they only got 6 o/o for their money. I won a £40 race some time ago of which only 4/6 was added money. Under such treatment horse-breeders became disgusted and racing has got to its present level whilst the stand owners are making frantic efforts to keep up their income by having pony races and may probably race pigs if they think they can draw a crowd and make gate-money. The Legislative Council has very properly withdrawn the grant of a Queen's Purse. In order to resuscitate breeding we must have race-horses, and I would recommend an annual grant of £200 for two purses of £100 each to be raced for on the Kingston Course for three year olds, one race for colts and one for fillies, 1½ miles. Queen's purse weights to be named as yearlings with a sweep of £1 for second horse.

6 nominations for each race. In this connexion I would point out that when Jamaica horses were at their highest standard, several Queen's purses were given yearly.

W. G. Clark, Esq.: 1st I should say "Remounts," as the Government can and probably would *guarantee* to take certain quantities at a fair price yearly.

This class of horses is handy for almost any *work* in the other Islands, as well as here.

W. Cradwick, Esq.: In two directions; the production of fine polo or riding ponies, and a production of a bigger and heavier mare for breeding bigger mules.

R. Craig, Esq.: In my opinion horse-breeders should be encouraged to raise the following classes of stock:—

I. Good carriage horses, say up to 15½ hands.
II. Horses suitable for mounted Infantry.
III. Strong hill ponies.
IV. Polo ponies (good).

Class I would be always saleable as would also classes III and IV.

For class II. I think there should be a system of Government Registration, and a grant (annual) for each colt or filly likely to answer requirements, up to four years old. These to be purchased by the Government, if sound and suitable, at a fixed price for the Army.

Cast horses in this class would come in well for travelling stock.

J Daly, Esq.: Government should endeavour to help the small settlers and large proprietors in the sale of Jamaica horses to other sister Colonies.

H. G. T. Drew, Esq.: Unfortunately, it is only racing that will induce or compel breeders, or those who buy their colts, to feed them, and these colts after their racing career is over generally go to the stud and being fed from foals are generally successful. Offer say a breeders' purse to be raced for each year for say two or three years, and thus encourage the production of the stamp of animal that will improve our horses. When your horse shows are more popular and better patronized by breeders, prizes can then be offered at such shows.

C. A. T. Fursdon, Esq.: To make a name for our horses and so command an export trade which would be sure to follow.

As far as the small man is concerned, help him to produce a saleable animal and realise that there is money in a better one than the runt he now gets.

It is doubtful if we can, under local conditions, produce an army horse.

J. M. Gibb, Esq., V.S.: Adopting a system of premiums to approved stallions; having annual horse shows in suitable localities and awarding cups as well as money prizes for sires with progeny—and in pressing the necessity of castrating all ungainly undersized colts on the owners of them.

H. W. Griffith, Esq.: I think the Government should, if possible, make some arrangement to purchase (even if it is only a few at first)

animals, which would be serviceable, either for Military or Police work in England or the colonies, from breeders.

I think I am correct in stating the stamp of animal required by Government are animals from 14·2 h h —15·2 h.h., from 4 years old to 6 years old, of stout build. The Government could issue circulars inviting anyone who has animals of the above description (more fully described) to send in information as to number, age, etc., of animal, or animals, for sale.

An official could be sent round to the various districts examining the horses and taking those which are suitable, these could be either shipped in small numbers or collected and shipped per transports coming to the West Indies.

I am certain if Government only made a move on some such basis breeders would see it worth while to breed.

Colonel H. E. C. Kitchener: Action and bone.

A. P. Lockwood Wingate, Esq.: The one and only way to encourage the aims of horse-breeders is to find a market for our four year old horses at prices that will pay one for breeding them. In other words, make the business a paying one. If we could sell all our sound 4 year old horses at from £30 to £40 each, most of the other difficulties would vanish.

Hon. G. McGrath: The aims of horse-breeders should be encouraged by the Government giving two or three substantial purses to be raced for by 3 year old fillies and colts, breeders would then be encouraged to feed their foals, and it must be borne in mind that a good animal for any purpose is produced by early and systematic feeding.

A. C. L. Martin, Esq.: Unless a market can be found for the animals produced it is no good encouraging the production of horse flesh. Given a steady reliable market any class of animal required can be produced here.

E. W. Muirhead, Esq.: With reference to horses my opinion is that there are plenty of the best blooded stallions from England now in the island to need further importation, but that some large serviceable Brood Mares, in foal to some good horses before leaving England would do more good

We are fearfully short of large brood mares to-day and it is unreasonable to expect the stallions to do all the good of improving horse-breeding that is expected of them. With the present price for horses it is impossible to produce same for sale at 4 years old at a profit, and it is very questionable with increased importations, unless sale can be obtained for some elsewhere, if we will be able to dispose of them.

J. T. Palache, Esq.: 1. Careful selection of stud animals.

2. The cultivation of knowledge as to breeding and crossing; careful attention to brood mares during the period of gestation and foaling; more attention to the care of foals and young stock and their feeding.

3. Instruction in agriculture so that more food supplies can be grown and thus lessen the cost of grain feeding, as at present this depends almost entirely on imported food stuffs. Oats cannot be grown here, but a substitute quite equal to it for horses can be found in

guinea corn, a species of millet which grows and yields enormous crops on our lowland lands but very little is grown.

Innumerable other feeding stuffs can be grown, but from want of knowledge of the best methods of cultivation not one fiftieth part of the crops per acre than can be produced is actually grown.

A. C. Paton, Esq.: The horse breeder should be encouraged to breed to a certain type and given an idea of the type required.

Hon. Dr Pringle: As the quality evolved as well as the quantity depends on steady demand at reasonably paying prices these two should be established; this might be done by the local government having mainly a mounted police—a less number but mounted—and paying a bonus on horses of certain standard on which the government would have an option—and the same in regard to our Militia—a small number but chiefly mounted.

(2) To have the Imperial authorities to pay bonus on horses and have options on those coming up to certain standards.

A. Roxburgh, Esq.: Encourage breeders in every way you can to *breed to a type.* There is as much to be learnt in this direction by breeders in Jamaica as there has been found to be in the cultivation of the soil.

Owners of mares in a large majority of cases fail entirely in the selection of *suitable* sires to which to put their mares. So long as they like the look of the horse they make use of him; no matter how far removed in character he may be from the mare. The result is a nondescript foal.

B. Toole, Esq.: This is a somewhat difficult question to answer, as so much depends on the individual efforts of the breeder himself. He should, however, be helped by the Government to the extent of affording him cheap access to the services of imported stock, and it might be considered advisable to offer for competition premiums for the breeding of horses of exceptionally fine quality. A great disability under which the breeders, and others having stock to dispose of, labour under is the absence of local markets. This could be easily and cheaply cured by the establishment in convenient centres—near the Railway if possible—of fairs, where persons requiring horses could be reasonably certain to procure them and sellers equally certain of securing a purchaser.

Facilities should be afforded by the Railway Department for the transport of animals to and from the fairs. The evils of hawking horses from place to place seeking purchasers are only too well known. The so-called horse markets at present in existence are mostly situated in backwood localities and are only resorted to for the disposal of worthless animals, and sometimes stolen ones.

United Fruit Co.: We are not quite clear in our understanding of this question, but so far as we can reason it out, we should say that much good should result from encouraging breeders to have a definite standard in view and to aim at producing the salient points of that standard, and to break away from the present listless method of breeding whatever comes most handy.

A. B. Ventresse, Esq.: I think we should encourage the class of

horses that would not exceed 15·2 in height. My experience is that large horses cannot stand our hill work, the weight is too great for the fore-legs to stand the going down hill with the present class of drivers procurable, and even apart from that for my own work I prefer a horse not to exceed 15 hands.

In replying to this question I have more in view the type of horse we require for our own use here, at the same time I think also for remounts they should not exceed 15·2.

R. A. Walcott, Esq.: Encourage them to feed and take care of their young stock, not to work them until they are four years old; not to breed *only* from *old* mares that have been worked off their legs and are going down the hill.

C. L. Walker, Esq.: Let the Government get out stallions and mares under contract with a company who will land them cheap in the island, the animals to be engaged by breeders, before ordered.

Hon. W. Watson: To import up-size stallions freely.

R. L. Young, Esq.: We want to improve chiefly the size and girth of our present stock the great fault being their flat ribs. Hence the reason for selecting our sires and not taking them at random on the strength of their pedigrees.

We want 16 hand studs, well ribbed up, good strong limbs, and we can look for like to beget like if we take ordinary precautions to select our mares.

This class of horse is generally found amongst our first-class hunting sires, and they would in this country produce fine serviceable stock ranging from 14.2 to 15.2 hands, and would be about the class of animal that would be required for Army remounts.

Summary by H. H. Cousins.

1. Before any action can be taken by the Government we must ascertain from the War Office their requirements in light, horses for tropical and sub-tropical conditions.

   If they could offer us £20 to £30 for a 3 year old or £25 to £35 for a 4 years old, it would pay breeders to go in for it. It should be explained that our horses are highly bred, inured to tropical sun and capable of prolonged work; but are not large showy animals.

   The machinery for producing a regulated supply of the required horses could then be established.
2. Purses should be re-established for 3 year olds.
3. Castration should be made compulsory or a heavy tax placed on entries not approved by a Government inspector.
4. A Government or subsidised sire should be made available to the peasantry in all districts producing horses at the usual fee for a runted stallion (6s. for service and 4s. for a foal).

5. What conclusions can be drawn from the results of the sires imported by the Agricultural Society?

S. C. Burke, Esq.: The conclusions which can be drawn from the results of the sires imported by the Society (which results are chiefly

to be seen in a few half bred Welsh ponies of doubtful utility) is that the general horse-breeding public in Jamaica cannot be trusted to mate their mares sensibly or successfully, if they are left to themselves. They will breed from any horse that is sufficiently cracked up to them, consequently care should be taken only to put before them a type of Stallion which is likely to breed a useful and serviceable type of horse.

Hon. J. V. Calder: The hackney stallions imported by the Agricultural Society died before they did any harm, but the Welsh pony is in my opinion doing a great deal of harm in producing undersized horses whilst the general complaint is that our horses are running too small.

Three of this horse's gets were at the Hope Show:—Geraldine, a very neat well fed little mare; a jerked up pony with only room for a child's saddle on his back; and a mis-shapen dwarf of the type that used to come from the Caymanas and sold for £3 to £4.

W. G. Clark, Esq.: 1. I have not seen any "Hackney" results.

2. Sir Gerald has given bone but is small.

R. Craig, Esq.: I am not in a position to answer this question.—I never saw either of the Hackney Stallions imported by the Agricultural Society nor any of their progeny so far as I am aware.

I have seen the pony stallion "Sir Gerald" and a number of his foals. He is in my opinion a very fine pony and his stock are remarkably true but he is too small for the purpose the Agricultural Society had in view, which was to get stout hill ponies of 14 hands and upwards. Unfortunately the tendency in breeding horsekind here, seems to be to produce smaller animals than the parents, in many or in probably the majority of cases.

J. Daly, Esq.: The sires imported by the Agricultural Society are in my opinion too small, as their progeny cannot meet the demand of heavy work.

H. G. T. Drew: The hackney stallion crossed with the average Jamaica brood mare, produces a misfit; in many cases maintaining the heavy head and forequarters of the hackney, while the other parts of the body reproduce the build of the dam which being so extremely opposed to the hackney the offspring is a coarse ungainly ill-proportioned animal.

As regard the Welsh pony stallion "Sir Gerald" I have little to say against him, save that his productions lack size.

C. A. T. Fursdon, Esq.: *Hackneys* a dead failure, which, being an artificial breed they are bound to be.

Welsh pony gets useful stock but deficient in size, but as he is apparently much sought after must be considered a success.

B. S. Gosset, Esq.: That Hackneys are of very little use in Jamaica.

That Welsh ponies are suitable for hacks and general purposes, but a size larger would be better.

I have also tried an imported Barb Stallion and an English Hunter sire neither of which were very satisfactory.

H. W. Griffith, Esq.: The Agricultural Society should do their best to import only really good stock.

I do not consider that "Cavalier" was the sort of horse to import; he was a hackney, but not a good one, and the price paid for him ought to have procured a first rate Hackney Stallion, bought direct from the breeder in England.

I have seen a pair of this stallion's progeny at shows, etc., and cannot say they have been a success, and have noticed that the feeling towards Cavalier, was anything but what it ought to have been and has created a great dislike amongst the older Penkeepers throughout the island towards any animal of the "Hackney type," and it is for this reason that such a lot of discontent nearly always follows "Shows."

"Sir Gerald" is a compact little pony stallion, but is not a Welsh pony stallion, I think he has done some good in getting ponies of a size useful to some. One thing his gets are very much like himself, the only fault with "Sir Gerald" is, he is *too small* as the tendency out here is for animals to become smaller.

A. P. Lockwood Wingate, Esq.: It is difficult yet to draw any definite conclusions on this point as the two Hackneys died early and without producing many foals and we have yet to see any "Sir Geralds" 4 or 5 years old on the road drawing their buggies over a journey of say 30 or 40 miles, and how they go under these circumstances. Until we see that it is hard to say if the "Sir Gerald" type is suitable for Jamaica, and our work here, or not.

Hon. G. McGrath: The sires imported by the Agricultural Society have undoubtedly produced good results, but owing to the death of the better of the two hackney stallions the number of foals produced has not been sufficient to mark this breed. The Cavalier's fillies put to thoroughbred stallions would undoubtedly produce excellent results and their foals sufficiently fed must make good substantial carriage horses, but no good results can be effected with this breed without proper feeding. Many of the mares in the Island have bad action and drooping quarters, both of which faults the introduction of the Hackney rectifies, while as a rule they have plenty of bone and breed big enough to the Hackney.

The *Welsh* Pony Stallion "Sir Gerald" was imported for the express purpose of producing "*mountain ponies*" and Sir Henry Blake when on leave in England was requested to procure a stallion for this particular purpose and Sir Gerald was selected by his Excellency and myself at the Government Stud Farm at Ballybrack near Dublin and after much trouble, and upon the representation of Sir Henry that the horse was required by the Agricultural Society of Jamaica, the Board for the Congested Districts of Ireland met and as a particular favour spared the Government of Jamaica Sir Gerald for the same sum as they had just paid for him. He was considered in Ireland one of the best pony stallions of his class and unsurpassed for the purposes required. I think this sire has done good service in Jamaica and given great satisfaction to those who own his progeny. He will leave a good impression on horse-breeding in the Island.

E. W. Muirhead, Esq.: "Sir Gerald" no doubt has been a success in the direction of imparting more quality into our 14 hands-Roadsters, but as this is possibly our strongest class of stock it was least needed. Most of our thoroughbred having run to this size.

"Courtier," the best in my opinion, did not have a show.

"Cavalier" was an expensive luxury, the least said about him the better.

A. C. L. Martin, Esq.: I have two fillies by Cavalier now two years old. One out of a thorougbred pony mare and the other from an ordinary pony mare Both these fillies are unsuited for working purposes but will make good mule mares.

J. T. Palache: Since Courtier II. died before he sired anything the results in his case are nil.

I have only seen one foal by Cavalier, a veritable beast not worth sixpence. Sir Gerald is doing real good work and all of his stock that I have seen are all that can be desired and his fillies crossed with carefully selected thoroughbreds of the type of Asteroid, Dinna Forget, Fitzherbert and some others I would name, will, I am certain, result in just the style of stock wanted for general work in Jamaica.

H. C. Paton, Esq.: The sires imported by the Agricultural Society were I think hardly a success. I don't think any one knew what type of horse was to be bred from them. The fillies got by Cavalier are eminently fitted to breed mules but for any other purpose his progeny would seem to me to be very little use. Sir Gerald has bred some "pretty" ponies, but they again do not seem to me to be serviceable animals for the island, nor would they be worth exporting as that type has been brought to very near perfection in England.

Hon. Dr. Pringle: I think undoubtedly they have done good and if they had been helped by system and art would have done more, but as they did not produce racing stock right off they were boycotted.

A. Roxburgh, Esq.: That the Yorkshire Hackney was unsuitable, but that the "Welsh Pony" so called has done good service, and will I trust be freely utilized and do still more.

The good wrought will be better appreciated—when his filly gets are put to *selected* thoroughbred stallions.

Bernard Toole, Esq: The conclusions to be drawn from the results of the sires imported by the Agricultural Society is that they have not fulfilled reasonable expectations, and I think the cause is not far to seek.

The types in my opinion were too extreme, if I may express it so; the Hackney too big and clumsy for a hilly country like Jamaica, where owing to our light vehicles, very heavy draught is seldom required, and, moreover, a Hackney is not a horse which the ordinary Jamaica settler can feed. The Welsh pony on the other hand, owing to his smallness, does not cross well with our ordinary Jamaica mares which seldom exceeds 14.2 in height, and although he has produced some exceptionally nice stock by *first class* mares the tendency to breed tiny animals (too small for practical purposes,) more than turns the scales against him.

United Fruit Co.: We have seen but two colts out of Sir Gerald, and so do not feel competent to express an opinion on this question, but the two colts we have seen have impressed us very favourably.

A. B. Ventresse, Esq.: In this case we are practically limited to Sir Gerald, the other results being practically nil, and unfortunately

so many inferior mares have been put to Sir Gerald evidently with the belief on the part of the owner that the sire was all that was necessary to produce good stock.

The progeny of properly selected mares by Sir Gerald appear to be the most promising and desirable stock for our own work, and even the most prejudiced must admit there are to-day many fine colts and fillies from Sir Gerald, although I do not think it was the best type of horse to import—as in the tropics horseflesh tends to decrease in size. We should certainly have had a larger pony than Sir Gerald, at the same time I think it must be admitted that upon the whole Sir Gerald has proved fairly satisfactory.

C. L. Walker, Esq.: I condemn the importation of ponies, the island producing them in great numbers. The Hackney Stallions imported by the Agricultural Society were not of the stamp required in the island.

Hon. W. Watson: Decided improvement, and with better care and more attention the benefits will be very much more marked. Those of Sir Gerald's colts which I have seen and known are very fine.

J. R. Williams, Esq.: I have only had opportunity of seeing the stock got by the Welsh Pony Stallion "Sir Gerald." I have had four of his colts—all out of well-bred mares but not thoroughbred. All have been satisfactory, showing much heavier frames than the ordinary creole stock, rather too heavy, and some of them inclined to be coarse and though purely grass-fed as colts, they are of very fair size.

I am trying one of the fillies for mule-breeding and look forward to getting stout and heavy mules from her.

My experience suggests that the ¼ bred stock of this strain, the issue of Sir Gerald's colts, will be of a very useful type and show considerable improvement on their purely creole progenitors.

R. L Young, Esq.: The Hackneys were too heavy a class to breed from in this country, the high stepping action would tend to tire them very soon. They are not meant for the class of work to which they would be put.

On the other hand Sir Gerald would have been just the sire for breeding serviceable ponies, if he had one hand more to his stature. As it is, his colts are fine handy little ponies, very active in the draught and up to great weight under the saddle. In my opinion his fillies crossed with thoroughbred sires are going to produce first rate polo ponies as weight carriers.

Summary by H. H. Cousins.

There is a general concensus of opinion that the Hackneys were not only a failure in fact but also in principle. The Hackney is a composite animal and when crossed with a pure breed is apt to throw back to undesirable ancestors.

It is possible that a smaller type of Hackney (14·3) might produce better results in getting actioned buggy horses for town use.

The Welsh pony has carried many away from the comeliness of his get, but clearly this has been 'breeding from capital' and has resulted in a deterioration of the size of our horses. It will be difficult to

recover from 'Geraldine' the size of her dam. Mr. Gosset's exhibit at the show illustrates the fallacy of breeding in the hills from Sir Gerald to get stout 'bone-substance' hill ponies.

6. What practical suggestions do you offer for the consideration of the Government,

(1) For promoting better returns from our present stock of horse-flesh?

(2) For infusing fresh blood by judicious importations?

S. C. Burke, Esq.: To carry out the idea of breeding polo ponies and mounted infantry remounts for export to England, I have drafted and submit the following scheme.

1. That the Government (or a Company) establish stud farms for purpose of breeding ponies in St. Ann and St. Elizabeth, on which careful and systematic attempts should be made to breed in sufficient numbers, the type of horse which is represented by the highest class polo pony.

2. That only animals of the type that are likely to breed high class polo ponies be kept on these farms, the stallions being mainly imported and the mares being native bred.

3. That the Government (or Company) furnish to every penkeeper in the island who will undertake to keep a stud of at least 25 suitable mares, a stallion of the required type free of charge, and that the penkeepers in return agree to give the Government (or Company) an option on the progeny of these mares.

4. That owners of mares throughout the country be induced to register their mares in a general register or stud book to be kept by the Government (or Company) such stud book or register would only contain the names of such mares as were deemed suitable for breeding ponies of the type required, and such mares would have to come up to a certain standard of excellence.

5. That each owner who registers a mare shall receive a bonus of 10/ for so doing and shall have the right of sending his registered mare to the stallions of the Government (or Company) free of charge.

6. That the owners of registered mares in consideration of the free service shall sign an agreement contracting to sell the progeny of these registered mares, provided they come up to a certain standard of excellence (which would be decided by the buyers) at a fixed price to the Government (or Company) either as yearlings, two year olds or three year olds.

7. That the prices agreed to be paid for the progeny of these registered mares be yearlings £7, two year olds £11 and three year olds £15.

8. That the foals of these registered mares be inspected in the month of September of each year, and that all that are healthy and promising be branded.

9. That the owners of these branded foals may in the month of May in the following year call on the Government (or Company) to buy them as yearlings at the contract price, or may keep them on until the following May and sell them as two year olds, or may keep them until the following May and sell them as three year olds.

W. G. Clark, Esq.: 1. Cheap freight to other islands, taking every opportunity of advertising Jamaica horses in those places where American horses are used.

An agent might be appointed attached to some department (say Sir. D. Morris's) in each island, this agent, to be in touch with the Agricultural Society here when horses are required.

2. Import two stallions of each kind making the fee as low as possible.

Tax *heavily* all entire horses not up to a certain standard, allow free freight, and duty, and subsidise every stallion imported from England.

W. Cradwick, Esq.: Put stallions within reach of the small settlers, particularly in St. Elizabeth and Southern Manchester at their own fees and on the terms which they are used to Then frame a law which would result in the castration of the three cornered, coffin headed, spider hocked, fetlock-upon-the ground, ewe necked, goose rumped brutes, that the majority of the small settlers now breed from.

H. G. T. Drew, Esq.: Import two or three healthy and strongly built stallions (thoroughbred): keep them under skilled supervision for say two months, then hire them out for a season to penkeepers who will give them strict attention, and have their services, and be allowed to serve a limited number of mares at a fee of not more than 1 guinea—Special care being taken to see that the stallion is properly fed.

We do not wish any better blood than the thoroughbred; they produce from the polo pony to the 16 hands carriage horse, and possess intelligence, spirit and endurance, and with careful selection of parents, good results will be procured.

The idea here is that every mare will make a brood mare, which is a big mistake, breeding from unsuitable animals is the principal cause of the poor results from this branch of pen keeping.

Dr C. R. Edwards: The importation of fresh blood must not stop at two or three importations but must be carried on regularly for a number of years. It cannot reasonably be expected that two or three horses will regenerate the stock of the whole country.

Import every year a thoroughbred Hunter and a Cob.

C. A. T. Fursdon, Esq.: (1) Forbid the use of any stallions under a certain standard and give the Magistrates the power to order their castration whether found on the high roads or not. Improve the quality and better returns will follow.

(2) Answered in Nos 1 and 2.

J. M Gibb, Esq., V.S.: The aim was a good one. Two—Bay Hackney and Welsh Pony—of the three were useful for the purposes for which Sir H Blake imported them, namely, bone and substance for big and little. Unfortunately the C. Hackney stallion was not a profitable selection.

B. S. Gosset, Esq.: Import a Normandy Coach horse sire for carriage horses and mares for breeding mules and horses.

Our light well bred mares should cross well with the Normandy horse which is a breed of long standing, not a cross bred like a hunter or a hackney.

A Welsh pony stallion about 14½ hands or a pony stallion of Mr. C.

Wilson's Rigg Maden breed in Westmoreland would be just the thing for saddle ponies and cobs for general use.

H. W. GRIFFITH, ESQ.: (1.) Besides the suggestion made in IV. I should suggest that the Government start a small "Stud Farm" to be managed by an experienced person from England, (not necessarily an expensive man) with two classes of stallion, namely thoroughbred and hackney and also a few mares with plenty of substance: these could either be bred from direct, or crossed one with the other, and their progeny sold throughout the Island.

(2.) Also mares to be taken in for service, and stallions sent to a district for only a short period.

In this way those who required the use of a good stallion can have it.

The progeny, either Fillies or Entires, could be sold either privately or by auction sale, this sale to become a feature towards the close of each year.

All animals used on the "Stud Farm" for breeding purposes *must be imported*, i.e., stallions and brood mares, belonging to the Stud Farm; not mares sent for service.

COLONEL H. E. C. KITCHENER: Small bonus for imported sires possessed by Agricultural Society.

H. P. LOCKWOOD WINGATE, ESQ.: (1.) If the business can be made a profitable one, better returns will follow, private enterprise will do a lot to improve the standard of horses in every way if one could see that a good return would be got from any outlay expended

(2) If the Government would give a bounty of say one-third the entire cost of every thoroughbred stallion imported, to the person who imported him, and so encourage the infusion of new blood continuously, I think this would encourage breeders to import more. Of course the stallion would have to satisfy the examiner that he would improve our horses here.

HON. G. MCGRATH: For promoting better returns from our present stock of horseflesh I would recommend:

1. That the people be encouraged by the Government to produce good stock by giving them the services of good sires at a nominal fee.
2. That Breeders be encouraged to feed their foals by the offer of substantial purses by the Government to be raced for and a certain market with reasonable prices for disposing of their stock.

A. C. L. MARTIN, Esq.: (1.) Premiums should be offered for animals of an approved type to stand for service at a fee within the reach of all sections of the community, in any district that requires a stud animal The premiums recently offered by the Agricultural Society have not been the success they should have been, owing to the fact that very often an animal was allotted to a district the services of which the people in the district did not require. I have known of more than one instance where a horse was awarded a premium to stand in a district, he served very few mares there, but if a donkey had been sent to the district he would have had more mares than he could serve.

J. T. PALACHE: The establishment of a well equipped, well managed Stock Farm where the stock imported by the Government could

be kept and mares received for service by the stallions and arrangements made for the letting of the stallions to persons in various parts of the Island on such terms as will ensure the services to mares belonging to all sections of the community around. Breeding done by the Government for experiment on the most approved methods and the progeny sold as stud animals to purchasers for improving their breed of stock. And where servants could be trained in the care, handling and management of stock; one of the greatest difficulties in Jamaica to-day, with regard to any enterprise, especially stock rearing, is to get servants with any degree of knowledge or skill.

H. C. Paton, Esq: (1) A better return could, I believe, be obtained if breeders could be induced to be more careful and judicious in the mating of their mares and learn what type of animal it is most desirable to produce. If an inducement could be offered such as a guaranteed purse for three year olds of the desired type, I think breeders would soon learn the type required.

2. I would suggest that stallions of the desired type be imported and located in the different horse-breeding districts of the island that they should serve approved mares free, and that the approval be not given unless the mare is really of the right stamp.

That native stallions of the desired type be given a substantial premium and be located in the different districts to serve approved mares free or for a very small fee as is done with King's premium stallions in England. The amount of premium would however have to be sufficient to make it worth the owner's while to take it rather than keep the horse at stud himself.

I would also suggest that an annual license be put on all ungelded horses of 3 years old and upwards. This would prevent the serving of mares by bad stallions whose fee is often as low as 8s. This class of stallion is much patronised by the small settlers, some of whom having nice mares which they put to the bad stallion, with the almost invariable result that bad progeny is produced. It is almost incalculable what an amount of damage these stallions do generally, and yet we see Agricultural Shows held under the auspices of the Agricultural Society where a prize is given to this class of animal under the heading of settlers' stallions.

A. Roxburgh, Esq.: Do something to make horse owners do away with worthless stallions. There are hundreds of these brutes in the country that annually do more damage to our horse breeding than any one can estimate. Mares are taken to them at small fees of from 8s. to 16s., and ignorant and short sighted owners of mares patronize them on that account. All they aim at is to *get a foal.*

Let all stallions be licensed and impose a penalty on any one keeping one that is not duly registered.

There would be plenty of work the first year for the professional castrator!

Messrs. T. H. Sharp & Son: (1) Start a Stock Farm and feed the foals from six months old in a proper manner so as to give them bone and sinew.

(2) Encourage by premiums the importation of thoroughbred horses from England as sires.

(3) Discourage the importation to Jamaica of Hackney Stock of any description. What we want is to produce a lot of good food such as cane, sweet potatoes, corn, guinea corn, maize, cassava, etc., etc, and to feed the young animals, the stock and blood is quite good enough.

JOSEPH SHORE: I. By having long distance competitions in riding and driving and awarding suitable prizes. This would cause horse owners to do more solid building up in better feeding, &c.

II. By replacing the premiums formerly granted for the importation of stud animals (to be approved by a veterinary board); and by importing sires and mares as in Nos. I. and II., on behalf of Agricultural Society, fees to be charged sufficient for outlay.

B. TOOLE, ESQ.: (1) The establishment of a Government Stock farm under competent management and breeding thereon what will be found by experience to be the most suitable animals and distributing them amongst the breeders at a reasonable cost *for breeding purposes only.*

Enforcing a strict system in the selection of mares proposed to be served by imported or subsidised stallions. This has been entirely neglected in the past The service fee should be if possible as low as that charged for the worthless stallions which are doing so much harm at present. The service fee is a serious consideration to the majority of the horse-breeders in Jamaica.

(2.) This and the former question may be answered together, as without importing fresh blood little improvement may be expected; the importations may be gradual according to the demand which may arise for the imported stallions. I have intimated at Reference I what I consider to be the best type of animal to import.

UNITED FRUIT CO: (1) Impress on breeders the necessity of aiming at the best results in whatever standard they adopt, and encourage their efforts in return by developing good markets for the disposal of their stock.

(2) Import the best blood of the most desirable classes, in numbers sufficient to serve the various parishes, and place them judiciously so that the humblest breeder may avail himself of their services at reasonable fees.

A. B. VENTRESSE, ESQ.: I can conceive but one practical method to secure better returns from our present stock, and that is to put a tax of at least £2 2s. for every entire donkey, and £4 4s for every entire horse I have seen the peasantry upon many occasions, as well indeed as other people use horses and donkeys that should never be used at all. I have spoken to many of them about it and I find that even with the difference of a fee of 4/ they would breed from inferior animals, although they perfectly realise that breeding from the better one would not only give them 4/ but £4 in advance, and I really believe that the most practical results would accrue to the country as a whole by the extinction of the very inferior entires in the island.

(2) This seems also somewhat indefinite as to whether you want ideas on the importation of stock by the Government, or the Government assisting the people By the Government assisting the people there is bound to be a great deal of favouritism shown which should not exist, but by the Government importing these, unless a large stock

farm were established, which seems rather a tall order under the present conditions of the country, it would appear to narrow itself down to the Government importing stallions to be used in a similar manner to what Sir Gerald has been. But like Sir Gerald it will at times no doubt create a bad feeling, and with some justification too on the part of the owners of entires in the vicinity of where these stallions are kept, but at the same time it seems to me the less unfair, and most workable scheme under the present conditions.

Hon. W. Watson: Encourage and facilitate in every conceivable way the opportunities for selecting the right kind of animal in England and elsewhere, and the facilities for getting them here. Have occasional horse shows.

More care in the selecting and attendance, and not expecting nature to do everything; adopting more enlightened methods in selecting and mating the animals.

J. R. Williams, Esq.: (a) I think a Stock Farm is very desirable where a supply of pure bred stock of the types approved and acclimatised can be kept up The risks attending the importation of animals deter all but the wealthiest; and these risks and the extraordinary care which imported animals for a time require, are strong arguments in favour of the establishment of a Stock Farm if any sustained effort for the improvement of the stock of the island is contemplated.

(b) Apart from the question of the Stock Farm, I do not see any way to improve the horsekind except by such efforts as have already been made, with slightly altered conditions, viz. the subsidizing of approved stallions in selected districts where their services shall be available for a very moderate fee, whatever happens to be the ordinary fee of the settlers' stallions in the neighbourhood. One change in the conditions hitherto offered would I think induce more general use of such services:—the subsidized stallions, like the settlers' stallions should be 'peripatetic', i.e. taken round to serve the mares on the premises of the mares' owners. And the experiment might be tried of charging so much *per cover*. I am doubtful of its success: it would be quite novel (in this neighbourhood at least) and the settler is conservative: but it might be offered as an alternative to a charge being made for service till 'stinted' (within that season) which is the ordinary procedure. The popularity of the common settlers' stallion is that he generally takes half his fee, or less, in advance, and waits till the colt is born for the balance There is generally some difficulty in getting this paid and where a very small fee is charged it is not worth the trouble of collection. I could not recommend this plan of exacting payment.

The services of stallions kept by the more independent class of people, i e. as a rule, the better class of stallions, will never be available while this method of payment prevails.

(c) We have to consider that in some districts, probably in most parts of the island except in St. Ann, St. Elizabeth and Manchester, the people need to be educated as to what they should aim at and what is really desirable and profitable—in horsebreeding as in other matters agricultural.

In a great many parts they are satisfied with the services of almost any stallion that is cheap.

(d) Perhaps something should be done to limit the harm done by the worst of the many unsuitable stallions which 'ply for hire' It might be done by a fairly substantial tax on stallions, say 30/- or by requiring any stallion serving for a fee to be *licensed* There might be some difficulty about the 'Licensing Body,' for it should be readily accessible.

Justices of the Peace would do the work but would be objectionable as likely to have stallions of their own competing in the neighbourhood. This would put them out of the question.

The Inspector of Police might be suggested; but the suggestion does not satisfy me. However, I am convinced something should be done in this direction It interferes with the liberty of individuals and may be misrepresented as oppressive to the poor; but if we are justified in spending public money for the improvement of horsekind in the island for the common good, I think we are justified in restraining people from going beyond a certain limit in doing what they can to neutralize the effect of such expenditure.

(e) Something might be done to facilitate the sale of horsekind In this neighbourhood, which is not by any means eminently favourable to, or celebrated for horsekind, the sale of horses is most irregular and the demand most uncertain.

The uncertainty of sale is a great discouragement to the breeding of horses.

From £15 to £20 is readily got for a decent mule, unbroken, and 3 years old: a pony must be well above the average, must be about 4 years old and broken to saddle and draft, to be worth £15. Could not something be done to officially recognise and regulate Horse Fairs at certain centres? At Newmarket, 14 miles from here, for several years a kind of Horse Fair was held every Saturday. In Clarendon I am told there is a similar institution. I don't know if the Newmarket Horse Fair continues. But something of the kind, regulated by the Society, held once in two months or so, at suitable centres, might do a good deal to encourage horsebreeding by bringing buyers and settlers together. Sir Henry Blake was, if I remember aright, much of this opinion.

(f) I may mention two experiences which illustrate my contention that one of the difficulties in the way of improving the breed of horses is the need for educating the people in many districts and raising their standards

At another property seven miles from here I have kept for two years one of my Sir Gerald colts, a fine stout horse (as I think) and one well calculated to improve the bone and body of the settlers' stock. I have charged 12/- for his services (the ordinary fee of the local 'hamper horse') but required the full amount to be paid on service—promising to give service free if the horse is on the Penn next season and the mare fails to breed. I have had two settlers' mares sent to him in two years. !

A friend of mine eight miles from here had a thorough-bred, the son of a very good imported stallion, for whose services he charged 20/.

In two years he served two mares. He then sent him into St. Ann and, at the same fee, the first year he was there he served thirty mares.

R. L. Young, Esq.: To promote better returns from our present stock of horse flesh, give us a sure market and a ready sale for our colts and fillies. As I have shown already, we have the raw material to work on, but we want some sort of assurance that we wont have the stock left on our hands after bringing them up to a required standard. If I know the Government want remounts I would select a few and raise them to the standard required, with the certainty that they would be taken off my hands at a given time. The same can be done with Polo Ponies, but with only two or three clubs in the Island, the inducement is nil.

With the importation of first class sires placing their services at a low rate so as to come within the reach of our peasant proprietors, and by keeping them moving from parish to parish—as has been done with Sir Gerald—I guarantee that in the course of a few years you will see produced in Jamaica as fine a class of horses and ponies as can be shown in any part of the world.

Summary by H. H. Cousins.

The following practical suggestions recommended themselves to me.

(1) Institute Stock Farm and import breeding stock. Distribute progeny at an annual sale. Take in mares for horse breeding department to be attached to Stock Farm Scheme.
(2) (a) Subsidise local stallions.
(b) Import and localise stallions—Each horse to have his own special attendant to travel with him.
(3) Pass a Castration Law on lines of Mr. Craig's former Law.
(4) Enquire and use influence with War Office for a remount trade.
(5) Offer King's Purses for 3 year olds.
(6) Enquire cost of landing mares of types suggested and advertise for applications from breeders.

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7. What prospects are there for an export trade in horseflesh.

(1) to other West Indian Islands:
(2) Polo Ponies:
(3) Mounted Infantry Remounts.

S. C. Burke, Esq.: The Jamaican horse is noted in all the other West India Islands, and is in good demand for racing and general hack purposes. A few years ago Jamaican race horses when running in the other islands were taxed under a special scale, higher than the creoles or native-bred horses. Extraordinary high prices have been fetched by Jamaican racers, but those days are past, and we shall never again see a "Best and Bravest" or a "Chanticleer" sell for £500. The bubble has been pricked, and the other West India Islands have now realised what we have also found out that a common English selling plater is good enough to take care of all the flyers we can produce. But although the trade in racehorses is dead, the demand for racing ponies is very brisk. Our Jamaican ponies seem to be a class in front of anything which the other islands can produce. An instance of this

was furnished at the Barbados meeting of 1902, when every race of the fifteen on the programme was won by a Jamaican pony. I had the pleasure of shipping the winners of seven of these races from Jamaica—two of them of my own breeding—and as none of them were sold for less than £40 in Jamaica, it may be judged that breeding racing ponies for export is not unremunerative. I have also sent several horses and ponies for hack purposes to Barbados and other islands. Sound useful horses can always sell over there for £30. When it is remembered that these islands cannot produce anything like the number of horses which they require for their own use, and that those which they do produce are inferior to the Jamaicans, it will be seen that Jamaica will always find a ready market in the West Indies. (In Barbados most of the larger horses are imported from Prince Edward Island and they take some time before they get acclimatised.)

For Polo Ponies there is practically an unlimited demand. England can take all that we can produce (provided we produce them good enough) and so will America. Polo has become so immensely popular in both countries during the last ten years, that the demand for Polo Ponies is greatly in excess of the supply. There is hardly a country town in England without its polo club, and every regiment in the service now has its polo team. When I mention that the officers of the Guards stationed at Windsor between them, own upwards of 60 ponies it will be realised the hold that the game has taken on young England. Polo Ponies in England fetch all sorts of prices ranging from £25 for a "crock" up to £800 for a flyer. The famous pony "Sailor" was purchased by Mr. Brassey for £800, and prices like £250, £300 are by no means uncommon for first class "tournament" ponies. Jamaican ponies have been sent to England and some of them have turned out well. Capt. (now Lt. Col.) Kavanagh of the 10th Hussars, who will be remembered in Jamaica as A.D.C. to Sir Henry Blake and a very keen polo player, took a couple of Jamaican ponies with him to England. These were Molly and Creole, both excellent players, up to weight and fast They measured about 14.2 These ponies sold for £250 the pair. Creole won a prize at Hurlingham Another pair Pilot and Vesta were taken to Ireland by Capt. Bewicke of the Gunners, and these besides playing in good class polo, won races there The average price of a made polo pony in England (not a first class tournament pony) is £50, and we should have no difficulty in producing quantities of these in Jamaica, with the chance of getting an occasional "Sailor" to bring up the average.

In this connection I may quote an extract from a letter which I received from Capt. E. D Miller, author of "Modern Polo," and perhaps the greatest authority and finest judge living of Polo ponies. He says, "I never import ponies except the best trained playing ponies that "the country produces, and I never buy young ponies, in fact nothing "under 5 years old as I have no room for young ones. The standard "in England is so high that not one in a hundred English ponies "playing Polo gets into the first class, so you can see that only the "best of those you produce in Jamaica would probably be good enough "for first class in England, and therefore only the best would be worth "importing. I can assure you that there could never be a general

"paying trade in sending home young ponies. If you could send me "home one or two of the best up to 14 stone which are now playing "in Jamaica, not under 5 years and not over 7, I think you would "get remunerative prices for them I have imported at different "times untrained ponies from India, Egypt. North America and Ar-"gentine and in no instance did it pay." These words would give us a fair idea of the standard which we must set up and breed up to.

Mounted Infantry:—The class of horse required for this purpose is an animal built on the lines of the weight carrying polo pony or something a trifle bigger. Horses suitable for this purpose are worth £30 to £35 in England. We should be able to produce any number of these in Jamaica and the breeding of them could be made quite a profitable business. Animals of this class would be easily produced at £20 each as four year olds or £15 each as three year olds (unbroken and grass fed). It would be necessary for the Government to move in the matter and to induce the War Office to establish a Remount Depot (for Mounted Infantry alone) in Jamaica, and buy our horses on the spot. The Depot would have to take our unbroke 3 year olds at £16. These should cost about £5 each to break and condition so as to be fit to ship to England the following year as 4 year olds Animals of the description which I advocate should be bred, and, which I maintain, can easily be bred in Jamaica, would thus cost the Imperial Government under £30 landed in England, a less price than they are now paying, and I venture to think that they would be getting a cheaper and better animal than they could get from any other part of the world. . .

Care should be taken only to put before them a type of stallion which is likely to breed a useful and serviceable type of horse. Without desiring to reopen a controversy, I would say that this is the reason why I have always been opposed to the use of the Welsh Pony Stallion.

Hon. J. V. Calder: 1. An attempt to establish an export trade was made 25 years ago and failed.

2. A dozen polo ponies would overstock the market

3. I see no reason why a certain number of remounts should not be provided.

The sire and dam should be approved by an officer. A payment should be made

1. On the birth of the foal on agreeing on price.
2. End of 1st year.
3. 2nd year.
4. 3rd year.

Security should be given by the breeder for the advances and insurance Colt should be delivered unbroken. If some such scheme were adopted a supply would grow. Some stringent safeguards could be provided for the care and feeding of the colt or he could be delivered on being weaned and kept at pasturage at some depot, costing less at 4 years old than is now paid for remounts.

W. G. Clark, Esq.: 1. Fairly good, if freight can be made cheap, and agents are appointed to protect exports, that is for carriage horses, and smart ponies.

2. The present weedy thoroughbred no doubt makes a smart handy and possibly *good* polo pony, but a thoroughly good representative, able to place and play a *good playing* pony in England, is what is absolutely necessary to get a price for such an animal; a good fast pony, sound, and a *good Polo* pony is worth anything, but if not first class is not worth shipping

3. Depends upon stipulation of the Government.

Captain T. Constantine, Superintendent Royal Mail S. P. Co., Kingston: I am of the opinion that a substantial business could be worked up and I may add that my Company has been, and is always, desirous of fostering this traffic. However, although every facility has been given, up to the present only a small number has been exported. The same remarks apply as to the export of Polo Ponies.

R. Craig, Esq.: There would be in my opinion excellent prospects of a big export trade in horses and ponies if Jamaica had these to sell. At present she has not. A systematic determination on the part of the Government to improve our horseflesh, would in my view, meet with a certain success. The difficulties are by no means insuperable, but assistance is, I think, imperative. The attempt to do something has been too long delayed, and in consequence, any scheme set agoing now will cost a great deal more than it would have done 15 years ago.

J. Daly, Esq.: (1) Yes

(2) Yes.

(3) Yes. Stock can claim a far better price and these make all breeders interested in the best stud.

H. G. T. Drew, Esq.: A good horse will always sell, and lately the demand for racing ponies, or rather ponies (as they are used as hacks as well) in Barbados is on the increase, lately they have had to buy 2 year old unbroken ponies—not being able to get what they want.

Good care should always be taken to send the right sort of animal ordered. Shipping one bad animal occasionally will do more harm to this trade than anything else. It is better to lose the sale of an animal than sell what is not suitable.

Dr. C. R. Edwards: The matter of an export trade needs to be worked up. It cannot be done without a vast amount of care and trouble—but if we value the trouble to breed carriage horses of size and action we shall without doubt secure the trade in

(1) Barbados, Trinidad and Demerara.

(2) Polo Ponies. I think we can breed Polo Ponies more easily here than elsewhere, because thoroughbred blood is very generally infused in our mares. Careful selection of the best Polo Ponies should be made and sent to Hurlingham as advertisements.

(3) Cavalry Remounts can certainly be bred here in large numbers.

C. A. T. Fursdon, Esq.: (1) Good—if we can produce what they require.

(2) Limited but at good prices.

(3) Good—if we can produce the required stamp, which is doubtful.

B. S. Gosset, Esq.: (1) There used to be a good demand for race horses and good prices were paid for horses that had made their mark on the turf, by racing men in the other West Indies, but they seem now to get their race horses from America or England.

(2) I believe Polo Ponies are not of much value in the rough, it is when they are trained by skilled polo players they become so valuable. Some have been taken to England and have realised good prices, but how much depended on their breeding and how much on their training I cannot say.

(3) We ought to be able to produce very good hardy infantry remounts, but during the late war no attempt was made to buy remounts by the Military authorities. I don't suppose more than a few hundred horses suitable could now be got, as on pens most mares that will breed mules are put to the jack, and only those that will not breed mules, are put to the horse. There being no demand, the birth of a horse foal is almost looked on in the light of a misfortune.

If it was known that colts could be sold at five years old from £20 to £30 the supply would soon be forthcoming

H. W. Griffith, Esq.,: (1) and (2) Small trade can be done in "Racing Ponies" and "Polo Ponies," with the other Islands.

(3) A great deal could be done here, if one has the chance of "Breeding Material" which we have not at present.

Animals of stout build, weight carriers, can be produced in Jamaica as well as anywhere else, *if* we have the mares to breed from; at present the majority of the best ponies in the island standing 14·2 h.h. are very narrow in the chest, light of bone, no width of quarters, and slightly ewe necked. This class of animal is useless for military purposes. A very swift horse is not necessary for Mounted Infantry use, but a strong powerful one is.

Colonel H. E. C. Kitchener: (1) Almost nil.

(2) Very small.

(3) Prices too small.

Hon. G. McGrath: I do not think there will be any appreciable trade in Polo Ponies—a few may be exported and a few disposed of here, but it would not justify any large production of Polo Ponies especially as they would be too small for draft purposes. We must look, I think, to the Mounted Infantry for our customers and the Government between that department and Breeders by their purchasing, as opportunity offers all good available stock, whether as yearlings and two year olds and keeping them until they are of serviceable age for remounts so as to have available at all times a sufficient number to induce a trade with the army. Other West India Islands may be induced through Government agencies on both sides to take some of our horses, but as stated above, I think we must look to the military departments for regular customers provided we are able to supply the description of horses required

E. W. Muirhead, Esq.: 1. I see little hope of doing much business in this direction. The freights are much too high. I have had several enquirers and the parties have had to drop the matter on this account.

2. Broken Polo Ponies in England would fetch high prices, but need some one with means to take them over and play them there to show their ability.

3. Cannot be filled now, I fear, but might as before suggested.

J. T. Palache, Esq.: In former years a considerable export trade was done with the other West Indian Islands, Mexico, Central and South America, and I know in my own time of a thoroughbred stallion Legatee, by Quicksilver, out of Legacy, being exported to the United States. He stood in Tennessee and was very much thought of and many of his descendants are now registered in the American Stud Book. Only last week I was applied to, to supply the pedigree on the figure system of a mare called Buzzing Bee, said to be one of the best race horses in Mexico, bred from a mare I sent over called Beretta and got by a horse sent over by Mr. C. L. Walker, of St. Ann, called Buzzard Wing.

The trade fell off with the depression consequent on the break down of the Sugar Industry affecting as it did the purchasing power of other Islands and the monetary condition of the breeders here, but I have no doubt that with anything like returning prosperity this trade will revive to the advantage of both sides

The advantage to importers to these countries to get a horse already acclimatised and bred in the same climate cannot be over estimated and will give us a very considerable advantage over countries in more Northern Latitudes.

When Major, now Colonel, Blagrove was in Jamaica investigating the question of Cavalry remounts I had the privilege of accompanying him to several places in St. Elizabeth to examine and measure the horses and brood mares. He informed me that whilst he did not think the Jamaican horses large enough for heavy cavalry he thought they would be admirably suited for mounted Infantry. He also expressed himself exceedingly pleased at the soundness of the Jamaican horses and their freedom from heritable unsoundness of any sort.

When the late Lord De Clifford was in Jamaica I had the pleasure of entertaining him at Montpelier. I then had three English Sires serving there, Sir Amyas, Black Bead and Hubert, and besides my own mares there were 30 or 40 mares from other pens to three horses. I showed Lord De Clifford about 60 mares, after carefully examining them, he said that in a large breeding establishment in England you would see larger and finer mares, with more fashion and quality—but you would never see such a collection of mares so sound and utterly free from heritable unsoundness which in England disfigures two thirds of the mares. I gather from this testimony and from my own knowledge of the subject that with care, attention and judicious feeding of the young stock we are capable of breeding, rearing and supplying the very horse for Mounted Infantry Remounts.

A. C. Paton, Esq.: (1) The prospect of an export trade to the West Indies is I think a very limited one and seems to be practically only for racing purposes, for which the supply in Jamaica seems to be quite equal to the demand, the West Indies seeming to find it more advantageous to get their working stock from America.

(2.) The exportation of Polo Ponies could, I believe, be caraied on

with good results, very few countries, if any, have such suitable mares to breed Polo Ponies from as Jamaica. We have got, whatcannot be got elsewhere, a breed of naturally small thoroughbreds. The mares of which, if the right type, are the ideal mares to breed Polo Ponies. These mares if crossed with a 14.3 h.h. or 15 h.h. weight-carrying hunter type of stallion would, I believe, breed us weight-carrying Polo Ponies. If we could export weight carrying "unmade" Polo Ponies as 4 year olds in February or March before the Polo season began I believe they would make about £40 each. If "made" prior to being sent over it is hard to say what they would make.

I consider that in breeding Polo Ponies here in Jamaica we have a considerable advantage to what we have in breeding any other variety of horse, firstly because we have the mares and general conditions most suited for Polo Ponies and secondly, the Polo Pony is comparatively a new variety of horse. To within a year or two ago a polo pony was only a chance bred animal. If we go in for Polo Pony breeding we are therefore starting at the begining whereas with hackneys, or any other breed we will be starting after the breed is practically perfected.

(3.) What I have said as regard Polo Ponies applies equally to remounts as the ideal remount is, I believe, the weight carrying Polo Pony type. The ponies that were too big or when tried were found unsuitable for Polo would make excellent remounts.

A. Roxburgh, Esq.: 1. Cannot form any idea.

2. Polo Ponies for England must be very fast. To breed such, special Stallions are necessary, as the ordinary thoroughbred is too big. But if we had a couple of real good pure bred pony stallions, the property of the Government, to which nothing but carefully selected mares be put, we could breed a Polo Pony second to none and well worth the expense of feeding and shipment to England, where for good ponies long prices are paid in a certain market. Mounted Infantry horses could also be raised here but breeders wont feed their young stock unless a sure market is before them.

J. Shore, Esq.: Many.

1. Barbados gladly takes Jamaican hard built ponies. Other Islands likely to, also.

2. I cannot say, but think there should be good prospects.

3. This is the main point, I am certain that Jamaica can be made a great centre for Remounts. Several estates abandoning cane cultivation in the drier districts can with profit go in for this, provided their is a chance of sale.

Cattle raising hardly pays now and will be worse when more sugar estates are abandoned; so that horse breeding for remounts should take its place.

B. Toole, Esq.: (1) A fair prospect (presuming we improve our present stock) provided the Steamship Companies reduce their present rates for conveyance to a moderate amount and offer better facilities generally for transport.

(2.) We can breed Polo Ponies all right, but the same difficulties arise as at (1)

(3.) This is somewhat different, we must raise the average height to

nearly fifteen hands, and the same difficulties with regard to the cost of conveyance will still exist.

A. B. Ventresse, Esq.: (1.) In this direction it appears to me from my experience in the other Islands that trade would be a very small one, and the people in these Islands are more inclined to import from the north, than they would be from Jamaica There will always be a small interchange owing to facilities being better and the Jamaican horse is already acclimatised, but I should not think the trade would be one to cater for except by the occasional breeder, who might have trade connections in the other Islands.

(2.) Our horses are small enough now, and if we go into the importation for Polo Ponies I think it will be a great mistake and again occasionally the individual breeder might do well to turn his attention to Polo Ponies, providing he has stock suitable therefor, but I think it would be a mistake for the Government to encourage anything in this line at the present time.

(3.) Mounted Infantry Remounts I think should be particularly encouraged and it is the one hope that should be looked forward to in the future of horse-breeding in Jamaica, my opinion on this is summed up in a few words in answer to question 1 and 2.

C. L. Walker, Esq.: 1 & 2. Larger animals will create a demand. Unforeseen, but good stock will be in demand for the other West Indian Islands, and for remounts, &c., &c.

Hon. W. Watson: At present our horses are so much run down that a decent selection for remounts could not be had, but the country affords every facility for working up our horses into a high class set of remounts, for any rough tropical or semi-tropical country.

Minute by H. H. Cousins.

1. There is a demand for racers and draft stock from the other islands. A considerable extension of this trade can be relied upon.

2. Polo Ponies must be left as a speculation for players who can make a smart Polo Pony out of a £12 animal.

3. The light cavalry remount is the foundation upon which a revival of our horse-breeding industry must be based. Steps should be taken to impress the War Office with the special and sterling merits of the Jamaican horse for tropical and sub-tropical work and to try and get terms that would enable breeders here to produce at a profit.

4. Get the War Office to appoint a local officer to see yearlings and collect and feed on pens yearlings from peasantry.

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8. What are your views as to the secondary advantages of producing larger stock for breeding draft mules?

S. C. Burke: The breeding of mules in Jamaica seems well able to take care of itself. As an industry it is in a very much more flourishing condition than horse-breeding, but as the two must go hand in hand it will be necessary when considering the horse question to deal with mules also. The demand for mules in consequence of the importance of the banana trade is so great and continuous that breeders have during the last ten years, been neglecting horses and turning their ener

gies to mule-breeding. The immediate result of this policy is that there are nearly twice as many mules as horses being bred in the country, and although we have not yet begun to feel it, in a few years there will be a very serious scarcity of horses. When that occurs there will be a proportionate scarcity of mules.

That the class of our mules can be generally improved goes without saying. Any mare is regarded as good enough to breed mules from. The class of jack from which the majority of persons breed is very bad and deficient in size. I believe that I have seen nearly all the donkeys in the large penns in the island and I am sure that there are not half a dozen which stand over 14 hands. I cannot help thinking, therefore, that more good can be done to improve the size of the mules which we breed by importing a larger and heavier class of jack than by trying to improve the size of our mares My experience is that the mares which breed the best mules are the short-legged, thick set deep bodied ones,—mares of the type of the weight carrying Polo Pony—and I believe that if all our mares were of this type we would get better mules from them when crossed with really big jacks—I mean 14·2 to 15 hands donkeys—than the mules bred from leggy mares. Large mules are not a necessity in Jamaica. In fact in the hilly parts of the country they are a disadvantage and cannot stand the work. A short legged, stout-bodied 14·2 mule is what everybody wants and what everybody will buy and I believe that such a mule can best be bred from mares of the polo type when crossed with large jacks.

Hon. J. V. Calder: The owners of the few mares who are now breeding mules are making a great mistake in not keeping a certain number to breed mule mares and thus keep up their supply and have for sale the colts.

I had to buy mules at £23 a few months ago that could have been bought 3 years ago for £18.

The mules bred by the peasantry are too small.

It would be wise for the Government to subsidize a Jackass in St. Catherine, Manchester, St. Elizabeth, St Ann and probably Clarendon and place their services at the disposal of the public for a nominal fee. I don't know why this was discontinued by the Agricultural Society. A bonus should be paid for each peasant's mare to the owner of the jack on evidence that the mare had produced a cub. I don't think it is desirable to pay a premium to the owner of the jack, as he may not get many mares.

Imported mares would not do to *breed mules* as a rule—but they would in the hands of competent owners.

W. G. Clark, Esq.: The mare progeny of the "Cleveland Bay," will certainly improve the size of mules in every way.

Jack Donkey importation should be encouraged in the same way as stallions; numbers of jack donkeys to-day have a disease called, I understand, "Donkey Farcy"; they are mostly little weedy things that must do no end of damage among mares or jinnies not only getting *weedy* miserable mules and cubs but diseased besides. They ought to be castrated or taxed heavily.

W. Cradwick, Esq.: In the event of a serious attempt being made to revive the horse-breeding industry, and to produce the class of animals mentioned, it should be done and confined to the best horse raising districts, and the greatest care should be taken to see that the mares are properly mated.

The mountainous parts of St. Elizabeth, near the sea, seem to be very favourable for the production of good small horses, the plains for bigger stock. The good little ones are, and always should be more plentiful than the good big ones, and I think success along these lines would be more easily obtained and be more worth obtaining than attempts to produce big horses except for mule breeding. This attempt should however certainly be made, and I take it that the crop of geldings which would inevitably be produced would furnish carriage horses, cavalry remounts, etc.

J. Daly, Esq.: A first class ass, and at a much cheaper rate to meet the purse of the peasant proprietors—Say at a charge of 15/ each mare.

H. G. T. Drew, Esq: Naturally the largest mares for this purpose are most desirable, but I think what is the principal cause of the production of the small weedy mules which are so plentiful, is the fact that old worked out mares, after they are unfit for any work are then "thrown up to breed," the result of this is that they themselves are run down in constitution, and are barely able to supply their cubs with proper nutriment With well built healthy young mares and a well fed donkey from say 4 to 12 years old, fairly large with plenty of bone, judiciously exercised, our Jamaica mules will be much improved.

C. A. T. Fursdon, Esq.: It is an open question if it is not advisable to leave the size of our mules alone, they are wonderful animals and speaking generally are well adapted for the work required of them. The demand for mules of the American type is limited to the level banana land and the coast towns, but an effort might, with advantage be made to put bigger bodies on to the shaft mules by the use of better donkeys.

For the present I would confine the effort to producing larger horsekind rather than mules.

J. M. Gibb, Esq., V.S.: 8. Selected mares bred with a 14 or 14.2 should give us mules of 14 hands and upwards. Districts that are known to be successful in horse-rearing should be the ones which should receive the attention of the Board of Agriculture in their selections for locating the stallions and mares and a strict return should be kept of all mares served, number of times put, number proved, and foaled.

The Board should be satisfied that the Stud Groom understands his duties. He should accompany the stallion at all times, so that, the animal whilst knowing him can be better cared and looked after. This groom could be employed by the Board, and subject to dismissal by them. Suitable quarters must at all times and places be provided for stallion and groom.

A certain dietary could be provided for "in season" and "out of season."

The Stud Groom must be fully cognisant of the diseases of mares which would be injurious to the health of the stallions.

B. S. Gosset, Esq.: I think it most important to breed larger stock for breeding draft mules. There is a ready sale for large well made mules but they are not easy to breed.

H. W. Griffith, Esq.: Mares from 15 h.h. to 15·2 h.h. are the most useful for breeding mules for draft purposes, above this height is not necessary as a good deal depends upon the "Ass."

Mules of from 14·1 h.h. to 14·2 h.h. are most useful; mules above this height cannot do quick, active work, such as drawing out bananas, and logwood, &c., out of difficult places. The larger mules are most useful for carrying dead weights on the level streets, such as town work.

Colonel H. E. C. Kitchener: Bonus for American Jacks.

A. P. Lockwood Wingate, Esq.: I think this can be safely left to private enterprise: we can now produce 14·1 to 14·3 mules, which I think are quite big enough for the work here, and sell them at remunerative prices, and as long as we can do that, mares big enough to produce these mules will be found. And if regular importations of stallions are kept up, the size of the mares will keep up too and not run small as they are doing now, and we shall always then have mares big enough to produce mules of the above size.

Hon G McGrath: While I do not appreciate a large and leggy mule for our description of work, I am willing to admit there are too many weedy and small mules being produced, this I think might be prevented, by the Government preventing the use of asses not up to a certain size and with this suggestion the mule-breeding industry may be left to take care of itself.

A. C. L. Martin, Esq.: Having bred mule Royals myself I can make bold to say they are hardier than the mules out of mares, will grow to a serviceable size and more cheaply bred They should be bred from large Jennies covered by a 14 hand horse. It is absolutely necessary that a few donkeys should be imported for sire purposes both to improve the class of jennies now existing and to produce native bred animals for sire purposes to produce mules from mares. It is with great difficulty at the present time to obtain the services of a really good ass to cover a jenny. The owner of the best ass I know of will only take jennies after the season for serving mares is over and to ensure success in donkey breeding the jennies should be covered when they are in heat otherwise the venture proves abortive.

There are too many undersized asses and horses serving in the island, at fees ranging from 6/- to 12/- and owing to this the peasantry do not patronise animals that will improve their stock whose service fee is a guinea.

E. W. Muirhead, Esq.: Mule Breeding is extensively taken up now, the increase in the fruit trade having caused a good demand in which there is much more money than horse breeding. If the Imperial

Government could be persuaded to undertake to buy all the horses and mules, of the description size and class they require, at 4 years old, say for £30 each, then there might be some inducement and hope of our doing all that Sir Alfred Jones would like to see in this direction.

Mares for mule breeding of the type of those used for livery, buss and car purposes (unsuited on account of some small blemishes) would be very useful here, where I suppose we have some of the best proof asses to be found anywhere.

Generally. It is quite possible for us to produce from our present stocks of mares and donkeys a mule of 14 or 15 hands at 4 years old. We have frequent enquiry and often effect sales at £30 each, but few of the breeders are in a position just now to wait till then.

With regard to horses they require more feeding from yearlings than the breeders can afford to give them with the uncertainty of a sale, but if a sale is guaranteed the extra expense will be incurred which is essential with increased importations.

J. T. Palache, Esq.: I have already partially answered this in reply to Reference II. but I would add that another point of mule breeding is the importation of some good she asses as well as proof asses for breeding; an improved ass in Jamaica and the encouragement by premiums of pony stallions that will cover Jennies and breed Mule Royals.

These Mule Royals are larger, more docile and in all respects better than the ordinary mule, and the saving in breeding is considerable as the price of one mule mare equals that of three or four Jennies and the keep of a Jenny one fourth that of the mare.

I desire to add a few suggestions not covered by the references but embraced in the subject generally. It is absolutely necessary to encourage racing so as to promote horse breeding.

In former days racing was encouraged by the Government and horse breeding flourished. In the early part of the last century at Pepper and Goshen larger breeding establishments existed than have ever existed in England even at the present day. As the encouragement for racing was withdrawn so horse breeding fell off until to-day it is almost nil.

It is racing and nothing else that has built up the British thoroughbred to what it is to-day, viz.: The standard from which all other parts of the world obtain their stud animals for improving their respective breeds. What Great Britain is to the world to-day, Jamaica was at one time to the rest of the West Indies, Mexico, Central and South America; and this position can be restored if only all those interested would join heart and hands for the purpose.

For centuries racing has been supported in England by grants from the Revenue for King's or Queen's plates.

But when races by means of companies and gate-money meetings were instituted, that attracted all the best horses, and left the Queen's plate to be competed for by inferior horses, Queen's plates were abolished.. The money however was not withdrawn from the original object of encouraging horse-breeding, but was continued in premiums

for stallions examined and approved to stand in certain districts at a regulated fee so as to come within the means of small farmers.

In the olden days Queen's plates were given in Jamaica and premiums for the importation of stud animals for improving the different breeds of domestic animals. The Law regulating this, 26 Vic. Sess. 1 c. 3, expired in 1866 and has never been wholly re-enacted, although the Government has granted one Queen's purse for Kingston every year until five years ago when it was discontinued. The Jamaica Agricultural Society started for a short time to grant premiums for stallions to serve in districts at a reduced fee and really good work was done when the services of horses like Blue Rock and Blue Jacket were available, but this has also been discontinued. I would therefore suggest the re-enactment of 26 Vic. Sess. 1, c. 3, with such modifications and improvements as the circumstances require Establish a system of premiums for stallions and proof asses to be stationed in various parts of the island at such fees as shall be within the means of all.

Adopt the French system of examining and certifying stallions and proof asses and allowing only such as are certified to serve. If any more details as to the framing of the scheme and the Law necessary for carrying it out are required, I shall be glad to give any further information or assistance in my power.

Hon. Dr. Pringle.: I think with the importation of good jacks, with our mares--especially improved as I have before suggested, we could produce the size mules best suited for Jamaica work and export too.

A. Roxburgh, Esq.: I don't think the want is in our mares but in the jacks. Our mares would produce much larger mules if our jacks were better.

Some of my best mules are produced from 14 hands 1 inch mares, of course they are *roomy* animals. This I consider a *sine quâ non* in all breeding that is to be successful.

The foal or calf or any thing *must* have *room to grow* before birth. However with the mares on hand but with better jacks we can produce a much better stamp of mule than we do.

Messrs. T. H. Sharp & Son: Our mares are quite good enough, a large premium should be given for the importation of jack asses from Malta. The progeny of the Maltese ass gives a splendid all round mule. The Kentucky asses and mares are unsuitable to this island. They breed big and worthless mules.

J. Shore, Esq.: I am of opinion that prepotency in the sire is of more advantage than large mares.

Good big jacks, well built, are better than smaller ones mated with big mares.

I have found that the dams as a rule convey their outward characteristics (such as quick or slow draught, good or bad gait, &c.) to their

progeny; but that stamina and toughness generally come from the sire, *after thorough acclimatization.*

B. Toole, Esq.: The production of large stock (mares) for breeding mules is highly desirable. Two-thirds of the mules at present in the Island while tough and hardy enough, are too small and this in many cases entails the working of three animals where two larger ones would suffice

The desired improvement cannot be attained by the breeding of large mares only. I think it of equal importance to have a few large jacks imported on the same lines as the stallions, or perhaps the large jacks at present in the Island, owned by private individuals, could be subsidised to such an extent that their service would be available for a moderate charge.

I do not mean it to be understood that there are not many good stallions, and mares too, at present in the Island, but the difficulty is that their services are beyond the reach of the ordinary settler, who in preference to paying what he considers a high fee and sending his mare a long distance, satisfies himself with the service of his neighbour's pony whose highest ambition is to carry his owner's breadkind to market in hampers, or perhaps to help to draw his John Crow mill.

United Fruit Co.: We think the producing of larger stock for breeding draft mules of primary rather than of secondary importance. And as we do not agree with the importation of mares, to attain this end, we hold, a law should be enacted to prohibit breeders and stock-owners in general from keeping either for breeding or other purposes, any stallion under the height of 14·2 hands. This done, it would be practically easy to raise the standard of our mares, and with good imported jacks, the desired end will be accomplished in a few years.

A. B. Ventresse, Esq.: I think my views in reply to this question are practically stated in answer to 6 (1). There is no doubt whatever that we do require larger stock for breeding draft mules, but the great reason at present why our mules are so small is on account of the small donkey stallions spread all over the country; some determined efforts should be made by the Government to do away with these, and at present I do not see anything more feasible than a heavy tax for the keeping of entires. We must get rid of our under-sized and under-bred stallions and jacks, then we shall breed up to the best we have, and not down to our worst as at present.

I should prefer the importation of mares if it can be encouraged on a large enough scale to produce the desired results. A sliding scale would have to be adopted to prevent monopoly and favouritism, hence a bounty might with advantage be paid, but the bounty should only be on Hunters and Hackneys; our own stallions crossed with these would produce just what is required for our own use and for remounts.

Probably something like the following might be advisable, namely, a bounty of five guineas per head each for one or two mares, for one pen or one individual Penkeeper; four guineas for each of three;

three guineas each for four or five; and two guineas each up to ten, etc.

The breeding of Polo Ponies and all other fancy fads is not the duty of the Government to promote, these should always be left to work out their own salvation.

R. A. Walcott, Esq.: It is desirable to have larger stock for breeding draft mules; but if our ordinary stock were properly and regularly fed when young they would be large enough, and could not be improved upon.

C. L. Walker Esq.: By importing large stallions and mares and large proof asses the natural result will be large mules.

Hon. William Watson: If the suggestions are carried out of importing largely of upsize stallions, with plenty of bone, there would be a wonderful improvement in our mares, then with a number of imported jacks, standing 14 or 15 hands, we could get a good type of mule.

It may be a little outside of this question, but it is highly desirable that some means be arrived at, whereby no one be allowed to keep or use as a stud any under-sized or runted creature. Let it be prohibitory to keep any horse, under 14 hands, to use him for breeding purposes. This will probably do more to improve the breed than anything else.

J. R. Williams, Esq.: The breeding of mares suitable for producing larger and stronger mules ought not I think to be styled a 'secondary' advantage. Considering the importance of mules in our agricultural development, it is of primary importance, putting aside the possibility of an export trade in horses, more important than the breeding of horses. And the majority of Pens which breed a limited number of horsekind have chiefly in view filly colts out of which they may supply mule-mares. It is not a very good plan, for the mares put to the horse are mostly those which refuse to breed readily for the ass, and these are likely to transmit the same disqualification to their issue But mule-breeding is of primary importance.

I think we would improve the standard of mule-mares by importing stallions of the type of which I have suggested my approval, and by using these imported stallions or local stallions subsidized in the way I have indicated.

But what we specially need is a better type of stud ass, attainable for something less, a good deal less, than from £70 to £100. And something might be done under Government subsidy in this direction, by importing large and good asses, half a dozen or so, to serve jennies only at approved centres. For the first few years 6 or 8 months at one centre would be sufficient. If we have a Stock Farm then it should certainly be one of its enterprises to breed and sell large thoroughbred asses. In consequence of the reluctance of the owners of the best stud asses to serve jennies—for good and sufficient reasons—and the consequent scarcity of really good *jacks*, the breeding of mules in Jamaica seems to me to be in rather worse case than horse-breeding, and to claim quite as urgently as the improvement of horsekind, if not more urgently, the attention of the authorities.

Summary by H. H. Cousins.

1. As regards horsekind, the mule problem will be solved by a general improvement in the former on lines already laid down.

2. Premiums should be paid for approved jacks to be used by the peasantry at a nominal fee.

I do not approve of compulsory castration of donkeys, since this would deteriorate the working powers of the beasts of burden of the small settlers.

3. One or more high class jacks of the Maltese type should be imported. Improved donkeys should be bred at the Stock Farm from selected Jamaican asses.

5. The Horse Show should be encouraged. A special grant for horse prizes to be made at the chief Shows in the Island.

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BULLETIN

OF THE

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EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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JAMAICA

BULLETIN

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DEPARTMENT OF AGRICULTURE.

Vol. I. NOVEMBER, 1903. Part 11.

JAMAICAN FODDERS.—I.

By H. H. Cousins, M.A. (Oxon.), F.C.S.
(Government Analytical and Agricultural Chemist.)

Introduction.

One of the great natural advantages of our island, and a feature which affords sure ground for basing an improved and progressive agriculture, is the facility with which luxuriant crops of grasses and fodder plants can be obtained over a large proportion of the country. So bountiful in this respect has nature been that the growing of fodder crops under tillage is almost unknown and the mere cutting down and clearing of bush and waste land is frequently sufficient to obtain a luxuriant growth of guinea grass.

The grounds of the Government Laboratory are a striking illustration of this fact. So luxuriant has been the growth of the guinea grass since the hurricane that specimens measuring over 11 feet in height to the point at which the flowering spike emerged have been recorded. The most far-reaching results in the social and material condition of our peasantry would follow from a general recognition by the people of the advantages of mixed farming and the steady improvement of a localised holding, as compared with the nomadic fire-stick wastage which at present ranks as the agriculture of a large section of our small cultivators.

The hurricane has taught us the national peril of growing bananas without a complement of ground provisions as security against a 'blow.' The logic of the empty stomach will drive this home to a practical conviction on many a peasant holding during the coming months. All teachers and advisers of the people, the clergy, the magistrates and all agricultural teachers should now use their influence to set the people to work to ensure against such a disaster in the future

by the regular and systematic cultivation of home-grown food-stuffs. A 6-months' crop of peas and sweet potatoes on a single acre will yield an adequate and balanced ration for five men for six months. If one half of each holding were reserved for the growth of fodder crops, and a cow or mare and a sow or two formed a portion of the live-stock of the establishment, the manure from the animals would give a security for the grade of fruit and the yield of provisions. After ten years of such farming the crops would, if anything, be better than at first.

The composition and feeding value of the various fodder products available in Jamaica and the possibility of obtaining improved varieties and the introduction of new fodder-plants is a matter that the Board of Agriculture will of necessity find it necessary to investigate.

The following results have been obtained in the Government Laboratory and may be regarded as a preliminary survey of matter which will need special treatment and investigation on its merits later.

The Samples.

I have to thank the following ladies and gentlemen for their personal services in securing representative and carefully prepared samples of fodders from different parts of the island:—

Miss Steer, Trafalgar, St. Ann; W. Cradwick, Esq., and Mrs. Cradwick, Mackfield, Westmoreland; John Edwards, Esq., Knockalva, Hanover; The Hon. R. P. Simmonds, Quebec, St. Mary; A. P. Lockwood Wingate, Esq, Pepper, Manchester.

The chemical analyses are all the work of Mr. H. S. Hammond of this Department.

Guinea Grass. (*Panicum maximum, Jacq.*)

This is without question the most valuable general-purpose fodder grown in Jamaica, and like most of our products shows great variation according to the soil and district upon which it is grown. Samples from five parishes have been analysed, of these that from St. Ann holds the first place, followed by that from Hanover. The Manchester grass shows an inferior quality, while that from St. Mary although considered a good grass for the district and genuine guinea grass, is decidedly the most inferior of the five.

The grass from St. Mary is little better than good oat-straw in feeding value, while such grass as that obtained from St. Ann is quite equal to good Timothy grass in general feeding value.

The effect of irrigation, manures and the period of ripening have still to be ascertained. There is evidently a reduction in the amides owing to their elaboration into the more valuable albuminoids with the ripening of the plant, although this is probably associated with an increase in the "bone" or indigestible stem and fibre of the grass.

Guinea grass is most susceptible to manuring, and where grass is valuable it should pay to treat the grass pieces liberally in this respect when they show signs of exhaustion.

GUINEA GRASS. (*Panicum maximum, Jacq.*)

	HAY. Sun Dried.					Dry Matter at 100° C.				
Number.	1.	2.	3.	4.	5.	1.	2.	3.	4.	5.
Parish.	St. Mary.	St. Ann.	Hanover.	Westmore-land.	Manche-ster.	St. Mary.	St. Ann.	Hanover.	Westmore-land	Man-chester.
Moisture ...	14·20	16·31	13·04	13·83	10·49	—	—	—	—	—
Fat, wax, &c. ...	0·26	1·16	0·20	trace	0·11	0·30	1·38	0·52	trace	0·12
Albuminoids ...	3·50	4·55	4·29	4·37	3·41	3·47	5·44	4·93	5·08	3·81
A ides ...	0·48	2·10	1·59	0·47	1.09	0·61	2·50	1·95	0·54	1·22
Total Nitrogenous Matter	3·98	6·65	5·88	4·84	4·50	4·08	7·94	6·88	5·62	5·03
Carbohydrates ...	42·07	36·46	36·99	36·90	41·88	49·39	43·58	39·08	42·82	46·70
Crude Fibre ...	31·63	33·71	34·99	36·34	36·35	36·86	40·28	39·87	42·17	40·70
Ash ..	7·86	5·71	8·80	8·09	6·67	9·37	6·82	7·63	9·39	7·45
Potash ...	Note.	Nos. 1, 2	& 3 were c	ut before flo	wering	0·17	0·10	0·67	1·95	1·12
Lime ...		Nos. 4 & 5	were cut	when just in	flower.	0·5[illegible]	0·93	0·39	0·99	0·49
Phosphoric Acid ...						0·30	0·43	0·44	0·62	0·41

PARA GRASS *Panicum muticum.*

Constituents.	A. St. Ann.		B. Hanover.	
	Sun Dried.	Dry	Sun Dri d	Dry.
Moisture ...	12 57	—	14·91	—
Fat, Wax, &c. ...	0·80	0·91	0·44	0 52
Albuminoids ...	5·64	6·44	5 85	6·87
Amides ...	1·57	1·81	5·13	6·03
Total Nitrogenous Matter	7·21	8·25	10·98	12·90
Carbohydrates ...	40 66	46 5	33 25	39 08
Fibre ...	33·68	37·83	33 93	39·87
Ash ...	5·68	6·50	6·49	7·63
Potash ...		0·5[illegible]		0·70
Lime ...		0·90		0·40
Phosphoric Acid		0·47		0·44

Here again we see marked variation in the composition of the same grass grown in two different situations and districts. The Hanover Para grass shows a very high feeding quality. For growing stock and milk production the Para grass shows a decided superiority to the Guinea grass grown under the same conditions. The nitrogenous constituents are in a most favourable proportion. This grass is undoubtedly of high value in those districts to which it is well suited.

PIMENTO GRASS. *Stenotaphrum americanum.*

Constituents.	Dried at 100° C.	Sun Dried.	Green.
Moisture ...	—	15·75	80·78
Fat, wax, &c. ...	1·64	1·38	0·32
Albuminoids ...	7·25	6·12	1·38
Amides ...	1·37	1·14	0.28
Total Nitrogenous Matter	8·62	7·26	1 66
Carbohydrates ...	48·58	40·93	9·33
Fibre ...	33·13	27·91	6·37
Ash ...	8·03	6·77	1·54
Potash ...	0 76		
Lime ...	0·66		
Phosphoric Acid ...	0 58		

This grass came from St. Ann and does not compare with either of the two preceding species as a source of large crops of luxuriant growth. It is, however, a valuable common grass. This sample appears to be slightly inferior in feeding quality to the common grass of the same species from Westmoreland of which Mr. Cradwick speaks so highly.

Miscellaneous Pasture Grasses from Westmoreland.

Constituents.	Common Grass. A. In flower.		Common Grass. B. In flower.		Corn Grass flowering.	
	Sun Dried.	Dried at 100° C.	Sun Dried.	Dried at 100° C.	Sun Dried.	Dried at 100° C.
Moisture ...	13·19	—	13·03	—	11 95	—
Fat, Wax &c. ...	1·0[illegible]	1·24	0·49	0·57	1·36	1·55
Albuminoids ...	8·02	9·24	8·36	9·61	7·77	8·82
Amides ...	1·23	1·42	0·33	0·39	1·58	1·80
Total Nitrogenous Matter	9·25	10·66	8·69	10·00	9·35	10·62
Carbohydrates	42·22	48·64	43·45	49·95	35·37	40·17
Fibre ...	27·52	31·70	27·24	31·32	32·73	37·17
Ash ...	6·74	7·76	7·10	8·16	9·24	10·49
Potash. ...		1·34		1·12		2·07
Lime ...		0·48		0·48		0·76
Phosphoric Acid ...		0·69		0·73		0 57

With reference to the Common grass of which he sent two samples Mr. Cradwick writes:

"This is the best permanent pasture probably in the world. I have a filly which gets five quarts of corn or oats a day, and the tenth share of about three acres of this pasture and is as fat as a mole; she works as a rule three or four day a week and is always in show condition. Common around Knockalva is equal to Guinea grass if kept clean, which very few are, I am sorry to say, always, of course, excepting Knockalva."

And with reference to 'Corn grass.'

"A very fine feeding for young brood, and out-of-condition stock; nearly as good as Spanish needle"

SPANISH NEEDLE. WESTMORELAND. (*Bidens leucantha, Willd.*)

Constituents.		Dried at 100° C.	Sun Dried.	Green.
Moisture	...	—	15·83	90·01
Fat	...	1 54	1·30	0·15
Albuminoids	...	10·91	9·19	1·09
Amides	...	0·91	0·76	0·09
Total Nitrogenous Matter	}	11 82	9·95	1·18
Carbohydrates	...	33·56	28·24	3 36
Fibre	...	38.34	32·27	3·83
Ash	...	14·74	12.41	1 47
Potash	...	3·80		
Lime	...	1·64		
Phosphoric Acid	...	0·54		

Mr. Cradwick who sent this sample writes:

"I find from actual experience that Spanish Needle is splendid feeding for horses off condition, picking them up very rapidly; it acts as a slight purgative and for a horse in poor condition, suffering from worms, etc., is a wonderful fodder. All horses eat it greedily."

The Analysis supports this claim. The proportion of flesh-producing albuminoids is high, decidedly in excess of any of the fodders previously reported upon. This plant grows freely in many banana plantations in St. Mary and would form an admirable addition to the local guinea-grass as a food for stock. It has been found excellent as a green manure on banana properties.

BREAD-NUT FODDER. (*Brosimum Alicastrum, Sw.*)

Constituents.		Dried at 100° C.	Sun Dried.	Green.
Moisture	.	—	15·86	61·08
Fat, wax, &c.	.	3·15	2·62	1·23
Albuminoids	.	10·69	8·99	4.16
Amides	.	3·62	3·05	1·41
Total Nitrogenous Matter	.	14·31	12·04	5·57
Carbohydrates	.	49 22	41·45	19.15
Fibre	.	25·57	21·51	9·05
Ash	.	7·75	6·52	3·02
Potash	.	0·72		
Lime	.	1 08		
Phosphoric Acid	.	0.50		

This is a valuable fodder-product. It is, for a tropical fodder, unusually rich in nitrogenous matter and deservedly holds a high place as a food for stock. The sample came from St. Ann where it grows freely.

RAMOON (*Trophis americana, Linn.*)

Constituents.	St. Ann.		Westmoreland.	
	Sun Dried.	Dried at 100° C.	Sun Dri d.	Dried at 100° C.
Moisture .	14·12	—	11·60	—
Fat, wax, &c. .	5·04	5·87	4·10	4·63
Albuminoids .	8 49	9·89	12·30	13·91
Amides .	1·15	1·34	2·22	2·51
Total Nitrogeneous Matter .	9·64	11·23	14·52	16 42
Carbohydrates .	41·61	48 45	38·96	44·08
Fibre .	22 74	26·48	19·47	22·03
Ash .	6·85	7·97	11·35	12·84
Potash .		0·78		1·63
Lime .		1·12		2·31
Phosphoric Acid .		0.51		0 45

Two samples of Ramoon, representing the leaves and young twigs of *Trophis americana* from St. Ann and Westmoreland are here compared. It is striking that the Ramoon from the latter parish is very greatly superior as regards nitrogenous constituents, This fodder holds pride of place in this series and must be considered of high nutritive value.

Mr. Cradwick, who sent this premier sample from Westmoreland writes: —" This is a fine stimulating and strengthening fodder. A little Ramoon and plenty of common grass are, from my experience, an ideal feed for horses and mules."

GUANGO (*Pithecolobium Saman, Benth*)

Contents.	Seeds.		Pods	
	Natural	Dried at 100°C.	Natural	Dried at 100° C.
Moisture .	13·46	—	20·46	—
Fat, &c .	5·15	5 95	0·56	0·71
Albuminoids .	18·09	20·90	8·95	11·25
Amides .	9·25	10 69	1·22	1·54
Total Nitrogenous Substance .	27·34	31·59	10·17	12 79
Glucose .	0·36	0·42	7·12	8·95
Total Carbohydrates	38·20	44·15	55·35	69·59
Fibre .	12 10	13·98	11·55	14·51
Ash .	3·75	4·33	1·91	2·40
Potash .		1·52		1·40
Lime .		0·22		0·04
Phosphoric Acid .		0·77		0·74

An analysis of the Guango as made by Professor J. B. Harrison of Demerara was published in the Botanical Bulletin 1901, p. 154. This, as the analyst has since pointed out, ignored the fact that cattle and and horses only digest the pods while the seeds are excreted entire.

In a recent report Professor Harrison has published separate analyses of the seed and the pods, and although the Demerara Guango varies greatly from that grown in the Liguanea plain in Jamaica, the main point is brought out by both analyses that the pods are greatly inferior to the seeds in nitrogenous matter and that, in practice, the Guango is by no means so rich a nitrogenous food as would appear from the composition of the entire fruit, seeds and pod. Our samples averaged pods to seed as 5 to 1.

The pods contain a good deal of glucose and a moderate proportion of albuminoids only. Could the seeds be ground up a high-class cattle-feed should result. One of the difficulties is that of the sticky consistency of the pulp of the pods, which would make the process of milling somewhat difficult. It is probable, however, that if the pods were thoroughly dried before being milled that a satisfactory result would follow.

MEMORANDUM *re* GUANGO. (*By J. Barclay.*)

Trees drop their leaves in January.

Fruit ripens March to May; drops when full ripe unless it is blown off by breeze. Eaten greedily by cattle and horses; latter as with mangoes, reject most of the seed in chewing, but former eat all, and seed passes through and the droppings a month later may be seen covered with sprouting seedlings. This is by far the best way indeed to establish a nursery of young plants to secure young seedlings.

Guango is a rich and cloying food, and when any other fodder is available cows and horses will, as a rule, only eat a little at a time, then go to drink and eat something else. When plenty of water is available at will for stock, they may live on it almost entirely for a month to two months, drinking freely all the time, but if water is scarce the seeds may then block the stomach or intestines and cause illness; but as the guango does not last in season very long and ceases with the rains, a diet chiefly consisting of it, is not generally continued long enough to do harm as the young springing grass following is very laxative in effect. Some people (and it ought to be done to a much wider extent that none should be wasted) gather the guango and store it, feeding it for months after it is out of season. Tons of it, however, are wasted and stock keepers, buying corn and oats at 5s. a bushel, crush the valuable pods under their feet every day. There is a difficulty in curing it because of its saccharine content easily causing fermentation when it is stored, and it does not dry up and cure like corn, exposed to the sun in the pod. The remedy I think is to crush it and dry it into a meal, and it needs a hot dry place to do this quickly. An artificial drier should work best.

RICE MEAL.

	Per Cent.
Moisture .	14·11
Fat .	0·23
(Crude) Albuminoids* .	6·12
Carbohydrates .	35·04
Fibre .	31·32
Ash .	13·18
*Containg Amides .	0.43

The above analysis is that of a sample of rice-meal from Walter Woollscroft, Esq., of Georges Plain, Westmoreland, who has established the rice industry on that property. This product is readily eaten by horses and should be regarded rather as a substitute for corn than for oats, since it is by no means rich in Nitrogenous Constituents.

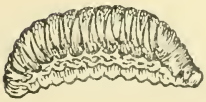
THE ORANGE WEEVIL.

BY E STUART PANTON.

The Orange Weevil* familiarly called "Fidler," represents a West Indian group of snout-beetles, said to number some 70 or 80 species, and is a member of an extensive family termed *Curculionidae*, which contains many insects of very brilliant colours.

The weevil generally measures from half an inch to an inch and a quarter long, and constitutes a variety of local forms, most of which are brightly coloured, and it is likely that several, if not all, feed upon Citrus.

The variety called *rubro vittatus* is probably that oftenest found clinging to Citrus trees. The male, (fig. 1) which is generally smaller than the female, (fig. 2) is shining black, with two bright red, longitudinal stripes on the elytra, or wing-cases, which enclose another similar, but white stripe down the middle of the back; while the female is generally, but not always, more or less covered with whitish scales, which make the two red stripes on the elytra but faintly visible, and the white median one, not at all.



* Præpodes vittatus, var. rubro vittatus.

In the imago or perfect state, they feed on the leaves of trees, while their grubs direct their attacks to the roots.

It is evident that prior to the introduction of Citrus and other cultivated plants into the West Indies, these insects must have lived upon some indigenous plant or plants; and in this connection it may be observed that I have seen them feeding on the leaves of the Trumpet tree (Cecropia peltata).

So far as I am acquainted, the attacks of the beetles themselves on the leaves of Citrus are unimportant, as they only nibble the edges of the leaves, effecting no real injury to the foliage But the larva, which, when mature, measures about three-quarters of an inch in length, and is a soft, white, fleshy, *footless* grub, with a brown head, is accused of doing serious damage to the roots of orange trees, where it is found to attack the outer tissues (fig. 3 side view of larva: fig. 4, view partly of underside).

Apart from what has been stated above, nothing more is known of the habits and life-history of these insects, but it is probable that the females lay their eggs in the ground close to one of the roots of the tree and the eggs hatching, the little grubs find their way to the roots.

But besides the larva of the Orange Weevil, I have found the grubs of two species of Lamellicorn beetles feeding within the decayed roots of orange trees. One is a very large, whitish, fleshy grub, and is probably that of *Strategus titanus.*

From my observations, however, I am led to believe that it is only when Citrus trees become diseased that any of these underground grubs attack the roots, and then for the purpose of feeding on the dead and decaying tissues only.

There is a very prevalent and mysterious disease that affects Citrus trees, and which I feel certain is responsible for the injury done to them that is generally attributed to the attacks of the Orange Weevil.

The first signs that an orange tree shows of being affected by this malady is a paleness of the foliage, which afterwards becomes yellow, and numerous shoots or gormandizers arise from the trunk.

The disease strikes to the heart of the tree, taking its rise at the end of the tap or main root, working its way upward through the middle of the trunk, and eventually in the same way spreading to the branches and lateral roots.

Should a tree in an advanced stage of the disease be dug up, it will generally be found that the tap root has rotted off; and if the trunk, larger branches and lateral roots be split open lengthwise, the centre or heart-wood will be seen to be dead, and of a brown colour, and probably the habitation of a colony of Duck Ants, which will be found in long narrow passages or burrows throughout the the dead portion of the tree

But it appears that the Duck Ants do no real damage to the tree, as they also only follow in the wake of the disease, obtaining an entrance from beneath the ground up through the decayed tap root, eating their way along through the dead wood only, in the centre and branching portions of the tree.

There are instances where orange trees have been deserted by Duck Ants after they have eaten away all the dead wood in the centre of the

tree, and yet in this shell-like state the tree retains sufficient vitality to bear good crops.

Where such instances of partial recovery occur, it is probable that a sufficient number of roots remained healthy to give the tree a chance of life.

Although the presence of Duck Ants in trees affected by this disease may be unimportant, efforts should be made to prevent them gaining an entrance to healthy trees, which they may do through dead branches, or from neglected cuts made in pruning, or other causes. Care should therefore be taken to remove all such branches, and to apply tar to cuts and wounds made in pruning. It is necessary, however, to be careful when applying the tar, not to let it touch the edge of the bark round the wound, as it burns the sap and so retards the bark closing up over the cut

Sometimes but one side of a tree, or one or two branches only, show signs of being affected by the disease.

The same disease attacks nursery plants, and destroys the tap root, but if the plants are removed before they become badly affected, and are put into good soil, they will send out fresh roots and develop into good trees.

The cause of this disease appears to be the lack of sufficient drainage, for trees that are grown on gravelly soil, or among rocks, and also those on land with a sub-stratum of marl that may have but ten or twelve inches of soil above, are often found to thrive better, and live longer than those in deep soil on level land, or in valleys where the natural drainage is not so good.

In view of these conclusions, the deep trenching of groves where possible, and high planting recommended for Citrus trees by the Government Agricultural Instructors, cannot but be of great importance.

But should planters still believe that the larva of the Orange Weevil is responsible for the damage done to the roots of Citrus trees, the following remedies should be found useful for keeping the insect in check

Remedies.

(1) The destruction of the beetles whenever found. When possible they should be picked off the trees, as they often take flight before reaching the ground, when shaken from the branches.

In May, June and July, the insect appears to be most frequently seen in the beetle stage.

(2) *Lime Dressing.* Remove all weeds from the tree, and with a fork stir the soil as far as the roots extend, and give a dressing of lime.

In connection with lime dressing it may be mentioned that a soil rich in lime is considered necessary for the production of superior fruit. The lime not only tends to bring about an early crop, but also aids in producing a smooth-skinned orange.

(3) *Sulphate of Potash Dressing.* To apply the Sulphate of Potash, prepare the ground in the same way as for lime dressing, and sprinkle about two quarts on the surface around each tree. This will produce a caustic action, penetrating to the roots and killing all grubs, etc., even destroying insect eggs that may be in the ground, or in the roots of

the tree. At the same time the sulphate of potash will, of course, act as a valuable fertilizer.

Before passing on to the subject of natural remedies, it may be observed that in Florida and California, and other countries where Citrus fruits are grown, the groves are kept very clean, and in thorough cultivation, and and that such groves suffer comparatively little from the borer and root-feeding class of insect pests And in those countries it has been found that land that has undergone deep ploughing prior to the planting of a grove, is especially exempt from these pests.

Natural Remedies.

The Burrowing Wasp.

Elis atrata.

The accompanying figure of a wasp will give some idea of a little friend of the planter which has latelycome under the notice of the Department of Public Gardens as feeding on the larvæ of the Orange Weevil. Whether or not the Orange Weevil is directly injurious to Citrus trees, it will be well to protect this wasp, which not only preys upon larvæ or grubs of this beetle, but also keeps in check other beetle-grubs and grasshoppers which, were they to become too numerous, might prove serious enemies to agriculture.

This insect belongs to a group of solitary wasps, abundant in warm climates, generally forming their nests by digging holes in the ground, provisioning them with beetle-grubs, grasshoppers and other insects, which form the food of the little wasp-grub as soon as it hatches

There are many kinds of solitary wasps in Jamaica, and some of them are very brightly coloured. The species under review is called here by the negroes "Grave Digger" from its habit of burrowing in the ground. It is a large black insect, measuring about an inch and a quarter in length, with two inches and a half expanse of wing. The wings are of a bluish-black colour, iridescent with flashes of red and violet towards the tips.

This wasp is found commonly in the West Indies, and may often be seen crawling among the blossoms of trees and shrubs; or, with a subdued droning hum, flying slowly in a zig-zag manner hither and thither

just above the surface of the ground, on which it often alights to poke about among the grass, or on the bare ground.

Though possessed of a very formidable sting, the Burrowing Wasp never uses it except in self-defence, or to assist it in overcoming its prey

An observer in Porto Rico gives a very amusing account of the habits of this insect. He states that after digging a burrow for its nest, it goes in search of a grasshopper, which it partially disables with its sting, then mounting on its back, rides it up to its own grave. Should the hole prove too small to receive the grasshopper, it drives it away, while it enlarges the hole to the required size, and then brings it back to be buried.

ON THE BUDDING OF MANGOES.

By T. J. Harris, Agricultural Instructor at Hope Experiment Station.

With a view to turning to profitable account the enormous amount of plant energy that is more or less wasted in Jamaica annually in the production of Mangoes of inferior quality, experiments in budding have for some time been conducted at the Hope Experiment Station resulting at last in success.

It is easy to foresee that in the near future Jamaica will be in possession of carefully arranged orchards of the best kinds of mango trees; the cultivation will cost practically nothing, and the cost of careful picking, packing, and shipping should not amount to very much.

The first work to be undertaken is to bud over the large common mango trees that are already growing, though the laying out of orchards with seedling stocks might be started at the same time; these latter would take some six to eight years after budding to bear, whilst the old stumps would quickly replace their tops with the wood from the bud and bear a fairly large crop in two or three years. The trees should be cut down carefully—with a cross cut saw to prevent bruising and splitting of the stump—to within two feet of the ground; the cut pared smooth with a knife or plane, and tarred; a number of shoots will very quickly spring from the stump and these must be thinned out to three for budding upon, taking care to get them as near the top as possible; as soon as they are three-quarters of an inch in diameter at the base, they will be ready for budding.

The operation of budding involves the application of one or two principles that are not generally known, and a detailed explanation would, therefore, be of use in many instances where mere practical directions would fail. Most trees have what may be termed a growing season and a resting or dormant season. In the growing season, between the wood and bark, the existence of the cambium layer becomes apparent; this is made up of several layers of thin-walled, rapidly growing and dividing cells.

On the removal of a piece of bark it will be found that a part of the delicate cambium has remained on the wood, and part comes away with the bark; and if these two surfaces of thin walled cells are exposed to dry air for a few minutes they will wither and die; but if immediately replaced and firmly tied, will just as assuredly grow to-

gether again The operation of budding is merely transferring a piece of bark, containing a bud, from the desirable tree to a place on the stock from which a corresponding piece of bark has been removed, but to ensure success the following essentials must be observed:—

That both the stock and the tree yielding the buds be growing rapidly.

That the bud-wood be a little larger in diameter than the stock, to ensure the area on the under side of the actual bud being brought into close contact with the wood when tied in; if the bud-wood be less in diameter than the stock, a hollow space will occur between these parts that should be closely applied; acting with this against success is the thinness of the bark of the younger wood and the consequent impossibility of tying in closely.

That the bud be tied in tightly, especially at the points just below and above the bud proper; but yet not tight enough to crush or bruise the bark.

That the piece of bark containing the bud be removed from the wood without bruising, bearing in mind that bending will bruise or crush the cells of a plant.

That the moisture be retained in the bud during the time required to join up by using tying material that will prevent evaporation, *i.e.* waxed tape. This is made by dipping $\frac{3}{8}$ in. tape into a melted mixture of 1 lb bees'-wax, a piece of resin the size of a hen's egg, and half a wine-glass of raw linseed oil, scraping off the superfluous wax with a dull knife after cooling.

The bud-wood should be near the stock to ensure no time being lost between the taking off of the bud and its insertion in the stock.

Practical directions:—

Use as bud-wood that which was the young shoot at the end of the branch four to six growing seasons ago; that is, four to six "joints" back from the last developed wood, being 1 in. to $1\frac{1}{2}$ in. in diameter. Let the piece of bark containing the bud in the centre be three inches long and about $\frac{3}{4}$ in. wide, and as near as possible rectangular in shape.

With a sharp pointed knife run two parallel lines, one on each side of the bud, beginning at a point $1\frac{1}{2}$ inches above and continuing down to a point $2\frac{1}{2}$ inches below the bud, drawing the two lines closer together as the knife approaches the lower point, (this allows an inch or so for laying hold of the bud to pull it away from the wood, and being bruised, this must be carefully cut away before the bud is inserted), taking care to cut quite through the bark into the wood; join the two upper points with a short straight cut and, with the edge of the knife sloping upwards, join the two lines at a point about a quarter of an inch from the end, *i.e.* $2\frac{1}{4}$ inches below the bud; now make a similar cut just below this and prize out the small piece of bark between. Having done this, insert the thin ivory handle of a budding knife, lever up the end of the piece of bark, slip the handle under and grip the bark between it and the thumb, and pull steadily in the direction of a angle of 45° with the bud-wood until the bud comes out; now cut off the bruised part that was held between the knife handle and the thumb and and place the bud lightly on the stock at a point where the diameter of the branch is a little less than that of the budwood; run a pencil line along each of the four sides of the bud, remove it

again, cut through the bark along the lines, and pick out the bark with the point of the knife, taking care not to injure the delicate cambium below. The piece of bark containing the bud may now be let into the space made for it and firmly tied, using two pieces of tape, one for the part below the actual bud (tying this first) and one for that above, beginning with the middle of the piece of tape at the bud and crossing it behind, finishing bottom and top.

Care must be taken that the space made for the reception of the bud be large enough to allow of the bud, when pressed in, to move slightly from side to side and up and down; indeed it is safest to err on the side of having the space too large, remembering that the union takes place *under* the bud and not at the sides.

If the "eye" of the bud is still green two weeks after budding, the whole of the branch above the bud must be cut off carefully; avoiding bending, twisting, splitting or anything that would tend to disturb the bud.

The budding tape may be removed when the bud has grown out some six or eight inches.

ON THE BUDDING OF COCOA.

By T. J. Harris, *Agricultural Instructor at Hope Experiment Station.*

The Cocoa tree having had, in its native habitat, to battle with other shrubs or trees for the possession of the light that is so necessary for proper nutrition, has developed the power of discarding whorl after whorl of primary branches by producing successive "gormandizers," each with its crown of primaries until the outer air is reached, bringing about an enormous lengthening of the stem. Under cultivation these gormandizers are not allowed to grow, the tree being thereby kept down to a convenient height and all its energies directed to the development of the first whorl of primary branches Now an observant cultivator will notice that these erect gormandizers grow out from the main stem only; though occasionally they will be found on the underside of the primaries near to the main stem. In a sense then we have two kinds of wood on a cocoa tree—the "*horizontal*" produced by the primaries and the "*vertical*" growths from the main stem; the primaries produce only horizontal shoots and the buds on the main stem never fail to grow into vertical shoots, each of which latter is capable of carrying a whorl of primaries at the top; in fact if a tree is badly damaged the best thing that can be done is to cut down the stem and confine future growth to one of these vertical growths or gormandizers.

Among cocoa growers it is well known that if they were able to ship to the manufacturers goods of an even sample better prices might be expected; now since the operation of budding is so simple, there is no reason why each estate should not have all its trees of *one approved variety*. Usually on a plantation there are one or two trees known "personally," we might say, to the overseer as being excellent croppers, bearing regularly large numbers of good sized, thin shelled pods, each con-

taining 35 to 40 large, well shaped beans of a light mauve colour inside. These trees should have their pods and primaries kept off and manured heavily to induce them to produce as many vertical shoots or "gormandizers" as possible, to be used as bud-wood. The next thing to be done is to cut down to within a foot or so from the ground all undesirable trees that do not pay for the rent and upkeep of the land they occupy and there are usually many of these—and train up two gormandizers; one for budding upon and the other "to keep up the root" when the other is cut down after the bud has taken, and until the bud is firmly established as the stem of the new tree As already stated the operation of budding is extremely simple, and it has to be very clumsily done indeed for a bud to fail to grow It is merely a matter of removing a piece of bark, containing a bud, from one of the gormandizers of the good tree and tying it into a place on one of the gormandizers of the inferior tree from which a corresponding piece of bark has been removed. The work may be commenced when the stock and bud-wood are about $\frac{3}{4}$ of an inch in diameter, though a stout old gormandizer an inch and a half in diameter yields excellent buds. The operation of budding involves the application of one or two principles that are not generally known, and a detailed explanation would, therefore, be of use in many instances where mere practical directions would fail.

Most trees have what may be termed a growing season and a resting or dormant season. In the growing season, between the wood and bark, the existence of the cambium layer becomes apparent, this is made up of several layers of thin-walled, rapidly growing and dividing cells.

On the removal of the piece of bark it will be found that a part of the delicate cambium has remained on the wood and part comes away with the bark, and if these two surfaces of thin-walled cells are exposed to dry air for a few minutes they will wither and die, but if immediately replaced and firmly tied, will just as assuredly grow together again; to ensure success, however, the following essentials must be observed:—

That both the stock and the tree yielding the buds be growing rapidly.

That the bud-wood be a little larger in diameter than the stock, to ensure the area on the under side of the actual bud being brought into close contact with the wood when tied in; if the bud-wood be less in diameter than the stock, a hollow space will occur between these parts that should be closely applied; acting with this against success is the thinness of the bark of the younger wood and the consequent impossibility of tying in closely.

That the bud be tied in tightly, especially at the points just below and above the bud proper, but yet not tight enough to crush or bruise the bark.

That the piece of bark containing the bud be removed from the wood without bruising, bearing in mind that bending will bruise or crush the cells of a plant.

That the moisture be retained in the bud during the time required to join up by using a tying material that will prevent evaporation; *i e.* waxed tape. This is made by dipping $\frac{3}{8}$ inch tape into a melted mixture of 1 lb bees'-wax, a piece of resin the size of a hen's egg, and

half a wine-glass of raw linseed oil, scraping off the superfluous wax with a dull knife after cooling.

The bud-wood should be near the stock to ensure no time being lost between the taking off of the bud and its insertion in the stock.

Practical Directions.

Let the piece of bark containing the bud in the centre be three inches long and about ¾ in. wide, and as near as possible, rectangular in shape.

With a sharp pointed knife run two parallel lines, one on each side of the bud, beginning at a point 1½ inches above and continuing down to a point 2½ inches below the bud, drawing the two lines closer together as the knife approaches the lower point, (this allows an inch or so for laying hold of the bud to pull it away from the wood, and being bruised, this must be carefully cut away before the bud is inserted), taking care to cut quite through the bark into the wood; join the two upper points with a short straight cut and, with the edge of the knife sloping upwards join the two lines at a point about a quarter of an inch from the end, *i.e.*, 2¼ inches below the bud, now make a similar cut just below this and prize out the small piece of bark between Having done this, insert the thin ivory handle of a budding knife, lever up to the end of the piece of bark, slip the handle under and grip the bark between it and the thumb, and pull steadily in the direction of an angle of 45° with the bud-wood until the bud comes out; now cut off the bruised part that was held between the knife handle and the thumb and place the end lightly on the stock at a point where the diameter of the branch is a little less than that of the bud-wood, run a pencil line along each of the four sides of the bud, remove it again, cut through the bark along the lines, and pick out the bark with the point of the knife, taking care not to injure the delicate cambium below. The piece of bark containing the bud may now be let into the space made for it and firmly tied, using two pieces of tape, one for the part below the actual bud (tying this first) and one for that above, beginning with the middle of the piece of tape at the bud and crossing it behind, finishing bottom and top. In two weeks the union will have been effected and in four to five weeks the shoot from the bud will be from six to eight inches long, and if all the shoots that spring from the stock be carefully kept off, the new plant should bear in a year.

PINES IN THE AZORES.

By Dr. M. Grabham.

While on a visit to St. Michael's, Azores, recently, I was much interested in the Pine-apple cultivation which is extensively carried on in that island, and I was particularly struck with the method usually employed by the growers for hastening the plants into flower. When the plants have reached an advanced stage of growth, and are apparently fully grown, a slow smouldering fire of damp and green leaves is made in the glasshouses and kept up for about eight or ten days, not longer. The windows and doors are kept securely closed during this time so that the atmosphere in the houses becomes densely charged with smoke. It is generally believed that the smoke stimulates the plants to bloom, and not the heat generated by the fire which is said to be not appreciable. Should the plants prove stubborn, the process is repeated after an interval of several weeks; but one application of smoke is, I understand, generally sufficient. I was told that the life of the plant was artificially shortened in this manner, from eighteen to eleven months. The plants are timed to attain their full growth in August or September, the "smoke" is then given, and the fruit matures in December or January, when the best values are obtained The discovery of the smoking process, which dates back to more than a decade, was made quite accidentally; a planter having made a smouldering fire in one of his pineries for the purpose of destroying an insect pest, was surprised to observe that his plants burst into flower prematurely.—(*Gardeners' Chronicle*)

THE COMPOSITION OF JAMAICA FRUITS.

By H. H. Cousins, M.A., F.C.S.

I. Pine-apples.

A collection of Pine-apple varieties is grown at the Hope Experiment Station in parallel beds on a light and porous soil The plants are set rather close and the fruit obtained last season was fairly representative of the grade of pines producible on the lighter soils of the Liguanea plain.

The specimens were not selected as being especially fine, but as average fruits.

The results of our analyses are as follows :—

Varieties of Pines—Chemical Composition of Edible Portion.

No.	Variety.	Moisture	Total Solids.	Insoluble Residue.	Ash.	Acidity.			Sugars		
						Fixed.	Volatile.	Total.	Invert.	Sucrose.	Total as Invert.
1	Green Ripley .	79·3	20·7	1·4	0·5	1·009	nil	1·009	2·77	10·03	13·33
2	Red Ripley .	80·1	19.9	1·4	0·5	0·580	0·008	0·588	4·54	10·30	15·38
3	Sam Clarke .	84·8	15·2	1·4	0·4	1·137	nil	1·137	2·56	7·06	10·00
4	Cowboy .	84·8	15·2	1·5	0·4	1·225	nil	1·225	2·50	7·62	10·52
5	Queen .	83·1	16·9	1·3	0·5	0·531	0·008	0·539	5·90	7·82	14·28
6	Porto Rico .	85·5	14·5	1·2	0·3	0·619	0·008	0·627	3·70	6·48	10·52
7	Bull Head .	84·1	15·9	1·7	0·5	0·878	0·004	0·882	2·80	7·88	11·10
8	Cheese .	87·0	13·0	1·2	0·4	0·829	0·004	0·833	1·88	6·84	9·08
9	Smooth Cayenne .	83·9	16·1	1·1	0·4	0·830	0·003	0·833	4·00	8·08	12·52
Munson & Tolman U. S. Dep. of Agri.	Average—										
	Florida .	86·1	13·9	1·5	0·4	—	—	0·515	4·44	6·88	11·69
	Cuban .	85·5	14·5	1·6	0·3	—	—	0·560	3·09	8·44	11·87
	Bahama Red Spanish .	85·3	14·7	1·6	0·4	—	—	0·747	2·75	8·98	12·21
	Florida Smooth Cayenne .	86·1	13·9	1·2	0·4	—	—	0·444	6·46	5·24	11·98

Varieties of *Pines*. Proportional Parts.

No.	Variety.	Weight of Fruit.	Top o/o.	Rind o/o.	Core o/o.	Non-Edible o/o.	Edible o/o.
1.	Green Ripley ...	3 lbs. 13 ozs.	7·6	31·7	6·1	45·4	54 6
2.	Red Ripley ...	4 lbs. 7 ozs.	5·7	33·8	5·4	44·9	55·1
3.	Sam Clarke ...	3 lbs. 10 ozs.	22·9	26·9	4·4	54·3	45·7
4.	Cowboy ...	4 lbs. 7 ozs.	12 3	26·9	4·7	43·8	56·2
5.	Queen ...	3 lbs.	6·2	35·4	8·7	50·2	49·8
6.	Porto Rico ...	10 lbs.*	9·0	26·0	1 9	36·9	63·1
7.	Bull Head ...	4 lbs. 4 ozs.	12·9	24·9	4·9	42·7	57·3
8.	Cheese ...	3 lbs. 2 ozs	10·5	33·0	3·1	46·6	53·4
9.	Smooth Cayenne ...	7 lbs. 8 ozs.	7·5	1·5	5·2	14·2	85·8

* Not average. Single fruit only.

From the point of view of the purchaser the great advantage of the "Smooth Cayenne" is clearly brought out from the table of proportional parts.

It will be noticed that this variety contains nearly double the proportion of edible fruit to that in such varieties as "Sam Clarke" and "Queen." A fruit that yields 86 per cent of edible matter is a very satisfactory one to the purchaser.

The Ripleys, although unsurpased for flavour and density of juice, yield only 55 per cent. of edible fruit, while the "Porto Rico" is second to the Cayenne in this respect.

These figures, it is submitted, put the case for the "Smooth Cayenne" as the commercial pine in a clear light. Under equal conditions, this variety gives us fruits just double those of the Ripley in weight and containing 60 per cent. more substance capable of being eaten.

The varieties "Sam Clarke," "Queen" and "Cheese" are obviously inferior for commercial purposes.

The chemical composition of the Pine shows as much variation among varieties as the Sugar Cane. The results for the Red Ripley in this series show a higher percentage of total solids and of sugars than any individual case reported on by Messrs L S Munson and L. M. Tolman of the U. S Department of Agriculture, who recently published the results of an exhaustive investigation on the composition of pine-apples.* At the foot of the table some of the American results are given for comparison. It will be noted that the Jamaican pine-apple is not surpassed by any of the fruits obtainable on the American market.

Some of our varieties such as "Sam Clarke," "Cheese" and "Cow Boy" are decidedly inferior and should only be grown *faute de mieux*.

The "Queen" and the "Ripleys" are the sweetest varieties and are, for local consumption, unsurpassed. For commercial purposes, however, the superior eating qualities of the Ripley are more than counterbalanced by the greater size, finer appearance and edible economy of the "Smooth Cayenne."

*Journal Amer: Chem: Soc. XXV. 272.

II.—Mangoes.

During the mango season the peasantry are said to live on mangoes and greatly to reduce the local consumption of bread and cereal foods.

It was therefore thought desirable to conduct some analyses to throw light on the chemical consumption and nutritive value of this fruit.

Unlike the pine-apple, the mango contains no volatile acids. Its aroma is due to essential oils and not to fruity acids and compound ethers.

The determination of 'edible' and 'non-edible' material in the mango is a matter of some difficulty. It was decided to use the natural discrimination of the native, and the 'stones' recorded represent the residue left after prolonged suction by an experienced practitioner.

The edible economy of the Bombay Mango which gave 65 per cent. as against 60 in 'No. XI' and 64 in the Black Mango, is here brought out.

As a food the Black Mango holds the first place. A content of 22 per cent. of total solids containing 17 per cent of sugar is truly remarkable for a fruit of this character.

The Bombay is superior to 'No. XI' in sugar content and this again to the 'Yam' Mango.

As a source of Carbohydrates the mango is not to be despised.

I estimate that a consumption of 10 lbs per diem would supply enough energy for the production of a day's work by a Jamaican labourer. As an addition to other foods providing adequate albuminoids for the needs of the body, the mango must be accepted as of value both from practical and chemical data.

Varieties of Mango. Proportional Parts.

No.	Variety.	Weight of Fruit, ozs.	Skin, o/o.	Stone, o/o.	Non-Edible, o/o.	Edible, o/o.
.	No. Eleven ...	6 ozs.	20·5	19·6	40·1	59·9
.	Yam ...	7 ozs.	26·8	18·0	44 8	55·2
3.	Bombay ...	8 ozs.	23·4	11·5	34 9	65·1
4.	Black ...	4 ozs.	16·7	29·7	46·4	53 6

Varieties of Mango. Chemical Composition of edible portion.

No.	Variety.	Moisture.	Total Solids.	Insoluble Residue.	Ash.	Acidity.			Sugars.		
						Volatile.	Non-Volatile.	Total.	Reducing.	Sucrose.	Total as invert.
1.	No. Eleven .	81·27	18·73	0·82	0·38	—	0·960	0·960	4·76	7·35	12·50
2.	Yam .	84 67	15 33	1 05	0·36	—	1·058	1·058	2·38	6·78	9·52
3.	Bombay .	81·19	18·81	1·05	0·35	—	0·980	0·980	2·50	10·28	13·32
4.	Black .	77·65	22·35	1·18	0·20	–	1·058	1·058	5·26	10·83	16.66

ADVICE TO THE OWNERS OF DAMAGED COCO-NUT TREES.

By W. Cradwick, Travelling Instructor

I find on personal examination of Coco-nut trees which are apparently little injured by the hurricane of 11th August, that many of them have had the young and tender leaves badly damaged, and many of the damaged leaves are rotting and injuring the heart leaves which are now trying to push their way through the battered and bruised young leaves All trees should have immediate and careful attention, all damaged parts of the young leaves should be cut away, so as to prevent further rotting

I find that in many trees the young leaves are so twisted and twined together that it is impossible for the young heart leaves to push their way out of the twisted leaves, and that under these green looking young leaves there are often leaves rotting from being battered by the storm

The twisted leaves should be opened out, the rotten rubbish removed, all dead leaves, or dead pieces cut off, or they will rot in the heart of the tree and injure the young shoots of both leaves and flowers.

Trees which have been blown down, but which are not killed, should be got into position as near as possible to what they were before the storm, but do not strain the roots in attempting this; remember that the trees have need of every good root and green leaf just now more than ever. Do not cut off any green leaves even if they are broken badly.

If part of the base is not out of the ground which was formerly covered with earth, re-cover it at once with good earth, and the roots will grow again.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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BULLETIN

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DEPARTMENT OF AGRICULTURE.

Vol. I. DECEMBER, 1903. Part 12.

SUGAR CONFERENCE.

A Conference of sugar planters and others interested in the industry was held at the Institute of Jamaica on the 11th November when Sir Daniel Morris spoke on the present condition of the industry in Jamaica consequent on the abolition of the continental bounties.

There was a large attendance. His Excellency Sir Augustus Hemming presided over the Conference and among those present besides Sir Daniel Morris, were: the Hons. Sydney Olivier, C.M.G., W. Fawcett, H. Cork, J. Allwood, C.M.G., Dr. J. Pringle, C.M.G., James Mitchell (Custos of Clarendon), T. H. Sharp, H. T. Ronaldson, L. J. Bertram, Messrs. Wellesley Bourke, Simon Soutar, J. L. Ashenheim, John Barclay, H. H. Cousins, S. J. Howe, R. A. Walcott. R. S. Gamble, A. B. Ventresse, Charles Stockhausen, F. W. Stockhausen, C. Arnold Malabre, James Wilson, H. McGilchrist, Alfred Pawsey, T. H. Sharp, jnr., F. Cundall, H. S. Hammond (Assistant Chemist), C. Allan (Fermentation Chemist), I. J. Mordacai, Sylvester Tilley, J. C. Messam, C. J. Georges, G. Muirhead, John Cameron, Dr. H. R. Miller and F. M. Ellis.

His Excellency the Governor in opening the proceedings said, the object for which they were met together that day was in the first place to listen to an address by Sir Daniel Morris on the present position and prospect of the sugar industry. This would be followed by a few remarks from the Director of Public Gardens and Plantations and from Mr. Cousins, the Analytical and Agricultural Chemist. After those speeches were concluded, he hoped they would have the remarks of sugar planters and any other persons interested in the industry. Any questions arising out of the speeches could be asked, and he was sure that Sir Daniel Morris and others would be glad to answer them to the best of their ability. He regarded the question that they were about to discuss as the most important that could possibly be brought before any meeting of this kind in Jamaica. He had never hesitated to express his opinion, and he still maintained it, that whatever might be the

value of other industrities, the cultivation of sugar must be the staple industry of this colony. Although it had in recent years fallen upon troublous times he still entertained great hopes that a revival of the industry would take place. He thought they had some reason to believe that that would be the result of the recent legislation which had taken place in Great Britain—the passing of the Brussels Sugar Convention Bill—which should go far towards helping in the revival of the sugar industry. He trusted that that revival would soon take place, because as he had said before, he looked to the sugar industry as the principal industry of this colony. He did not think that it was necessary or desirable that he should make any lengthy remarks on the subject considering that they had a great deal to do, and that they would hear addresses from those who would be more qualified to speak on the subject than he was. He would therefore conclude by asking Sir Daniel Morris to favour them with his address.

Sir Daniel Morris said it was only right that he should mention that he appeared before them that day at the invitation of the Board of Agriculture. When he arrived in the colony he was approached with a request that he should speak on one or two subjects of immediate interest to Jamaica, and amongst the subjects suggested was that of the sugar industry, consequent upon the abolition of what were called the continental bounties. He might mention that since he had been in the West Indies in connection with his present work he had been closely interested, and had taken an active part in endeavouring to improve the prospects of sugar growing. His connection with the sugar industry while he was in Jamaica was not a very close one owing to the fact that the whole of his time was taken up with the consideration of other subjects, and not because he was wanting in sympathy with the sugar industry. He did not appear before them as wishing to lay down a definite policy or suggest to them anything more than that it was desirable that they should carefully review the position of the sugar industry in order to find out whether it was possible to improve or extend that industry in such a way that it might be of benefit to the general community. With regard to the sugar industry in Jamaica a large mass of valuable information was collected by the Sugar Planters' Association and placed before the Royal Commissioners who visited the West Indies in 1897, to enquire into the sugar industry Those who desired to obtain authentic information in regard to the industry, would do well to consult those statistics or refer people who might wish to know something about the industry in this Island to them. Later on Mr. Francis Watts, who was the Government and Agricultural Chemist in Jamaica for a short time, wrote a valuable memorandum on the position of the sugar industry in Jamaica Since then he was glad to state that Mr. Cousins, the present Chemist, had taken up the subject with great energy and he had brought out several interesting facts which were desirable for them to place on record for the information of capitalists at home or the people in the Island who desird to know how an improvement in the sugar industry here could be attained.

It was stated before the Royal Commission that the capital invested in sugar in 1897 was something over one million sterling.

It was also stated that the number of working estates at that time

was about 130. Possibly some of those estates had given up sugar cultivation and were planted in bananas. Approximately they might conclude that there were about 100 sugar estates in Jamaica at the present time.

The Commission was informed that the yield per acre in sugar alone was about one ton, but for each ton of sugar there was usually obtained 100 gallons of rum. It was impossible to estimate the real value of the sugar industry in Jamaica, unless they took into consideration the whole of the crop—that was the sugar, rum and molasses. Little molasses was exported from Jamaica In other parts of the West Indies, as in Barbados and Antigua, molasses was nearly as valuable as sugar itself.

As regards the cost of cultivation and of producing sugar per ton in Jamaica they had had information other than that placed before the Commission Mr Farquharson had stated that the cost of producing sugar alone in Westmoreland was from £6 to £7 per ton. It was mentioned that the cost of producing a ton of sugar and 100 gallons of rum varied considerably in each district. It might be from £13 to £15, or a little more. As regarded the value of the industry twenty years ago, he found that the value of the sugar and rum exported from Jamaica (in 1882-83) was £800,000. At that time the sugar and rum exported represented 50 per cent. of the total exports of the colony. At the present time (1902-03) the value of the exports of sugar and rum from Jamaica was only 15 per cent. of the total exports of the colony, while the exports of bananas had increased to something like 59 per cent There was, therefore, a shrinkage in the value of the exports of sugar and rum from £800,000 to £324,000 —in other words, the value of sugar had fallen to less than one-half in 20 years As a result of the removal of the bounties the planters and those interested in sugar growing in Jamaica should ask themselves, what was the present position of the industry? The abolition of the bounties was a matter that was strenuously fought for for between 30 and 40 years. At last it had come, and become effective within the last two or three months. The position of sugar now was much better than it was before the abolition of the bounties, and in consequence it might be worth while to extend the industry. The position in England was that sugar went into a perfectly open market. Bounty-fed sugar was excluded, and in future it must come into the market on its own merits. The question was, what were the prospects of muscovado sugar produced in Jamaica? They had a conservative opinion expressed by Mr. Czarnikow, who stated that it was not likely that the price of sugar in the London market would rise above the average price for the last 10 years. He was not in a position to state what the average price of Jamaican sugar for the last 10 years was, but as far as Barbados was concerned it was estimated according to Mr Czarnikow's forecast that the price of sugar should not fall much below £9 per ton.

As regards the United States, the position of Jamaican sugar was not so good, as owing to the abolition of the bounties it would have to meet the general competition of all the world's sugar. As regards Canada, there was a reduction of one-third of the duties in Canada in favour of sugar from the West Indies. In addition to the improved

prospects in England and Canada, there was another advantage likely to arise from the abolition of the bounties, and that was that the credit of the sugar industry would be improved, but to what extent he could not say. That was a question for commercial men to consider, but speaking generally they could say now that continental bounties had been removed the prospects of the sugar industry were better than during any period within the last thirty years.

He had consulted with Messrs. Watts and Cousins on the question of the soil, and the opinion of these gentlemen was undoubtedly that the soil in Jamaica was good and would grow canes as well as, if not better than, almost any other part of the West Indies. No doubt had been cast upon the capabilities of the soil here. As regards moisture in most districts of the island the rainfall had been found to be sufficient to bring fairly large crops. An important matter brought before the Royal Commission in respect of irrigation in Vere was now being settled, and if irrigation could be successfully applied to considerable areas in Vere the sugar industry in that part of the island should be placed on a prosperous footing As to the question of labour there might be a great difference of opinion—the question depended upon the district in the island—but speaking generally be believed that labour in the sugar districts in Jamaica was not very far short of what might be counted upon as sufficient to carry on the industry, especially if use were made of labour-saving appliances and the many inventions that were now being put into operation in the United States, British Guiana, Trinidad and other parts of the tropics. They also had the possibility of coolie immigration. It might be said that coolie immigration was expensive and often unsatisfactory, but still it was possible as a means of carrying on the industry, and he believed that the Government would place no obstacle in the way of introducing more coolies if they were absolutely necessary to carry on the industry. As regarded natural facilities and circumstances he thought Jamaica was extremely well placed. As probably the proceedings at this Conference would be reported and would reach capitalists in the United Kingdom, and other parts of the world, it was important that they should endeavour to place on record as many facts as they could, in order that those who were inclined to embark in the sugar industry might be fully informed as regards the capabilities and the circumstances of this island.

There were certain special conditions favourable to the maintenance of the industry in Jamaica. Outside the banana districts there were fairly large tracts of land still available for sugar cultivation, with good soil and moderate rainfall. These were not only suitable for the cultivation of sugar, but they had contiguous areas which were suitable for feeding stock and raising food-stuffs. In some parts of the West Indies these contiguous areas did not exist and thus difficulty was experienced in obtaining fodder and in raising food-stuffs.

It might be possible to extend cane-farming in certain districts of Jamaica In Trinidad a large portion of the cane grown there was raised by small farmers. He found that in one locality here—in Westmoreland, on Cornwall Estate,—1,500 tons of canes were bought from settlers. On Shrewsburry Estate they had also been buying canes from settlers. The question was in what way could cane-farming be extended in Jamaica? The black people were fond of growing canes.

It was most the popular cultivation in the West Indies, and if arrangements could be made whereby cane-farming could be encouraged some of the difficulties connected with labour might disappear It was much in favour of Jamaica that there was practically no cane disease here. As they probably knew cane disease appeared in Barbados and Antigua, and there was at one time great danger of the industries being destroyed. He had made enquiries here and those qualified to speak on the subject were of the opinion that the canes in Jamaica might be regarded as thoroughly healthy and free from disease. Another important point to be considered was the high quality of Jamaican rum as compared with rum from other parts of the world. That gave the Jamaican planter a position to which no other planter in the West Indies could attain.

To immediately improve the sugar industry, the first thing that was necessary everywhere in Jamaica was a system of effective crushing mills He believed that on most estates the extraction was too low to be remunerative. He would repeat that whatever they did with their sugar—whether it was muscovado or any other variety—they must have better mills.

Another matter was the possibility of producing a grocery sugar similar to the Demerara crystals ; next came the possibility of establishing central factories. This question had already been fully discussed here. Proposals had been put forward to start a central factory in the Plantain Garden River district. He thought a factory there might be successful if it were large enough. It might also be possible to start a successful factory in the neighbourhood of the clay soils af St Catherine that were not suitable for bananas ; and possibly in Vere and the sea-side estates in St. James. A central factory to be successful in any of the districts referred to must be on a large scale. The rum would not be of very good quality. This was well known ; but the profit would be in the larger quantity of sugar produced. If capital were available and the sugar industry were placed on such a footing as to allow of the establishment of central factories, there was little doubt that it would be a successful undertaking.

The last point he would bring forward was the possible improvement of the yield of the canes. Mr. Cousins was of opinion that at present seedling canes from Barbados and Demerara would justify a claim to at least 20 per cent superiority over the canes now grown in Jamaica. In introducing new canes and the sorts that were suited for each district, Mr. Cousins was of opinion that they might obtain 20 per cent. more sugar from the new canes than they did at present.

With regard to Barbados, Antigua and St. Kitts the seedling canes that had been raised and tested there certainly showed a superiority over the older canes. In British Guiana at the present moment there were 10,000 acres of land in seedling canes and in the reports published by Professor Harrison he gave the results of the trials of these canes. On one estate in Demerara — the Diamond estate —there were 400 acres of land cultivated with seedling cane, No. B. 208. The leading estates were so convinced of the value of this cane that they had gone in for its cultivation on a large scale. The "208" Barbados cane at Diamond estate had yielded one-third more sugar than

the Bourbon cane. He would not, however, recommend this "208" cane for Jamaica until it had been thoroughly tested beforehand.

He now came to the question of markets open to Jamaican sugars. He had already mentioned the English and American markets, and would now enter more fully into the question of the Canadian market. During his recent visit to the United States he was told by those interested in West Indian sugar that the preference offered by Canada to the West Indies was not available under all circumstances.

Quoting from a letter received on the subject by the Hon. the Colonial Secretary, Sir Daniel stated that previous to the abolition of European bounties, the preferential rebate offered by Canada to the West Indies of 33⅓ per cent. reduction in the duty was non-effective owing to the United States Government charging a countervailing duty equal to the amount of the bounty paid on European beet when exported, thereby enabling the United States refiners to pay proportionately a greater premium for West Indian and other cane sugars than the Canadian refiners could afford to do, as the amount of the bounty was greater than the preference in the Canadian tariff. Now that bounties have been abolished and all sugars are on an equality in the United States market, Jamaica will not command the premium in New York which it, along with other cane sugars, did while bounty-fed beet was subject to a countervailing duty on entering the States Therefore, it is from now on that the Canadian preference should show itself; and that Canadian refiners should be willing to pay a higher price for West Indian sugars than can be obtained for them in other markets. The Canadian refiners will, of course, continue their efforts to secure British West Indian grown sugars at the same price as the United States and United Kingdom refiners will be willing to pay for them, and take the benefit to themselves of the preferential rebate. So it rests with the sellers in the West Indies to enter into an agreement between themselves whereby all shippers will refuse to sell to Canada unless a premium is paid in proof of the preference Canada offers to the West Indies and which it was the intention of the Dominion Government should be given as an enhanced price to the West Indian planter for his sugar. An agreement might be arrived at that a fixed mininum premium be established at which sales are to be made to the Canadian refiners, either direct or through selling agents, either in New York, London or Canada, and that wherever possible an extra price over this minimum premiun should be extracted from the Canadian buyer. Selling prices, of course, to be governed by what the Canadian refiners can buy other sugars at, but these buyers should at least be willing to pay half the amount of the preferential rebate in the Canadian tariff. The specific duty on sugar entering Canada, on raw sugar for a minimum polarization of 75 degrees, is 40 cents per 100 lbs advancing 1½ cents per degree up to 100 degrees paying 77½ cents. The duty on 89 degrees, which is the basis of test for sale of muscovado, is 61 cents, from which the preference of 33⅓ per cent. to British grown sugar is 20.83 cents. per 100 lbs. and the duty on 96 deg. test, which is the basis for sale of centrifugal refining crystal sugar, is 71½ cents the preference on this rate being 23.83 cents per 100 lbs. There really is no reason why the

Canadian refiners should not pay the whole of the preferential rebate, as an extra return on the purchased price to the West Indian grower. Otherwise the Canadian refiners will get their supplies of British West Indian sugar at nearly £1 per ton cheaper than anybody else, thereby increasing their own protection to that extent at the expense of the West Indies.

Now, proceeded Sir Daniel, that the bounties had been abolished, and as all sugars were on an equality in the United States, he brought the question forward because it should be carefully considered in all the British West Indian Colonies. In the face of the preference offered by Canada, the tendency appeared to be for refiners in Canada to buy their sugar in such a way as to deprive the West Indian planter of preference, which represented altogether about £1 a ton, which went to them instead of the sugar planter. It might be possible to take up the subject and obtain the full benefit of the preference offered for their sugar in the Canadian market.

He had endeavoured to give a brief review of the circumstances connected with the sugar industry He submitted these for their consideration and hoped it might be possible for those engaged in the industry to discuss them and thereby place the facts before the general public in order to see if anything could be done to improve the sugar industry sn Jamaica.

Discussion.

His Excellency said he was sure they all felt grateful to Sir Daniel Morris for his address, and would now call upon Mr. Fawcett to address the conference.

Mr Fawcett said, in connection with the various methods for the improvement of cane mentioned by Sir D. Morris, one mode was by the adoption of new varieties and this they were doing. Whenever they heard of any new cane, they had sent for it and the result was that with one of these canes (D. 95) a sugar planter had told him that he had made twice as much sugar in the same area as he did before. Part of this was due to the increase in agricultural yield in the cane. That same cane had been tried in other places and was not successful. They recognised that it was important for sugar planters to try these new canes in their own districts, for a cane which suited one district was not always likely to suit other districts, and it was well for sugar planters to try different canes and to study the results. That had been going on for some years, and he hoped now to make it more universal. Under Mr. Cousins' management he felt sure that more sugar planters would take up the question of trying these new sugar canes. There was another point. In ordering these canes from Barbados or British Guiana, they had to order them about a year beforehand. Planters wishing any of these new canes should write to him, and let him know what they wanted and how many they wanted, and he would undertake to get them.

Mr Cousins said he spoke with some hesitation, because as they all knew he had been here for only a short time and he was only just beginning to study the industry. He could not give them the benefit of any practical experience, but he could give them

his views as a student and as a chemist. Whatever had happened in the past, the future of the industry depended on what Jamaica could do for it and what the people living here were capable of getting out of the soil. A new state of things had arisen in connection with the industry and it was important that they should try and arrive at some accurate method of showing what the commercial security for Jamaica was under suitable soil and other conditions. There were certain districts in the island where they could not grow bananas—certain districts which nature seemed to have selected for the cultivation of cane, and it was for these special districts that the future had a great deal in store for Jamaica. When he came here he was told that the Island needed an agricultural chemist to work up the soil, but he found that all that was needed was to help the soil to do its best. If they could get a reasonably secured distribution of water in the Vere Irrigation area they would have a magnificent stretch of land that would grow canes perhaps at a lower price than in any island in the West Indies. If they also got a moderate system of irrigation on a few of the estates on the northside, and had the machinery worked by steam, with all the latest appliances, they would be able to throw down the gauntlet to any grower of cane or beet. He believed they could produce a ton of crude sugar from the juice of the sugar cane at a cheaper rate than could be done anywhere else. There was another point, if they could only maintain the old prestige of Jamaican rum there was a reasonable security for it on many estates. Through the genorosity of the Government, even when funds were very low, they had appointed a Fermentation Chemist to study this subject. This gentleman (Mr Allan), had come out to Jamaica and was going round to the various estates. They wanted to find out where rum was and how it was produced, and in what direction they could improve the quality, and on some estates, the quantity as well. There should be no variations on a reasonably and accurately managed estate, and he hoped that certain estates might be able to produce a certain high quality of commercial rum with regularity and security.

Mr. Cork asked Sir Daniel Morris whether the majority of the cane farmers in Trinidad were time-expired coolies or whether they were creoles.

Sir D. Morris said that for the most part they were time-expired-coolies and they rented lands in the neighbouring districts of the estates.

Mr. Sharp said that Sir Daniel Morris had stated that central factories might be a good thing to start in certain localities, and on the other hand he stated that the starting of the sugar central factories would affect the value of rum.

Sir D. Morris said he thought the question was one which Mr. Cousins could answer; but the point was if they took all the sugar out of the molasses they would have nothing left to make rum with.

Mr. Olivier said he would state what the Government intended to do with regard to the sugar industry this winter. They had been carrying out experimental cane plots on a good many estates. They had

now a grant of £10,000 for the benefit of the sugar industry. It had not yet been decided what would be done with the capital of the grant, but the accumulated interest on the money amounted to a very fair sum, and the Island Chemist had made proposals for utilizing that fund. They were anxious to get to work to do so. In the first place they had appointed a Fermentation Chemist who would travel round the island and study distillation on various estates, but they wanted to push forward their experimental cane cultivation wherever they could find estate proprietors willing to co-operate with them and they would spend a little more money on that side of the work. They also wanted to increase the cultivation of seedling canes at Hope Gardens so that they might have a greater variety of canes under different conditions in different parts of the island. Then they proposed to extend the Laboratory at Hope so as to enable the Island Chemist and the Fermentation Chemist to deal chemically with samples from the estates If the planters thought there was any way in which the Agricultural Department could co-operate with them on their estates or elsewhere they should apply to the Board of Agriculture. Another important question was that of the Canadian preference. According to information given to Sir D. Morris and himself, the whole of that preference was going into the pockets of the Canadian sugar refiners, and although Canada had received great credit for working in the interests of the Empire, the preferential arrangement was simply being run for the benefit of a few sugar refiners in Halifax, Montreal and elsewhere. The planters in Jamaica should make such arrangements as to secure their fair share of the preference.

Mr. Gamble said seeing that Jamaica could produce good sugar, the other point to be considered was the successful marketing of the sugar. With regard to that Canadian preference he would just quote one instance of a shipment He shipped one half of the produce to New York and the other half to Halifax, and as a matter of fact the Halifax shipment realized about 15 to 20 per cent more than the shipment to New York, owing of course to the preference. This was a most recent example. In that particular case they did get the preference and as far as they could see it might be a most difficult thing to enforce by any combination the paying to the the planters of this advantage. The shipper had to use his knowledge as to what place was going to give him the best return. In the past they had had some advantage and he did not see why in the future they should not get it again. When there was no advantage in Canada, the sugars in preference went to New York. He should like to have heard there that day the prospects of beet. The question was, what price could their great competitor, beet sugar, be produced at to secure a profit? That was a point that remained to be seen. His opinion was that at the present time when they had to deal with a large proportion of beet sugar, cane sugar would show its superiority and beet supplies would be reduced, but as a matter of fact it was hard to find out what was the bottom price at which beet, unsupported by bounties, could be produced. Since the Brussels Convention they had already secured a very substantial advance in the price of sugar. There had been an advance of between 25 and 30 per cent in the value of sugar. Beet sugar was quoted as low as 5s. 9d., per cwt.

His Excellency said that as no other gentlemen appeared to be desirous of speaking he thought it might be taken for granted that those present were in accord with the statements made by Sir Daniel Morris, Mr. Fawcett, and Mr. Cousins. If that was the case it seemed to him that there was a hopeful outlook. He thought that from what Sir Daniel Morris had told them there was a decided reason to think that they might look for improvement in the results of the sale of cane sugar, and also that cane sugar could be cultivated in Jamaica with a great deal of advantage. That being so he could only express the sincere hope that there would be a great revival of sugar growing here, and that they might see an increase in the number of acres under cane cultivation. He knew that when he was in British Guiana he was always told there that all the sugar planters wanted was a fair field and no favour and that if the bounties were done away with they felt certain that they could compete on equal terms with beet sugar and defeat it If those statements were correct, which he had no reason to doubt, it seemed to him that those connected with the sugar industry might well feel hopeful, and what Mr. Gamble had told them of the recent rise in prices should certainly encourage the sugar planters here. If no one present had anything further to say they might consider that the meeting had come to an end, and he took it that the feeling of the meeting was decidedly in accord with the speeches that had been made. (Cheers,)

After His Excellency had conveyed the thanks of the meeting to Sir Daniel for his address, Sir Daniel said he wished he had had time to have placed a fuller statement before them. Nevertheless he hoped that this meeting of the sugar planters of Jamaica would lead them to consider whether the circumstance of sugar planting was not of so promising a character as would justify them making a great effort to improve the condition of the industry. He believed that the circumstances were favourable and that the industry could not only be maintained but could also be extended. It was an important industry from many standpoints. A great feature connected with it was that nearly all the expenses were disbursed in the form of wages to labourers and tradesmen. It was claimed for this industry that there was no other that spent so large a proportion of money in labour. A prosperous sugar industry would also mean a prosperous pen-keeping industry. The sugar industry and cocoa and other industries were essential in order to place the circumstances of the island in a stable condition so that if anything happened to one industry the others should be able to take its place. It was not safe to depend alone on a flourishing banana industry. It was necessary that a flourishing sugar industry and flourishing cocoa, coffee and other industries should also be maintained in the island.

The proceedings then ended.

GRASS OILS, II.

An article on Grass Oils appeared in the March Bulletin, page 53; the following information is now added:—

Mr. J. Ch. Sawer to Director Public Gardens and Plantations.

6, Cleveland Road, Brighton,
17th April, 1903.

Dear Sir,

I received to-day your favour dated 1st instant. The 2 samples of grass oils were forwarded to the laboratory of Messrs. Schimmel & Co. and will probably be noticed in their April and May Report. I think you will find that Schimmel & Co. agree with me that Lemon grass is Andropogon citratus of DeCandolle—which is certainly a different plant to A. Schoenanthus (which yields palm-rosa oil.)

I took a small sample out of the bottle of lemon-grass oil and submitted it to Messrs. Lambert and Strong of Mincing Lane—eminent drug-brokers. They pronounced it to be "very good"—I gave your name and address, and they said they would communicate with you direct respecting same. The E. Indian oils are now so grossly adulterated that the market is glad to get anything from a reliable source. We are obliged to have analysis for oils in London now, and their certificates are required in Mincing Lane,—otherwise buyers would be afraid to bid at the drug sales or buy by private treaty. New uses have lately been found for lemon-grass oil, and from citronella they extract the citronellal for fabricating an imitation oil of rose.

I should like *one* copy of the Bulletin (March) and perhaps you could send one to Mr. Ernest J. Parry.

I sincerely hope your distillers will succeed in this enterprise, and I will at all times do my best to further it.

Yours very truly,

J. Ch. Sawer.

"The May price quoted by Schimmel & Co. in the wholesale list is 8/6 per lb. for Lemon-grass, and 1/1d. per lb. for Ceylon Citronella." J. Ch. Sawer, in letter dated 8th June.

Messrs. Lambert & Strong to Director Public Gardens and Plantations

Dunster House, Mincing Lane, London, E.C.,
31st March, 1903.

Dear Sir,

Mr. J. Ch. Sawer of Brighton has sent us a sample of lemon grass oil which came from you. We think this is a very good specimen of the article and it ought to find a ready sale here, provided the citral contents are equal to the Travancore oil—this latter is selling at 6d. per ounce, but we should expect to get more for the West Indian.

We shall be glad to know whether you can forward any, and if so, what quantity annually.

We are, Dear Sir,
Yours faithfully,

Lambert & Strong.

EXTRACT FROM SEMI-ANNUAL REPORT OF SCHIMMEL & CO., APRIL-MAY, 1903.

CITRONELLA OIL, CEYLON.—The prices of this important article reached their lowest position in October last year at about ½d. per lb. The distillation was then completely suspended on account of continuous rainfall in the citronella districts, and this led to a rise in the prices up to 9¾d. This last figure represents approximately the present market value. The quotations had to be raised proportionately.

The exports from Ceylon have slightly receded in 1902. They were:

In 1902	...	1,294,750	lbs
against " 1901	...	1,430,168	"
" 1900	...	1,409,050	"
" 1899	...	1,478,756	"
" 1898	...	1,365,917	"
" 1897	...	1,182,867	"

The figures for the various countries were as follows:—

to the United Kingdom		556,096	lbs
" America	...	538,970	"
" Germany	...	146,518	"
" Australia	...	26,408	"
" China	...	17,115	"
" France	..	2,376	"
" Singapore	...	1,867	"
" India	...	5,400	"
	Total	1,294,750	

The low value of the article has lately, unfortunately, again led to numerous and very peculiar adulterations, such as have never been observed before.

A sample of citronella oil which takes about an intermediate place between Ceylon and Java citronella oils, was received by us some time ago from the Government Laboratory in Jamaica. We found for this oil: d 0,8947, a 4°16,′ and n 147,098· It also showed a 15°— D— D20° low acid number, and contained 86·4 per cent. total C H with 10 18° a citronella-content of 25,43 per cent.

In a note appearing in the "Tropenflanzer"* we find that in the Botanical Garden at Victoria in the Cameroons, under the name *Andropogon citratus*, a species of grass in cultivated, which, according to an examination by Strunk, yields an oil which is seemingly identical

* Vol. 7 (1903), 37.

with citronella oil. Strunk distilled 10 kilos of the fresh grass with water, and obtained a yield of 0·38 per cent oil With the primitive means at his disposal he was able to ascertain that this oil contains about 15 per cent. of an aldehyde, which appears to be identical with citronellal.

According to the foregoing, the grass cultivated at Victoria, of which it had not hitherto been possible to determine the species as the plant never reached the flower stage, may possibly be identical with *Andropogon Nardus*, L., which in the East Indies is cultivated on a large scale for the production of citronella oil.

It has repeatedly attracted our attent;on, that when it is a question of their origin, the *Andropogon* grasses are frequently confounded with each other. The thought which first occurs is, that such confusion is caused by the omission of the name of the author after the designation of the species. But this does not apply in every case, for there are some exactly-defined species indicated as the mother-plants of oils which, according to our information, could not possibly be produced from them. We will give some examples of this. Tschirch, in his work "Indische Heil—und Nutzflanzen"* mentions on page 124 *Andropogon Schoenanthus*, L., as the mother-plant of lemon grass oil. The same statement is made in the chapter *Gramineae* edited by Hackel, in Engler and Prantl's "Naturlichen Pflanzenfamilien"; the oil obtained from it is said to be met with in commerce as "lemon oil". Sadebeck** also states, that *Andropogon* Schoenanthus, L, is cultivated in some parts of East Africa, and that the fragrant lemon grass oil is distilled from it. But at the same time he mentions also, that this oil is used for adulterating rose oil, and thereby (and also by referring to the synonymous words rusa, palmarosa, or Turkish geranium oil) he identifies it with palmarosa oil. Finally, the annual report of the Buitenzorg Botanical Gardens also mentions *Andropogon Schoenathus*, L. (sereh) as the mother-plant of lemon grass oil.

Lemon grass Oil. The value of this article has undergone considerable fluctuations. The lowest point was reached in November, at 4d. per oz. whilst at the present time it cannot be bought below 5¼d.

The export from Cochin amounted in 1902 to only 2,350 cases, but, on the other hand, fresh sources of supplies have appeared, which in the near future may possibly make competition to the present monopoly.

To all appearances the cultivation of *Andropogon* grasses in the West Indian Islands, to which we referred in our last October Report, is extending. We have lately received two further samples of *Andropogon* oils from the Government Laboratory in Jamaica. On one of these oils we have already reported under the heading citronella oil; the other one was, like the previous one from Antigua† designated as having been obtained from *Andropogon Schoenathus*, but it has such a pronounced odour of lemon grass oil, that we have no hesitation in calling it by that name. It compares favourably with the Antigua oil

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* Berlin 1892. R. Gaertner

** Die Culturgewachse der deutschen Colonien. Jena 1899, p. 247.

† Report October, 1902, 50.

by its considerably higher aldehyde-content (83·5 per cent., against 48·2 per cent for the other) but it shares with the latter its insolubility in 70 and 80 per cent. alcohol; 90 per cent. and absolute alcohol form at first a clear solution, but when more is added, they cause strong turbidity. In its physical constants the oil does not show any specially great differences from those observed at other times; we found d 15° = 0,8922, a (100 mm) = o and n 20° = D 0 9′ D = 1,48825.

West Indian Grass Oils.

By Ernest J. Parry, B.Sc., F I.C.

Extract from the Chemist and Druggist, September 19.

In the March issue of the *Bulletin* of the Department of Agriculture for Jamaica an account of some grass oils distilled in Trinidad and in Jamaica was given by the Jamaica official analyst, Mr. H. H. Cousins. It appears that a vigorous attempt is intended to take up the cultivation of the *Andropogon* grasses, with a view to devoloping the essential oil industry, on account of the reduced cultivation of the sugar cane. The Trinidad oils distilled experimentally were those of the *Andropogon Nardus* and *A. Schoenanthus*, and were found to possess the following characters :—

		A. Nardus.	*A. Schoenanthus.*
Sp. gr. at 15°	...	0·9084	0·9315
Rotation	...	+0·1°	+3°
Aldehydes	...	15·5 per cent.	48·2 per cent.

The oil from the *A. Nardus* showed a total geraniol and citronellal value of 53 per cent., and thus corresponds with an ordinary Ceylon citronella oil, except that its content in active constituents is somewhat low. This however is possibly accidental, and with proper distillation a normal oil would no doubt result. The *A. Schoenanthus* oil did not in the least resemble a palmarosa oil, but much more closely resembles lemon grass oil.

I am indebted to Mr. Cousins for samples of the Jamaican oils, which are of very great interest. I propose to investigate them more fully, but in the meantime give the following details of them :—

The oil from *A. Nardus* is a pale oil of exceptionally fine odour, and has the following characters:

Sp. gr. at 15°	...	0·8955
Rotation, 100 mm.	...	—3° 30′
Refractive index at 20°	...	1·4712
Aledhydes	...	25 per cent.
Geraniol and citronellal	...	87 per cent.

In general it appears to closely resemble the fine Java citronella oils, being of much finer odour than the normal Ceylon distillates. It is

soluble in 1 volume of 80 per cent. alcohol, and on addition of 10 volumes shows only the faintest opalescence If it could be produced at a reasonable price in quantity, it would no doubt find great favour in this market. Messrs. Schimmel & Co., have reported on what appears to be the same oil, and say that it takes about an intermediate place between the Java and Ceylon oils; but I am of opinion that it is more of the Java type than of the Ceylon.

The Jamaican oil distilled from *A. Schoenanthus* is not a palmarosa oil, and is accurately described as a true lemon-grass oil. This raises the question as to which grass is really the parent of lemon grass oil, as it appears out of the question that so enormous a change in the character of the product could take place by the grass being cultivated in Jamaica.

This lemon-grass oil has the following characters:

Sp. gr. at 15°	...	0·8965
Rotation, 100 mm.	...	—0° 30′
Aldehydes	...	83 per cent.
Refractive index at 20°	...	1·4896

Insoluble in 70 per cent. or 80 per cent. alcohol.

The oil is a typically fine lemon grass oil, with a very high aldehyde-content, and differs only from normal Eastern oils in its insolubility in alcohol. The insoluble portion of the oil is a heavy body, sinking to the bottom of the alcohol, which I am now investigating. Apart from this insolubility, which may not be normal, and may be found to disappear when the oil is distilled under normal conditions, the oil may be described as a fine lemon grass oil, with a very high citral value; and, since the value of lemon grass oil depends entirely on its citral-content the oil should command a ready market if produced at a reasonable price.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held on the 14th July at Headquarter House, present Hon. W. Fawcett in the Chair, Hon. J. V. Calder, Messrs. H. H. Cousins, C. A. T. Fursdon, J. W. Middleton, T. L. Roxburgh, and John Barclay, the Secretary.

The minutes of the previous meeting were read and approved.

A letter from the Acting Colonial Secretary was read intimating that Mr. Buttenshaw had been appointed Scientific Assistant to the Imperial Commissioner of Agriculture for the West Indies.

Mr. Cousins submitted a summary of reports from some of the most experienced horse breeders and experts in the island.

The Acting Colonial Secretary intimated that the £10,000 grant in aid of the Sugar Industry could only be applied for the benefit of the Sugar Industry.

It was decided to recommend to the Privy Council the purchase of a

Sugar Estate for the purpose of an Experiment Sugar Station, for testing and investigating on an extensive scale ;

1. New varieties of cane
2. Methods of cultivation.
3. Economical methods of sugar production under local conditions.
4. Fermentation of rum.

An agreement between the Director of Public Gardens and Mr. H Bolton at Gordon Town, as to lease of land at Hope was read, and with the suggestion from Mr. Calder to insert a clause reserving the right of planting out trees, was approved.

A special meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 22nd July at 12 o'clock, present Hon. W. Fawcett, Acting Chairman, Hons. J. V. Calder, and T. H. Sharp, Messrs. H. H. Cousins, C. A. T. Fursdon, J. W. Middleton, T. L Roxburgh, J. Shore and John Barclay, the Secretary.

The meeting considered the scheme of Mr. Cousins for the establishment of a Sugar Experiment Station, and the matter was referred to a Committee consisting of Messrs Calder, Middleton, and Cousins, who were to make a confidential enquiry and report.

A special meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 28th July, at 12 o'clock, present Hon. W. Fawcett, Acting Chairman, presiding, Messrs. H. H. Cousins, C. A. T. Fursdon, J. W. Middleton, T. L. Roxburgh, and John Barclay, the Secretary.

The Committee appointed at the last special meeting submitted their Report, which was directed to be sent to the Acting Colonial Secretary to be submitted to the Privy Council.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday the 18th August, at 9 o'clock a.m., present, Hon. W. Fawcett, presiding, Hon. T. H. Sharp, Messrs. H. H. Cousins, J. W. Middleton, T. L. Roxbourgh, and John Barclay, the Secretary.

The Secretary read the minutes of the last monthly meeting and the two special meetings, which were confirmed.

Mr. Cousins submitted the result of his enquiries regarding a successor to Mr. Buttenshaw, and it was decided to recommend to the Government the engagement of Mr. T. F. Teversham, England, at a salary of £250 a year, for three years, passage to be paid.

It was decided to print the Report *re* Horse Breeding in a double number of the Bulletin.

It was decided to do nothing further in the matter of the Sugar Experiment Station until it was known what the effects of the hurricane were.

The Acting Coloniul Secretary said the £10,000 did not affect our local finances at all. It was a grant from the Imperial Government to the Sugar Industry only and as the amount would bear interest at 3 %

there would be no loss financially in delay, while the interest would go towards the salary of the Fermentation Chemist.

It was intimated that Sir D Morris might visit the Island, and the Board decided to extend a most cordial invitation to him

It was decided to send the following Resolution to the Goverment. "The Board desires to bring to the notice of the Government the great straits in which all classes of cultivators throughout the island are placed through the hurricane. Very many planters have no money to continue their cultivations and resuscitate the plants injured. The Board therefore recommends that assistance be given to the larger planters by advances to them, as this is the only means of safely reaching the working classes. It also suggests assisting the small settlers by helping to rebuild their homes and providing them with seeds free at once."

The Acting Chairman reported that a Cotton Gin had been sent out and that arrangements were being made to establish it at Spanish Town.

Mr. Sharp moved that a grant be made for investigating the Cassava Industry. Mr Cousins said he would first like to satisfy his mind on the whole subject from experiments made in the Laboratory. This was agreed to.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 15th September at 11.30 o'clock, present, Hon. Sydney Olivier, presiding, Hons. W. Fawcett and T. H. Sharp, Messrs H. H. Cousins, C. A. T. Fursdon, C. E. deMercado, and John Barclay, the Secretary.

The minutes of the previous meeting were read and approved.

The Chairman said that the occurrence of the hurricane should not be allowed to interfere with the establishment of the proposed Sugar Experiment Station. They had a good nest egg to begin with in the £10,000 Imperial Grant, and they could issue debentures for any additional amount they might require.

It was intimated that Mr. T. F. Teversham who had been appointed Science Lecturer had left England on the 12th inst., to take up his duties. It was decided that Mr. Teversham be placed at first under the control of Mr. Cousins.

The Chemist submitted an interim report on his experiment with Cassava, and it was resolved to send a sufficient quantityof the dried pulp to England to be tested as a source of glucose, and valued.

A resolution from the Hurricane Relief Committee was submitted asking that the various Agricultural Instructors be utilized as much as possible in the districts which had suffered most from the hurricane.

It was decided that Mr. Cradwick be transferred from the western parishes to Portland for six or eight weeks and that the Agricultural Society be asked if they would agree to transfer Mr. Palache for the same period from Manchester to St. Mary.

A memorandum from Mr. Robert Johnstone was submitted, pointing out that in the Port Royal Mountains district the China or Dwarf banana had not suffered from the hurricane at all, while all the Jamaican bananas had been blown down. The Secretary was asked to have attention called to the matter in the Agricultural Journal.

Mr. Fawcett submitted list of damages done by the storm to the

Gardens at Hope, Castleton and Cinchona, and a further limited grant was recommended to be made to make good the damages as these gardens were great sources of attraction to tourists.

Mr Fawcett submitted a memorandum showing that from the cotton grown at Hope they had already a sufficient quantity to start ginning.

On Mr. Cousins' application it was decided that two more apprentices were to be admitted to the Laboratory and that students should receive free third class passes to enable them to visit estates.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 13th October, at 9 o'clock, present, Hon. S. Olivier in the Chair, the Directer of Public Gardens and Plantations, the Government Chemist, and Messrs. C. E. deMercado, and C. A. T. Fursdon.

The minutes of the previous meeting were read and confirmed.

The Estimates for Agricultural Services for 1904-05, were discussed and passed.

It was agreed to ask the Government to communicate with the steamship companies on the subject of having plants from Hope Gardens taken round the island free of freight and of wharfage.

Correspondence was submitted by the Colonial Secretary in regard to two bull calves, presented by His Majesty the King to the island It was resolved to refer the matter to the Agricultural Society.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on 10th November, at which the following members were present:—Honourable Colonial Secretary (in the chair), the Director of Public Gardens, Hon. T. H. Sharp, Hon. H. Cork, and Messrs. C. E. deMercado, and C. A. T. Fursdon.

Sir Daniel Morris spoke on the subject of teaching elementary science and agriculture in elementary schools, and suggested that greater importance should be given to these subjects in the Code by allotting to them the same number of marks on inspection as are given for the primary subjects. He stated that in Trinidad there were already 200 school gardens established and that probably the reason for the small number in Jamaica was that the regulations were too severe, *i.e.*, that the ground must be half of an acre, and must be fenced. He also suggesetd that at all Agricultural Shows there should be a special section for school children, where they might exhibit plants grown by themselves in pots. The question of inspection was discussed, and it appeared to the Board that if the agricultural instructors were increased say by four, the Education Department might invite their assistance to supervise and assist the working of school gardens and to inspect them for the Department.

The Board after discussion of Sir Daniel Morris's criticism, recorded its opinion that the progress made in the development of agricultural elementary education during the five years to which attention has been directed to it it, was not so satisfactory as could be desired.

It was resolved to recommend to the Governor that the Superintending Inspector of Schools should be placed on the Board of Agricultnre

in order to afford him an opportunity of keeping in closer touch with agricultural development in the colony.

The question of bidding for the purchase of Bushy Park at the forthcoming advertised sale was discussed. It was decided not to recommend the Government to bid for the property.

It was reported that Mr. C. Allan, B.Sc, the Fermentation Chemist, had arrived and was to commence work at once at the Laboratory, and afterwards proceed to work on sugar estates.

It was agreed to make arrangements to send Mr. T. J. Harris to take accurate weights, &c., of cassava at Longville, the Estate of Mr. J. W. Middleton, so as to ascertain the probable results to be expected from cultivation on a large scale

It was agreed to provide additional clerical assistance for Mr. Barclay in his secretarial duties, and an allotment of 10s. a week was approved for this purpose.

A scheme submitted by the Island Chemist for utilising the Imperial Grant of £10,000 for the benefit of the sugar industry was considered It was decided that no portion of the capital of the grant should at present be trenched on, but that the arrangements proposed should be proceeded with so far as the amount at credit of the fund for accrued interest would permit.

VARIETIES OF THE BANANA.

By Walter Jekyll.

The frequent suggestions in the press, that other bananas than the established Martinique variety should be grown in Jamaica, lead me to request the insertion in your Bulletin of the following reflections:

First and principally, is it wise to make any change where the industry is so thriving? That there are bananas superior to the Martinique in flavour is an undoubted fact. There are however several points to be considered before coming to the conclusion that it is desirable to substitute any one of these for the kind now grown. Market requirements are peculiar, and it does not follow as a matter of course that the best fruit gets a readier sale than the good The public is conservative and likes what it knows. Its eye is caught by appearances and it wants something handsome. This is well exemplified in the apple trade. Probably the most popular apple in England is Blenheim Orange, and yet to connoisseurs it is not particularly good. In any market may be found lower-priced apples of far better quality, which are neglected either because they are unknown or because they are less attactive in appearance.

Now no banana is handsomer than the Martinique Especially beautiful in the light-yellow satin jacket of its perfection, it is also good to look at both before that stage and after it. Only when brown stains begin to disfigure the skin, whose hue has gradually deepened from light yellow to dark yellow, does it proclaim that it is no longer fit to eat raw. Even then it is excellent when cooked.

The Martinique keeps well, especially in cool climates, and a point in its favour is that it may be eaten in several stages of maturity.

Some people like it best when it has a slight tartness suggesting apple, which is before the finger has become quite yellow. In this stage the skin screams if torn off rather quickly, and the flesh is fine and hard. Others prefer it when quite coloured, of an even light yellow all over. Others again like it in the more mellow state, when it has begun to taste like a sleepy pear and its jacket has turned to a deep yellow. Not a few still enjoy it in the further stage when more blotches begin to invade the skin. For my own part that is a sign that it should no longer be eaten raw, and that it is in the best condition for the oven.

The original banana of commerce in England is the China banana. This as grown in the Canaries has a better flavour than the Jamaica-grown China. I do not think that even an undiscerning public would accept the Jamaican—China banana. This is too coarse a fruit, and it would be a most dangerous experiment to attempt to substitute it for the Martinique.

On the other hand, some of the fine Indian kinds might be tried. They are of the highest excellence, decidedly superior to Martinique, though as we have seen in the case of apples, that is not necessarily a recommendation to the public. None that I have seen are as handsome in appearance. In any case, experiments of this kind should be left to the discretion of growers. Those who advocate new cultivations incur a grave responsibility. The great maxim of political economy, that progress is due to the pursuit of wealth by the individual, should never be lost sight of. The growing of a new fruit should be undertaken only because the grower is persuaded that he willl make money by it. And the condition that he will succeed should come from himself and not be forced upon him from outside.

Leaving market requirements, those who wish to have the best bananas for their own eating should grow them upon the poorest soil. The small fingers of Martinique have a far higher flavour than the larger ones grown on good land.

INDEX.

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