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WEATHER AND CROPS.

The temperature during the month of August, 1905, was slightly above the seasonal normal, the mean for the Group being 1.1 degrees higher than that of the preceding month. The precipitation was generally abundant, in most sections being quite well distributed throughout the month and exceeding in amount that of any preceding month of the year. A sudden decrease in atmospheric pressure during the evening of the 8th occasioned beneficial rains in nearly all leeward sections; with this single exception, normal pressure conditions prevailed throughout the month.

Conditions on the whole were quite favorable for the rapid growth of 1906 cane, but young plant cane would have advanced more rapidly in windward sections with less moisture and more sunshine. Excessively moist condition of the soil in windward plantations interfered at times with proper cultivation and occasioned a rapid and troublesome growth of weeds. During the third decade, high winds interfered with cane growth in the north Kohala district of Hawaii and caused some damage in northern Oahu, and hot, drying winds were very hard on young cane in the Kau district of Hawaii during the latter half of the month. The grinding of 1905 cane continued throughout the month at a few of the mills, but plowing, planting, hoeing, cultivating and fertilizing were the principal plantation operations. Damage by leafhoppers was reported in northern Kauai early in the month.

"Methods of Chemical Control in Cane Sugar Factories."—By H. C. Prinsen Geerligs, Director of the West Java Sugar Experiment Station, Pekalongan, Java:

Norman Rodger, (Editor International Sugar Journal), Altrincham, is the publisher of this handy *vade mecum* of the sugar chemist.

The name of the author is sufficiently well known in the sugar world to ensure the book a welcome in every sugar mill laboratory.

The volume has 86 pages; the first half consists of a reprint of a series of articles, which appeared in the International Sugar Journal in 1904; the second half of a number of useful tables and model-blanks for the statement of results.

Mr. Prinsen Geerligs is well acquainted with the conditions in Java, and it is to be presumed that the methods put down in this book have been found by him to suit the local conditions.

The methods could, however, not be adopted in these Islands without material modifications. For instance in regard to the sampling of the bagasse, the author says on page 5:

"The bagasse is sampled at the last mill by taking every now and then a small quantity of bagasse and throwing it immediately into a basket, covered with a lid. Once every hour this sample is brought to the laboratory, mixed, chopped rapidly."

If the finely broken hot bagasse from our nine and twelve roller mills were treated as described, the loss of moisture would be considerable. Again—same page—if such a small sample (20 grains bagasse to 300 grains water) were taken for polarization, the reading would be so small as to unduly affect the accuracy of the result.

On page 14 it will be seen, that the purity of the waste molasses is found by spindling the diluted molasses and single polarization. A figure obtained in this manner would, in these Islands, be of absolutely no value for comparisons owing to the vast differences in both the percentage and the composition of the ash.

On page 23 we find the definitions:

Brix normal juice=Brix first mill juice
Quotient normal juice=Quotient mixed juice

Neither of these definitions could be applied here, as it has been found by experience, that the density of the normal juice is lower than the density of the first mill juice, and also that the purity of the normal juice is lower than the purity of the mixed juice.

On page 17 there is a recapitulation of the analyses considered necessary. The amount of work involved therein is best measured by what the author has to say on page 47 about "Native Assistance."

"The exact execution of the analyses and calculations mentioned in the foregoing pages requires the assistance of a well trained staff of native helpers. Two shifts each consisting of two assistants have proved sufficient for the regular analyses during day and night; one of these men analyzes the juices and the other the bagasse, filter press cake, etc. Further, a fifth assistant only working during day time examines the field and factory samples of the cane, the molasses, the fibre contents, etc.

"The execution of the analyses and determinations in this treatise has been rendered so simple that the European chemist need not occupy himself with them and only exercises a general supervision. An important factor is the strict rule, that the juices in which the Brix has been determined, and the tubes which have served for the polariscopical test, remain untouched for a certain time in order to enable the chemist to verify at any unexpected moment the results entered in the books with his own observation of the same sample. Only the most important determinations, such as polarization of sugar delivered, etc., need be trusted to the personal care of the European chemist instead of to his assistants."

HAWAIIAN SUGAR INDUSTRY.—By K. R. Hamakers. The July number of the Archief contains a 40-page report on the Hawaiian sugar industry by K. R. Hamakers, whose services the Planters' Association engaged last year for the purpose of introducing the Java process of boiling sugar.

The report seems to be on the whole a very fair one. The writer has recognized our superiority in milling machinery, and particularly that of the Honolulu-built mills, as compared with those built on the mainland.

The chemical control he finds "very imperfect. The per-
"sonnel of the laboratory has nothing to do with the manu-
"facture, as it happens but rarely, that the chemist is also
"superintendent. The knowledge of most of the chemists
"in regard to manufacture is grievously scant. In this re-
"spect these islands stand to-day, where Java stood 14 years
"ago, when chemists were considered as a necessary evil, and
"were not supposed to bother about the manufacture."

"The sugar boilers" the writer goes on to say "have, just
"like our Chinese sugar boilers of that period, mostly anti-
"quated ideas. They live on a war-footing with the labora-
"tory, because the results of the daily analyses often disagree
"with their wishes."

On the subject of labor the writer tells his Java people, that the readmission of contract labor seems to him to be a matter of time only, as the cultivation of the sugar cane is the only important industry in Hawaii, and this one cannot exist without an abundant supply of good labor.

SUPERHEATED STEAM.

The Deutsche Zuckerindustrie contains a lucid article by R. Frank on the advantages and the practical value of superheated steam.

The use of superheated steam has many advantages, the foremost of which are, that the volume is greater than that of saturated steam and that in direct proportion to the increase in volume a greater effect is obtained with the same pressure and a considerable saving in heat.

Saturated steam always contains a certain percentage of water, which is thrown out of the boiler and is afterwards augmented by a quantity of condensed water, proportionate to the length of the pipe. Even in the best insulated pipes, the formation of a certain amount of condensed water is not to be avoided. This water has a bad effect in the cylinder.

The addition of a superheater does not only do away with these losses, it also enables us to utilize the heat in the water, which would otherwise be lost, by evaporating it and superheating the resulting steam.

As the advantages and qualities of superheated steam are yet too little known in wider circles, a description might not be out of place here.

The tendency of vapor or gas to give up its heat to the walls within which it is confined, is expressed by what is called the "Coefficient of transmission." (a).

This coefficient indicates the quantity of heat—measured in heat units—which penetrates 1 square meter of wall-surface in one hour for 1 deg. C difference in temperature between the vapor and the wall.

For wet steam, taken direct from the boiler, a=8000 to 10000, for air, generator gases and superheated steam a=20 to 50.

This illustrates, that under otherwise similar circumstances the superheated steam yields to the pipe and cylinder-walls but 1-160 to 1-500 of the heat, which is absorbed from wet steam. By coming in contact with the cold walls, the superheated steam loses a little of its heat; but its pressure does not decrease, nor does any condensation take place. It can even do part of the expansion work in the cylinder until it has cooled down to the point where its pressure corresponds with its temperature.

Only then does it reassume the properties of saturated steam. If the evaporation is rapid, wet steam is sure to result. As soon as this steam comes in contact with the cold pipe or cylinder-wall, a large amount of it is, owing to the decrease in temperature, precipitated in the form of water, this precipitation going on as long as there is a difference in temperature between the steam and the walls. This steam, on an average from 10 to 25 per cent. of the quantity that entered the cylinder, is of course of no further value, as far as work is concerned.

The loss amounts to 600 heat units or 254,000 K. G. M. for each K. G. steam condensed.

The use of superheated steam consequently does away with the great loss through condensation in the pipes and cylinders; this alone means a considerable saving. The steam arrives in the engine dry, still in a superheated condition and therefore without loss in pressure.

With the increase in temperature of the superheated steam goes of course an increase in volume. One K. G. steam overheated 100 deg. C fills at a boiler-pressure of 7 atmospheres a space of 0.318 cubic meters; 1 K. G. saturated steam occupies at the same pressure only 0.242 cubic meters. 1 K. G. superheated steam takes up therefore 31.4 per cent. more room than 1 K. G. saturated steam.

To produce 1 cubic meter of superheated steam 2205 heat units are required, for 1 cubic meter saturated steam 2720 heat units, which represents a saving in heat of 18.9 per cent.

The weight of one cubic meter of superheated steam is 3.15 K. G.; that of the same volume of saturated steam 4.14 K. G. As the superheated steam is lighter then the saturated steam, it can assume a considerably greater velocity, and pipes of smaller diameter may be used. This means a reduction in the wall surface and a consequent reduction in the loss caused by cooling.

As the steam engines accomplish the same work with a lesser weight of superheated steam than would be necessary of saturated steam, less is demanded of the boilers, and less fuel is required. Or given the same amount of boiler work, an additional amount of energy becomes available, so that a superheater may take the place of an additional boiler. The superheater allows of an increase of 30 to 40 K. G. of steam per square meter of heating surface, or of 6 to 8 lbs. per square foot. H.

FERTILIZER EXPERIMENTS, 1897-1905.

BY C. F. ECKART.

The series of experiments considered in this bulletin were planned and started by Dr. Walter Maxwell in 1897 and deal with four successive crops of Lahaina and Rose Bamboo cane grown on small field plats (1,000 sq. ft. area) to which fertilizing materials were applied as follows:*

Plats 1 and 2	100 lbs. nitrogen per acre (as dried blood).
	100 lbs. potash per acre (as sulphate of potash).
	100 lbs. phosphoric acid per acre (as double superphosphate).
Plats 3 and 4	100 lbs. nitrogen per acre (as sulphate of ammonia).
	100 lbs. potash per acre (as sulphate of potash).
	100 lbs. phosphoric acid per acre (as double superphosphate).
Plats 5 and 6	100 lbs. nitrogen per acre (as nitrate of soda).
	100 lbs. potash per acre (as sulphate of potash).
	100 lbs. phosphoric acid per acre (as double superphosphate).
Plats 7 and 8	100 lbs. potash per acre (as sulphate of potash).
	100 lbs. phosphoric acid per acre (as double superphosphate).
Plats 9 and 10	100 lbs. nitrogen per acre (⅓ as nitrate of soda, ⅓ as sulphate of ammonia, ⅓ as dried blood).
	100 lbs. potash per acre (as sulphate of potash).
Plats 11 and 12	100 lbs. nitrogen per acre (⅓ as nitrate of soda, ⅓ as sulphate of ammonia, ⅓ as dried blood).
	100 lbs. phosphoric acid per acre (as double superphosphate).

*The records of these experiments allowed some difference of opinion to exist as to the exact amounts of the fertilizing materials which were applied to the first ratoon crop, harvested in 1901. In this bulletin it is assumed that the quantities were applied in conformity with the original plan of the experiments. Each plat received only those elements which are shown in the plan of fertilization.

Plats 13 and 14 100 lbs. potash per acre (as sulphate of potash).
Plats 15 and 16 100 lbs. phosphoric acid per acre (as double superphosphate).
Plats 17 and 18 100 lbs. nitrogen per acre (⅓ as nitrate of soda, ⅓ as sulphate of ammonia, ⅓ as dried blood).
Plats 19 and 20 No fertilizer.

The average yields of cane and sugar and the quality of the juices furnish data of particular value, insomuch as the action of the different fertilizers is shown for the varying conditions obtaining during an eight years' test. While local conditions necessarily influence in large measure the relative yields on experiment areas of the nature described, a number of results are furnished by the present series of experiments which are worthy of general consideration as regards the plant food requirements of the sugar cane.

Before giving the yields of cane and sugar following the fertilization of the plats in question, it will be well to consider the analysis of the soil of the Experiment Station field on which these tests were carried out as compared with the average analysis of the soils on the various islands of the group. In the application of the mixed fertilizers ordinarily used in Hawaii, the four essential elements receiving consideration are lime, potash, phosphoric acid, and nitrogen. These elements formed the chief component parts of the fertilizers applied in the tests under consideration and on this account the analysis of the Station soil and the soils from the different islands present figures showing only the percentages of these particular elements. The agricultural analysis shows the amounts of lime, potash, and phosphoric acid removed from the soil during digestion with a strong mineral acid, while the aspartic acid analysis gives the quantities of the same elements which may be dissolved from the soil by use of a weak organic acid (1% solution of aspartic acid). Naturally the availability of the elements of the respective soils will be somewhat proportionate to the readiness with which they enter into solution in the weak acid medium.

ANALYSIS OF STATION SOIL.

Element.	Agric. Method.	Aspartic Acid Method.
Lime	.861%	.3254%
Potash	.581	.0231
Phos. Acid	1.050	.0218
Nitrogen	.149	....

AVERAGE ANALYSIS OF ISLAND SOILS.

Agricultural Method.

Element.	Kauai.	Hawaii.	Oahu.	Maui.	General Average.
Lime	.504%	.833%	.411%	.691%	.609%
Potash	.358	.353	.348	.401	.365
Phos. Acid	.237	.320	.269	.200	.256
Nitrogen	.246	.388	.119	.222	.243

Aspartic Acid Method.

Element.	Kauai.	Hawaii.	Oahu.	Maui.	General Average.
Lime	.1423%	.0804%	.1460%	.2019%	.1426%
Potash	.0258	.0164	.0248	.0335	.0257
Phos. Acid.....	.0008	.0013	.0017	.0018	.0014

It will be noted that the figures for lime, potash and phosphoric acid as obtained by the agricultural method of analysis are higher for the Station soil than they are for the average soil of any of the islands. The percentage of nitrogen is low as is characteristic of the average soil on the Island of Oahu. With respect to the percentage of the elements soluble in a dilute solution of aspartic acid, it is shown that the Station soil contains more available lime and phosphoric acid than the average samples of soil from the various islands, while the potash is about the same as that for Kauai and Oahu, greater than that for Hawaii and considerably less than that for Maui. Comparing the quantities of available lime, potash, and phosphoric acid in the Station soil with the amount contained in the average sample from all the islands, we find a large excess of lime and phosphoric acid in the Station soil and a somewhat smaller percentage of potash. The nitrogen of the average island soil is about 0.1% higher than that of the Experiment Station field.

In gauging the relative fertility of the average soil from the different islands and that from the Experiment Station, a number of factors naturally require consideration other than that representing the chemical analysis. The mechanical condition is of hardly less importance than the chemical composition, and likewise the depth, drainage, water absorptive power, and exposure are paramount influences in determining the relative productive value of different lands. While the Station soil has an advantage as regards depth and chemical composition, it may be safely stated with respect to the other salient features that it is somewhat below the average of the general run of soils in the islands. The large yields of cane and sugar which are obtained at the Experiment Station during ordinary seasons may be attributed chiefly to the depth and chemical composition of the soil, the preparation of the land for planting, and the even distribution of the irrigation water over the respective plats. It is customary before planting to thoroughly plow and harrow the land and then fork and spade it to a depth of about fourteen inches. This careful though laborious process insures a greater uniformity in the tilth of the separate plats than would result from the treatment to which plantation fields are ordinarily subjected. In carrying out plat experiments in the field, however, it is essential that the condition of the soil of the separate areas shall be particularly uniform, in order that the results which are sought with respect to the relative value of various agricultural practices may not become impaired through undue advantages which one plat might have over another at the start. The forking and spading of the field after plowing and harrowing, while representing a feature of agricultural work which could not be practiced with economy on the plantations, at the same time affords a means of supplying the plantations with more accurate data for their consideration than could otherwise be obtained. The reasons for this were discussed at some length in Bulletin No. 13 of this Division.

In presenting data bearing on the yields of numerous field plats brought into competition with each other, it is considered best to tabulate the figures in such a way that their relative significance may the more readily be called to one's attention. To facilitate comparison resource is also made in numerous instances to diagrams, and it is hoped that through this means a more convenient interpretation of the somewhat exhaustive tables may be permitted.

The weights of cane produced on the separate plats were as follows:

WEIGHT OF CANE PER ACRE.

Rose Bamboo.

	Pounds of Cane per Acre.				
Plat.	1899.	1901.	1903.	1905.	Average.
1	188,280	173,767	139,828	116,131	154,501
3	194,040	192,491	148,148	138,434	168,278
5	175,200	196,846	148,757	130,898	162,925
7	189,600	158,056	132,597	......	160,084
9	192,800	162,063	142,877	108,638	151,594
11	184,080	216,879	125,322	116,784	160,766
13	182,400	152,425	106,504	67,910	127,309
15	152,800	174,200	92,696	65,035	121,182
17	180,080	175,071	114,301	96,790	141,560
19	148,000	115,230	111,688	62,552	109,367

Lahaina.

Plat.	1899.	1901.	1903.	1905.	Average.
2	157,040	216,679	157,382	149,030	170,042
4	157,600	272,723	140,693	145,708	179,181
6	156,960	275,276	142,223	128,883	185,834
8	150,640	148,070	131,595	......	143,435
10	171,600	282,204	137,955	135,994	181,938
12	156,000	203,443	133,119	132,640	156,300
14	160,160	151,135	94,394	77,232	120,730
16	136,160	115,230	100,275	74,575	106,560
18	164,000	174,200	137,519	123,231	149,737
20	133,760	137,618	112,559	78,930	115,716

WEIGHT OF CANE PER ACRE.

Average of Lahaina and Rose Bamboo.

	Pounds of Cane per Acre.				
Plat.	1899.	1901.	1903.	1905.	Average.
1 & 2....	172,660	195,223	148,605	132,580	162,271
3 & 4....	175,820	232,607	144,420	142,071	173,729
5 & 6....	166,080	236,061	145,490	129,890	174,379
7 & 8....	170,120	153,063	132,096	......	151,759
9 & 10....	182,200	222,133	140,416	122,316	166,766
11 & 12....	170,040	210,161	129,220	124,712	158,533
13 & 14....	171,280	151,780	100,449	72,571	124,019
15 & 16....	144,480	144,715	96,485	69,805	113,871
17 & 18....	172,040	174,635	125,910	110,010	145,648
19 & 20....	140,880	126,424	112,123	70,741	112,541

It is regretted that figures are wanting to show the weights of cane and sugar, and the quality of the juices for plats 7 and 8 (fertilized with phosphoric acid and potash) for the 1905 crop. Some of the cane on the plats became affected with a root disease in the spring of 1904. Owing to the fact that this was prior to the organization and equipment of the present Division of Pathology and Physiology, the Experiment Station forwarded samples of this diseased cane, taken from plats 7 and 8, to the Department of Agriculture in Washington, D. C., for examination. Plats 7 and 8 were then sacrificed to permit an investigation bearing on the nature of this parasitic root fungus, and a series of planting tests with treated and untreated cuttings were started with this end in view. The results from these latter experiments are contained in Bulletin No. 1 of the Division of Pathology and Physiology.

With the Rose Bamboo variety the highest average yield was obtained on plat 3 receiving potash, phosphoric acid, and nitrogen in the form of sulphate of ammonia. The lowest average yield was obtained on the unfertilized plat. The Lahaina variety gave the largest average production of cane on plat 6, receiving potash, phosphoric acid, and nitrogen in the form of nitrate of soda, showing a small gain of 6,653 lbs. of 3.6 per cent. over the plat receiving a complete fertilizer with nitrogen in the form of nitrate of soda and which gave the largest weights for Rose Bamboo. The lowest average yield was produced on plat 16 receiving phosphoric acid only. Compared with the unfertilized plat Lahaina showed a loss in cane amounting to about 8 per cent.

ANALYSIS OF JUICES.

DENSITY BY BRIX.

Rose Bamboo.

Plat.	1899.	1901.	1903.	1905.	Average.
1	18.64	16.82	17.50	19.35	18.07
3	19.26	17.40	18.40	19.92	18.74
5	18.52	17.50	18.64	21.15	18.95
7	18.96	18.28	19.30	....	18.84
9	18.62	17.07	18.88	20.84	18.85
11	18.15	17.67	19.30	20.84	18.99
13	18.50	18.67	19.91	21.59	19.66
15	18.44	19.32	19.61	20.42	19.44
17	18.34	18.18	19.28	21.01	19.20
19	18.85	19.98	19.44	21.22	19.87

Lahaina.

Plat.	1899.	1901.	1903.	1905.	Average.
2	18.93	17.50	17.47	20.64	18.64
4	19.03	16.60	17.29	20.99	18.47
6	19.15	16.60	18.40	21.91	19.01
8	18.37	18.72	19.04	....	18.71
10	18.83	17.99	18.80	22.15	19.44
12	18.81	16.87	18.44	21.28	18.85
14	18.98	20.38	18.74	21.82	19.98
16	19.66	19.28	18.90	21.89	19.94
18	19.58	17.46	19.40	21.08	19.38
20	20.09	20.88	19.11	21.92	20.50

DENSITY BY BRIX.

Average of Lahaina and Rose Bamboo.

Plat.	1899.	1901.	1903.	1905.	Average.
1 & 2......	18.79	17.16	17.49	20.00	18.36
3 & 4......	19.15	17.00	17.85	20.46	18.61
5 & 6......	18.84	17.05	18.52	21.53	18.98
7 & 8......	18.67	18.50	19.17	....	18.78
9 & 10......	18.73	17.53	18.84	21.50	19.15
11 & 12......	18.48	17.27	18.87	21.06	18.92
13 & 14......	18.74	19.53	19.33	21.71	19.82
15 & 16......	19.05	19.30	19.26	21.16	19.69
17 & 18......	18.96	17.82	19.34	21.05	19.29
19 & 20......	19.47	20.43	19.28	21.57	20.19

SUCROSE IN JUICE.

Rose Bamboo.

Plat.	1899.	1901.	1903.	1905.	Average.
1	16.15	15.00	15.95	17.70	16.20
3	16.70	14.95	16.90	18.10	16.66
5	15.90	15.50	17.15	19.40	16.98
7	16.55	16.40	17.80	....	16.91
9	16.50	15.00	17.40	19.19	17.00
11	15.70	15.70	17.95	18.90	17.06
13	16.02	17.00	18.00	19.70	17.68
15	16.12	17.40	18.40	18.80	17.68
17	16.10	16.30	17.85	19.40	17.41
19	16.80	18.25	18.00	19.20	18.06

SUCROSE IN JUICE.

Lahaina.

Plat.	1899.	1901.	1903.	1905.	Average.
2	16.80	15.30	15.80	18.50	16.60
4	16.80	14.05	15.30	18.80	16.23
6	17.10	14.30	16.70	19.60	16.92
8	16.28	16.09	17.45	....	16.60
10	16.68	15.95	17.20	20.00	17.45
12	16.40	14.50	16.85	19.10	16.71
14	16.68	18.30	17.00	19.60	17.89
16	17.65	17.45	17.15	19.80	18.01
18	17.55	15.20	17.90	18.80	17.36
20	17.80	18.95	17.40	19.70	18.46

SUCROSE IN JUICE.

Average of Rose Bamboo and Lahaina.

Plat.	1899.	1901.	1903.	1905.	Average.
1 & 2......	16.48	15.15	15.88	18.10	16.40
3 & 4......	16.75	14.50	16.10	18.45	16.45
5 & 6......	16.50	14.90	16.93	19.50	16.95
7 & 8......	16.42	16.25	17.63	....	16.76
9 & 10......	16.59	15.48	17.30	19.55	17.23
11 & 12......	16.05	15.10	17.45	19.00	16.89
13 & 14......	16.35	17.65	17.50	19.65	17.79
15 & 16......	16.89	17.43	17.78	19.30	17.85
17 & 18......	16.83	15.75	17.88	19.10	17.39
19 & 20......	17.30	18.60	17.70	19.45	18.26

GLUCOSE IN JUICE.

Rose Bamboo.

Plat.	1899.	1901.	1903.	1905.	Average.
1	0.23	0.41	0.26	0.35	0.31
3	0.24	0.45	0.21	0.30	0.31
5	0.31	0.42	0.20	0.20	0.28
7	0.28	0.21	0.20	...	0.23
9	0.21	0.37	0.26	0.22	0.26
11	0.30	0.38	0.18	0.28	0.28
13	0.17	0.25	0.13	0.22	0.19
15	0.25	0.24	0.10	0.27	0.21
17	0.24	0.32	0.14	0.21	0.22
19	0.23	0.18	0.12	0.20	0.18

Lahaina.

Plat.	1899.	1901.	1903.	1905.	Average.
2	0.33	0.73	0.56	0.54	0.54
4	0.41	0.82	0.55	0.50	0.57
6	0.31	0.73	0.36	0.48	0.47
8	0.38	0.39	0.37	...	0.38
10	0.37	0.47	0.37	0.34	0.38
12	0.52	0.76	0.36	0.35	0.49
14	0.51	0.24	0.33	0.36	0.36
16	0.33	0.32	0.30	0.29	0.31
18	0.34	0.71	0.25	0.40	0.42
20	0.23	0.21	0.30	0.32	0.26

GLUCOSE IN JUICE.

Average of Lahaina and Rose Bamboo.

Plat.	1899.	1901.	1903.	1905.	Average.
1 & 2......	0.28	0.57	0.41	0.45	0.43
3 & 4......	0.33	0.64	0.38	0.40	0.44
5 & 6......	0.31	0.58	0.28	0.34	0.38
7 & 8......	0.33	0.30	0.29	...	0.31
9 & 10......	0.29	0.42	0.32	0.28	0.32
11 & 12......	0.41	0.57	0.27	0.32	0.38
13 & 14......	0.34	0.25	0.23	0.29	0.28
15 & 16......	0.29	0.28	0.20	0.28	0.26
17 & 18......	0.29	0.52	0.20	0.31	0.32
19 & 20......	0.23	0.20	0.21	0.26	0.22

PURITY OF JUICE.

Rose Bamboo.

Plat.	1899.	1901.	1903.	1905.	Average.
1	86.64	89.17	91.14	91.47	89.60
3	86.70	85.91	91.84	90.86	88.82
5	85.85	88.56	92.00	91.73	89.53
7	87.28	89.71	92.22	....	89.73
9	88.61	87.87	92.16	91.65	90.07
11	86.50	88.85	93.00	90.69	89.76
13	86.60	91.05	90.40	91.29	89.83
15	87.42	90.06	93.83	92.06	90.84
17	87.78	89.65	92.58	92.34	90.58
19	89.12	91.34	92.59	90.48	90.88

PURITY OF JUICE.

Lahaina.

Plat.	1899.	1901.	1903.	1905.	Average.
2	88.76	87.42	90.44	89.63	89.06
4	88.28	84.62	88.59	89.56	87.76
6	89.29	86.14	90.76	89.45	88.91
8	88.62	90.27	91.64	....	90.17
10	88.58	88.66	91.48	90.29	89.75
12	87.18	85.95	91.37	89.75	88.56
14	87.88	89.79	90.71	89.83	89.54
16	89.77	90.50	90.74	90.45	90.36
18	91.41	87.05	92.26	89.19	89.97
20	90.44	90.75	91.05	89.88	90.50

PURITY OF JUICE.

Average of Lahaina and Rose Bamboo.

Plats.	1899.	1901.	1903.	1905.	Average.
1 & 2......	87.70	88.29	90.79	90.55	89.33
3 & 4......	87.49	85.26	90.21	90.21	88.29
5 & 6......	87.57	87.35	91.38	90.59	89.22
7 & 8......	87.95	89.99	91.93	....	89.95
9 & 10......	88.59	88.26	91.82	90.97	89.91
11 & 12......	86.84	87.40	92.18	90.22	89.16
13 & 14......	87.24	90.42	90.55	90.56	89.68
15 & 16......	88.59	90.28	92.28	91.25	90.60
17 & 18......	89.59	88.35	92.42	90.76	90.27
19 & 20......	89.78	91.04	91.82	90.18	90.69

The foregoing tables give very complete data as to the influence exerted by the different fertilizing materials on the quality of the juice of the two varieties of cane. The following summary shows the relative order as regards the average sucrose content and purity of the juice for the Lahaina and Rose Bamboo cane on the separate plats.

RELATIVE ORDER WITH RESPECT TO PURITY OF JUICE.

Rose Bamboo.

Highest Purity, 90.88. Unfertilized plat.
Lowest Purity, 89.53. Complete fertilizer with nitrogen as nitrate of soda.

Order.	Fertilization.	Purity
1	No fertilizer	90.88
2	Phosphoric acid	90.84
3	Nitrogen	90.58
4	Nitrogen and potash	90.07
5	Potash	89.83
6	Potash, phos. acid, nitrogen as sulphate of ammonia	88.82
7	Nitrogen and phosphoric acid	89.76
8	Potash and phosphoric acid	89.73
9	Potash, phos. acid, and nitrogen as dried blood	89.60
10	Potash, phos. acid, and nitrogen as nitrate of soda	89.53

Lahaina.

Highest Purity, 90.50 Unfertilized plat.
Lowest Purity, 87.76. Complete fertilizer with nitrogen as sulphate of ammonia.

Order.	Fertilization.	Purity
1	No fertilizer	90.50
2	Phosphoric acid	90.36
3	Potash and phos. acid	90.17
4	Nitrogen	89.97
5	Nitrogen and potash	89.75
6	Potash	89.54
7	Potash, phos. acid, and nitrogen as dried blood	89.06
8	Potash, phos. acid, and nitrogen as nitrate of soda	88.91
9	Nitrogen and phos. acid	88.56
10	Potash, phos .acid, and nitrogen as sulphate of ammonia	87.76

RELATIVE ORDER WITH RESPECT TO PURITY OF JUICE.

, Average of Lahaina and Rose Bamboo.

Highest Purity, 90.69%. Unfertilized plats.
Lowest Purity, 88.29%. Complete fertilizer with nitrogen in the form of sulphate of ammonia.

Order.	Fertilization.	Purity Per Cent.
1	No fertilizer	90.69
2	Phos. acid	90.60
3	Nitrogen	90.27
4	Potash and phos. acid	89.95
5	Nitrogen and potash	89.91
6	Potash	89.68
7	Potash, phos. acid and nitrogen as blood	89.33
8	Potash, phos. acid and nitrogen as nitrate of soda	89.22
9	Nitrogen and phos. acid	89.16
10	Potash, phos. acid, and nitrogen as sulphate of ammonia	88.29

RELATIVE ORDER WITH RESPECT TO THE PERCENTAGE OF SUCROSE IN JUICE.

Rose Bamboo.

Highest Sucrose, 18.06%. Unfertilized plat.
Lowest Sucrose, 16.20%. Complete fertilizer with nitrogen as dried blood.

Order.	Fertilization.	Sucrose Per Cent.
1	No fertilizer	18.06
2	Phosphoric acid	17.68
	Potash	17.68
3	Nitrogen	17.41
4	Nitrogen and phosphoric acid	17.06
5	Nitrogen and potash	17.00
6	Potash, phos. acid and nitrogen as nitrate of soda	16.98
7	Potash and phosphoric acid	16.91
8	Potash, phos. acid and nitrogen as sulphate of ammonia	16.66
9	Potash, phos. acid and nitrogen as dried blood	16.20

Lahaina.

Highest Sucrose, 18.46%. Unfertilized plat.
Lowest Sucrose, 16.23%. Complete fertilizer with nitrogen as sulphate of ammonia.

Order.	Fertilization.	Sucrose Per Cent.
1	No fertilizer	18.46
2	Phosphoric acid	18.01
3	Potash	17.89
4	Nitrogen and potash	17.45
5	Nitrogen	17.36
6	Potash, phos. acid and nitrogen as nitrate of soda	16.92
7	Nitrogen and phos. acid	16.71
8	Potash, phos. acid and nitrogen as dried blood	16.60
	Potash and phosphoric acid	16.60
9	Potash, phosphoric acid and nitrogen as sulphate of ammonia	16.23

RELATIVE ORDER WITH RESPECT TO THE PERCENTAGE OF SUCROSE IN JUICE.

Average of Lahaina and Rose Bamboo.

Highest Sucrose Content, 18.26%. Unfertilized plats.
Lowest Sucrose Content, 16.40%. Complete fertilizer with nitrogen in the form of dried blood.

Order.	Fertilization.	Sucrose Per Cent.
1	No fertilizer	18.26
2	Phosphoric acid	17.85
3	Potash	17.79
4	Nitrogen	17.39
5	Nitrogen and potash	17.23
6	Potash, phos. acid and nitrogen as nitrate of soda	16.95
7	Nitrogen and phos. acid	16.89
8	Potash and phos. acid	16.76
9	Potash, phos. acid and nitrogen as sulphate of ammonia	16.45
10	Potash, phos. acid and nitrogen as blood	16.40

The difference between the highest and lowest purity of the juice of Rose Bamboo cane was 1.35 per cent.; with Lahaina cane, the difference between the maximum and minimum purities was 2.74 per cent. With both varieties the purest juice was obtained from the cane on the unfertilized area. The lowest purity of Lahaina juice was obtained from the cane on the plat receiving potash, phosphoric acid and nitrogen, the latter ingredient being in the form of sulphate of ammonia. The Rose Bamboo cane yielded a juice of lowest purity on the area treated with potash, phosphoric acid, and nitrogen with the last ingredient in the form of nitrate of soda. The application of phosphoric acid alone resulted in a juice from each of the two varieties which stood second to that of the unfertilized plats. Nitrogen alone gave a juice from Rose Bamboo cane standing third in the relative order, while with Lahaina the juice of this plat ranked fourth. In general the unfertilized plats and those receiving incomplete fertilizers yielded juices of greater purity than those plats to which the three elements were applied together. The average of Lahaina and Rose Bamboo juices shows an exception to this general statement in respect to plats receiving nitrogen and phosphoric acid, potash being omitted.

The difference between the maximum and minimum sucrose percentages of the juice from Rose Bamboo cane was 1.86 per cent.; with the Lahaina variety this difference was 2.23 per cent. The richest juice from each variety was expressed from the cane on the unfertilized plats. The plats receiving phosphoric acid and those treated with potash come next in order. With Rose Bamboo cane the average percentage of sucrose in the juice obtained with phosphoric acid fertilization was identical with that where the cane received potash alone. The sucrose content of the juice of Lahaina cane receiving phosphoric acid showed a gain of only .12% over cane receiving potash separately. Nitrogen alone gave juices above the average quality. As with the relative purities of the juice it will be noted that the percentage of sucrose drops with the application of complete fertilizers.

The yields of sugar per acre are now given, attention being called to the fact that for Plats Nos. 7 and 8 receiving potash and phosphoric acid, the average results are for three crops instead of four as in the case of other plats. The average results of Plats Nos. 7 and 8 do not permit a fair comparison with the four crop averages of the other plats and a proper allowance must therefore be made.

WEIGHT OF SUGAR PER ACRE. (POUNDS).

Rose Bamboo.

Plat.	1899.	1901.	1903.	1905.	Average.
1	27,375	23,406	19,953	18,058	22,198
3	29,189	25,832	22,400	22,011	24,858
5	25,088	27,401	22,834	22,305	24,407
7	28,149	23,266	21,128	.....	24,181
9	28,669	21,830	22,246	18,229	22,743
11	26,047	30,580	20,127	19,386	24,035
13	26,330	23,275	17,158	11,748	19,628
15	22,186	27,210	15,267	10,737	18,850
17	26,147	25,613	18,254	16,493	21,626
19	22,407	18,886	17,993	10,546	17,458

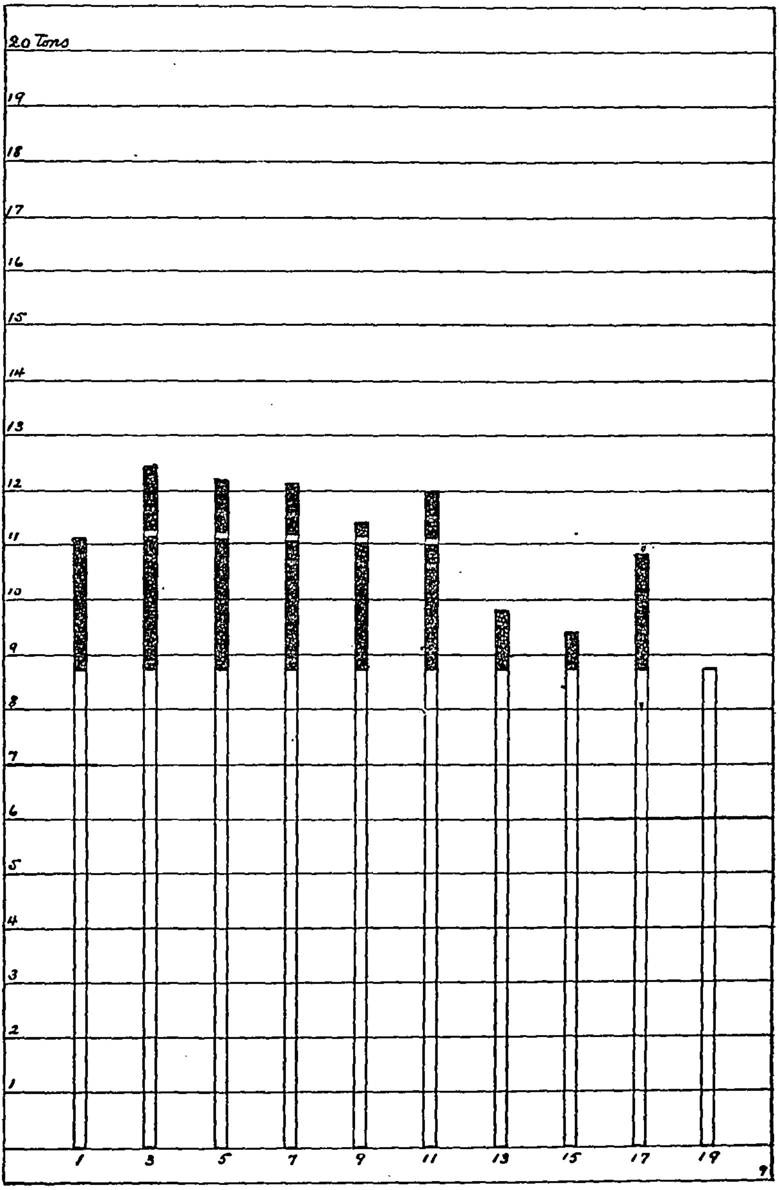
WEIGHT OF SUGAR PER ACRE. (POUNDS).

Lahaina.

Plat.	1899.	1901.	1903.	1905.	Average.
2	23,603	29,601	22,254	24,545	25,001
4	23,687	34,199	19,262	24,377	25,381
6	24,014	35,153	21,262	22,477	25,726
8	21,933	21,278	20,555	.....	21,255
10	25,791	40,186	21,231	24,207	27,854
12	22,885	26,346	20.074	22,549	22,964
14	24,072	24,695	14,357	13,469	19,148
16	21,499	18,068	15,392	13,140	17,025
18	24,780	23,649	22,031	20,617	22,769
20	21,257	23,285	17,525	13,835	18,975

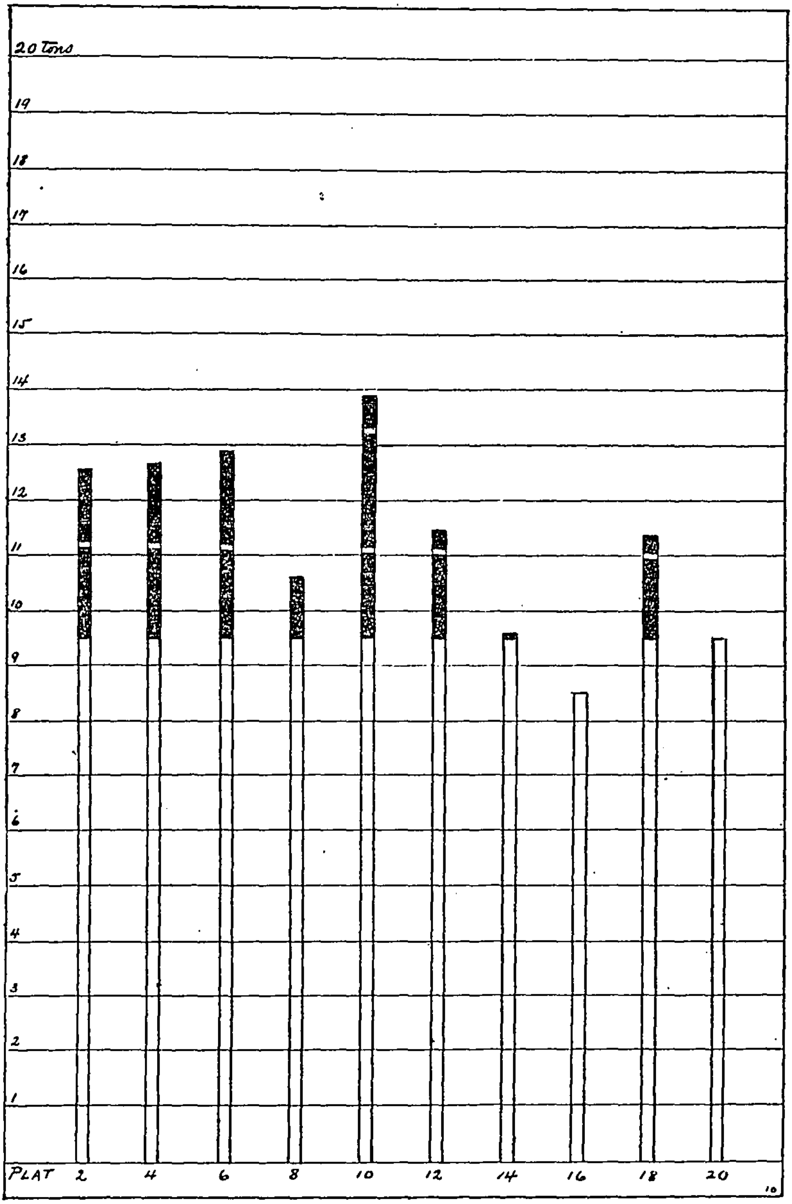
WEIGHT OF SUGAR PER ACRE.

Rose Bamboo.



WEIGHT OF SUGAR PER ACRE.

Lahaina.



WEIGHT OF SUGAR PER ACRE. (POUNDS).

Average of Lahaina and Rose Bamboo.

Plats.	1899.	1901.	1903.	1905.	Average.
1 & 2.....	25,489	26,503	21,103	21,301	23,599
3 & 4.....	26,438	30,015	20,831	23,194	25,119
5 & 6.....	24,551	31,277	22,048	22,391	25,066
7 & 8.....	25,041	22,272	20,841	.....	22,718
9 & 10.....	27,230	31,008	21,738	21,218	25,298
11 & 12.....	24,466	28,463	20,100	20,967	23,499
13 & 14.....	25,201	23,985	15,757	12,608	19,388
15 & 16.....	21,843	22,639	15,329	11,938	17,937
17 & 18.....	25,463	24,631	20,142	18,555	22,197
19 & 20.....	21,832	21,085	17,759	12,190	18,216

The significance of these results may probably be better illustrated by the following diagrams showing the sugar yields for the two varieties of cane. At the extreme right of each of the diagrams the quantity of sugar produced on the unfertilized area is shown, the shaded portion of the other bars indicating the gain in production following the application of the different fertilizing materials.

With Rose Bamboo cane the greatest average yield for four crops was 24,858 pounds of sugar, produced on the plat receiving a complete fertilizer with nitrogen in the form of sulphate of ammonia. This quantity shows a gain of 7,400 pounds over that produced on the unfertilized plat. The smallest average yield of the fertilized plats was 18,850 pounds, obtained where phosphoric acid was applied alone. The gain in this instance amounted to 1,392 pounds. The Lahaina variety gave its greatest yield on the plat to which a mixture of nitrogen and potash was applied. The gain in this case amounted to 8,879 pounds. Phosphoric acid alone produced 17,025 pounds of sugar or a loss of 1,950 pounds or practically one short ton.

The application of nitrogen was followed by a material gain in the case of each variety, the increased yields for Lahaina cane being 3,794 pounds and for Rose Bamboo cane 4,168 pounds of sugar. The analysis of the Station soil showed a comparatively small amount of nitrogen and a material gain following the use of this element as a fertilizer was expected. Phosphoric acid was found to exist in the Experiment Station soil in quantities far in excess of those found in the average island soils. The use of this material alone gave an average gain of 1,392 pounds of sugar for Rose Bamboo and a loss of

1,950 pounds for Lahaina. Potash which was present in the Station soil in quantities slightly below the average for the islands gave a gain with the Rose Bamboo variety amounting to 2,170 pounds of sugar; with Lahaina cane this element produced an increased yield amounting to 173 pounds.

With Rose Bamboo cane the combined application of nitrogen and phosphoric acid gave an increased production of sugar amounting to 6,577 pounds. This fact is of interest insomuch as phosphoric acid alone only increased the yield by 1,392 pounds, and nitrogen alone showed a gain of 4,168 pounds. When equal weights of these two elements were added together instead of a resulting gain of 5,560 pounds, which quantity is the sum of the separate gains following the use of individual elements when applied alone, this figure was increased by 1,017 pounds. Applying nitrogen and phosphoric acid together to Lahaina cane resulted in an increase of 3,989 pounds of sugar. Nitrogen alone gave a gain of 3,794 pounds, and phosphoric acid alone a loss of 1,950 pounds.

Nitrogen and potash used together increased the Rose Bamboo yields by 5,285 pounds, or 1,117 pounds more than where nitrogen was applied alone, and 3,115 pounds more than where potash was applied separately. Potash applied alone to Lahaina cane only caused an increase of 173 pounds, but when applied with nitrogen the resulting gain was 8,879 pounds. In this case the increase in production from the combined use of nitrogen and potash was more than twice the sum of gains resulting from the use of the two elements individually.

Where complete fertilizers were used, the average yields were about the same when the nitrogen was in the form of nitrate of soda or sulphate of ammonia. Dried blood appeared to be inferior to the other nitrogenous ingredients for Rose Bamboo cane.

To note the relative effect of potash and phosphoric acid applications when these two elements were used together, as compared with the results obtaind when used individually, it will be necessary to consider the average yields obtained for the crop of 1899, 1901 and 1903; this owing to the fact, as previously stated, that plats 7 and 8 were not carried through the last crop period. The average production of sugar per acre obtained with the Rose Bamboo and Lahaina varieties was as follows:

WEIGHT OF SUGAR PER ACRE. (POUNDS).

Average for three crops.

Rose Bamboo.

Plat.	1899.	1901.	1903.	Average.
1	27,375	23,406	19,953	23,578
3	29,189	25,832	22,400	25,951
5	25,088	27,401	22,834	25,107
7	28,149	23,266	21,128	24,181
9	28,669	21,830	22,246	24,248
11	26,047	30,580	20,127	25,584
13	26,330	23,275	17,158	22,254
15	22,186	27,210	15,267	21,554
17	26,147	25,613	18,254	23,338
19	22,407	18,886	17,993	19,762

Lahaina.

Plat.	1899.	1901.	1903.	Average.
2	23,603	29,601	22,254	25,152
4	23,687	34,199	19,262	25,716
6	24,014	35,153	21,262	26,809
8	21,933	21,278	20,555	21,255
10	25,791	40,186	21,231	29,069
12	22,885	26,346	20,074	23,101
14	24,072	24,695	14,357	21,041
16	21,499	18,068	15,392	18,319
18	24,780	23,649	22,031	23,486
20	21,257	23,285	17,525	20,689

WEIGHT OF SUGAR PER ACRE. (POUNDS).

Average of Rose Bamboo and Lahaina for three crops.

Plats.	1899.	1901.	1903.	General Average.
1 & 2	25,489	26,503	21,103	24,365
3 & 4	26,438	30,015	20,831	25,761
5 & 6	24,551	31,277	22,048	25,958
7 & 8	25,041	22,272	20,841	22,718
9 & 10	27,230	31,008	21,738	26,658
11 & 12	24,466	28,463	20,100	24,343
13 & 14	25,201	23,985	15,757	21,647
15 & 16	21,842	22,639	15,329	19,936
17 & 18	25,463	24,631	20,142	23,412
19 & 20	21,832	21,085	17,759	20,225

With Rose Bamboo cane phosphoric acid alone gave a gain of 1,792 pounds over the unfertilized plat. Potash used separately gave an increase of 2,492 pounds. The combined use of the two materials gave a gain of 4,419 pounds or only 135 pounds more than the sum of the gains following the use of the elements individually. Potash and phosphoric acid applied together gave almost as large a yield as nitrogen and potash together, the difference being only 67 pounds of sugar.

If we let the gain from nitrogen be represented by N, that of potash by K, and that of phosphoric acid by P, we would have the following values:

N=3,576 lbs.
K=2,492 "
P=1,792 "

If the gains in sugar resulting from the application of fertilizing elements were equal to the sums of the gains following the application of the respective elements individually, then the value of different combinations would be:

N+K= 6,068 lbs.
N+P= 5,368 "
K+P= 4,284 "
N+K+P=7,860 "

When mixtures of the elements are applied, however, very material departures from such calculated yields are often manifested—differences which are due to the association of the different elements. The presence of considerable quantities of one plant food material in an available form may cause more of another to be appropriated by the cane than would be the case were the former present in only small quantities, owing to the supplementary action of different elements in the processes of plant growth. In a general way the fertility of a land (leaving aside the consideration of mechanical condition) is determied by the quantity of that element which is relatively deficient. Again, the fact that ordinary fertilizing ingredients when applied to the land cause other materials to become available for the use of plants, results in many complicated reactions in the soil which are not thoroughly understood but which nevertheless exercise a considerable influence upon crop development.

To measure the effect on the growth of Rose Bamboo cane due to the association of the various fertilizing elements under consideration, it will be necessary to compare the actual gains obtained following the application of the different combinations, with the sum of the gains resulting from the separate use of the component parts of the combination. This may be shown as follows:

INFLUENCE ON YIELDS DUE TO ASSOCIATED APPLICATION OF ELEMENTS.

Rose Bamboo.

Combination of Elements.	Actual Gain. Lbs.	Calculated Gain. Lbs.	Difference. Lbs.
N+K	4,486	6,068	—1,582
N+P	5,822	5,368	+ 454
K+P	4,419	4,284	+ 135
N+K+P	5,116	7,860	—2,744

With Lahaina cane, phosphoric acid applied separately resulted in a loss in yield amounting to 2,370 pounds; potash showed a gain of 352 pounds. Applied together potash and phosphoric acid gave an increased yield of 566 pounds.

To ascertain the influence on yields due to the associated application of elements to Lahaina cane the following values may be used:

N= 2,797 lbs.
K= 352 "
P=—2,370 "

Combining these values and comparing them with the actual yields, we have:

Lahaina.

Combination of Elements.	Actual Gain. Lbs.	Calculated Gain. Lbs.	Difference. Lbs.
N+K	8,380	3,149	+5,231
N+P	2,412	427	+1,985
K+P	566	—2,018	+2,584
N+K+P	5,203	779	+4,424

In the case of both the Rose Bamboo and Lahaina varieties, the calculated gain for the complete fertilizer is found by averaging the increase in sugar obtained on the three plats to which the three elements were jointly applied, the nitrogen in each plat being in a different form.

It is noted that the Lahaina cane not only showed a different response to the application of the various fertilizing ingredients, as compared with Rose Bamboo, but also that the influence exerted through the association of elements was materially greater for the Lahaina than for the Rose Bamboo cane.

(To be Continued.)

HISTORICAL REVIEW OF THE PHILIPPINE SUGAR INDUSTRY.

U. S. GOVERNMENT REPORT ON THE PHILIPPINES.

In a historical review of the sugar industry of the Philippines in the light of its export trade we are confronted by figures altogether different—the outgrowth of conditions altogether different—from those of hemp. While hemp with the strong position of a natural monopoly grew with a steadily increasing output from year to year, the sugar of the islands with no other distinction in the markets of the world than the discrediting one of its generally inferior quality, has shared to the full in the losing struggle that has been the lot of cane sugar throughout the world during the past quarter of a century, and besides has suffered from the many changes of conditions peculiar to the Philippines, which have combined to make the history of the industry in more recent times a gloomy one indeed; and the export figures amply bear out the general report of the Philippine sugar industry being in a serious state of decadence.

In earlier days, however, when beet sugar was yet unknown as a factor in the world market, when the cane product of tropical countries had no competition, and when crude and wasteful methods were the rule—it was then that the Philippine industry prospered. But with the coming of the powerful and unequal competition of European bounty-fed sugars that has all but forced into bankruptcy so many tropical sugar-producing countries the Philippine industry lingered on in a struggle for existence. Growth ceased, the old primitive and wasteful methods largely persisted in a competition grown so keen that only the greatest economy in production made success possible, and the way was paved for the collapse that has overtaken the industry in the past few years.

The period 1855 to 1870 seems to have been a prosperous one for the Filipino sugar producer. Prices ruled higher than during any subsequent period, though there was but slight increase in exports, which ranged from about forty to fifty thousand tons throughout. One reason for this slight response to the stimulus of good prices is doubtless to be found in the remoteness of the Philippines from the sugar consuming centres of the world. With the opening of the Suez Canal this remoteness in a large measure vanished, and exports leaping very soon to a hundred thousand tons, almost doubled that figure within ten years of the opening of the new highway. From the late sixties to the early eighties sugar exports had quadrupled, with prices fairly constant at about three cents a pound, and this may be deemed the golden era of the sugar industry in the Philippines.

The exports of the early eighties were in the neighborhood of 200,000 tons, but in the meantime changes were coming about on the other side of the world to set a limit to the further expansion of the Philippine industry. Germany was nearly doubling her exports of beet sugar yearly and paving the way to what is known as the sugar crisis of 1885, and to the establishment of a new low record of prices which would prove disastrous to the insular industry and make the succeeding years a struggle for existence.

Prices had begun to fall before 1885, and the three succeeding years, according to consular reports, were characterized by great depression in the industry, with further declines in prices and persistently diminishing exports. Reaction followed, and prices and exports fluctuated throughout the closing years of Spanish rule, but never again reached the figures that prevailed prior to 1880, and though much has been said of the heavy exports of 1893, the banner year of the industry, amounting to 257,389 tons, it should be stated that in a crop as uncertain as sugar, which often shows a doubling or halving of exports due to climatic conditions, the significance of a single year's figures are to be discounted. An averaging of quinquennial periods from 1880 shows that while there was a slight increase down to the close of the Spanish regime, it was relatively slight, and 200,000 tons may be taken as a rough but fair approximation of the annual trade throughout.

We have thus a summing up of the industry in three stages; a period of exceptional prices but of small exports in pre-Suez days; a period of remunerative prices, great activity, and rapid growth under the stimulus of access to the world markets—not yet surfeited by over-production; and a period of low prices for fifteen years with a nominal increase in exports during which the industry finds it yearly harder with its primitive methods and low-grade product to hold its own in the world market.

In the stress of hot competition that the sugar industry of the world has undergone since 1885, the preponderating weight of scientific invention and improved methods seems to have been on the side of beet sugar in the matter of economic production. While cane sugar has also made advances in this respect, the fact that it is in the main a product of tropical and less progressive peoples explains no doubt the slower progress that improved methods have made in this branch of the industry. In this particular it would seem that the Philippines have lagged behind all other tropical countries. At least it appears that in this era of competition, when economic production grew paramount, the old stone mill with its extraction of 40 per cent. of the weight of the cane in juice and the old open kettle, with its distinctly Philippine and low grade product still remained large factors in the industry. The fact that Philippine sugar production was able to hold its own after 1885—and even make slight gains—under such a handicap of antiquated methods is only to be explained on the basis of the cheapness of labor, which made a measure of profit still possible and saved the industry from extinction or the alternative necessity of the extensive inauguration of the improved methods of more progressive countries.

Such was the condition of the Philippine sugar industry as inherited by the United States in 1898—an industry operating with antiquated equipment and the crudest methods in competition with modern science and progress, engaged in a losing struggle for nearly two decades, and subsisting only through labor conditions as oriental and primitive as its equipment. If to this we add that other American heritage from Spain, of insurrectionary disorder and other ills of plague and famine that have since afflicted the islands, we find no difficulty in explaining the collapse of the Philippine sugar industry in American times.

This collapse, as evidenced by the export figures, amounts to a shrinkage from the average of 200,000 tons of the closing decades of Spanish rule to exports in American occupation that have not amounted in any year to half this amount, and we must go back thirty years in the industry, in the earliest years of the opening of the Suez Canal, to find an analogous period in the smallness of the islands' sugar production.

This shrinkage of over half in sugar exports coincident with American occupation has been generally credited to insurrectionary disorders. Much stress has been laid on the actual destruction of sugar plants and equipment; great weight has been attributed, and no doubt justly, to the scourge of rinderpest leaving the islands without draft animals; but in view of the general condition of the industry above stated, it would seem that the ultimate reason lies deeper and that these, however immediately cogent, are only incidental and subsidiary to it.

With the industry characterized by primitive and wasteful methods and based on oriental labor conditions, and yet for a period of years scarcely more than holding its own against the bounty-fed and scientifically produced article of Europe, it is easy to see how without any disturbance of labor conditions it must inevitably perish. The advent of the United States in the islands is considered to have marked a new political era, but that it should at the same time inaugurate a new industrial era was inevitable. That the new era should manifest itself most forcibly in the primitive, but at the same time the most highly organized industry of the islands, was only natural; and that its effect should be disastrous is unfortunate, but it is the general penalty that extreme cases for regeneration must be preceded by destruction, and the Philippine sugar industry seems simply to be undergoing the drastic preliminaries of a reorganization on a modern basis.

From all sides comes the report that wages have doubled in the islands under American rule. On the other hand, a study of sugar exports shows no such increase in prices, and for result we have the above noted shrinkage in exports to half their former volume. Consular reports and other information for the years succeeding 1885 are all to the general effect that sugar, once a profitable industry, no longer pays more at best than a bare margin above cost of production and interest on investment, and the fact of the slight increase in exports would seem to indicate that the planter found little encouragement to extend his acres and increase his output, but was rather merely clinging on to his investment—keeping his machinery in order and his land from growing up in brush—while he hoped and waited for better times.

With the so-called "demoralization of labor" attending the American occupation that perhaps might be better named "increase in wages," the sugar planter has found it impossible to cling longer to his antiquated method of production and keep his mill going. There is not enough margin of profit with which to meet the new scale of wages, hence the dismantled mills and over-grown plantations frequently referred to, with a corresponding shrinkage in exports. While no doubt there were *haciendas* devastated during the insurrection, and there was a scarcity of carabao to start the old mills revolving again, the real cause of the situation seems to be economic, and the future of the Philippine sugar industry depends on its reorganization upon a modern basis to meet the new standard of wages.

That Philippine sugar cane would be entirely adequate under other conditions to this increased demand upon its output and could compete with the beet and cane product of other countries, admits of no doubt. In an interesting survey of the Philippine industry by United States Consul Webb, in 1889, he states that with the stone and wooden mills of the islands only about 40 per cent. of the weight of the cane is expressed in juice and shows how the low grade Philippine sugar could be doubled in value by the use of the improved methods of his day. By all accounts, the conditions which he described have not since greatly mended, and it is obvious that between the sugar that is thus burned up in the bagasse and what is lost by unintelligent production of what is one of the lowest grade sugars on the world market, there would be ample to pay the laborer his increased wage as well as to restore the industry to some measure of its former prosperity.

Among the countries who have been purchasers of Philippine sugar the United States and the United Kingdom occupy the most conspicuous position, as was the case in the hemp trade. In the earliest years the exports to the United Kingdom were much in excess of those to the United States; Australasian trade being in years immediately following 1855 generally second to the British. But Australia loses continuous importance after 1862 and gives place to the United States, figuring at irregular intervals during the next twenty years and virtually disappearing with the extension of Australian sugar production. The exports to the United States suffer a slight temporary decline during the war period of 1861-1863, to rise again to about the old level in 1864; but British trade is still dominant, and not until in 1873, or in the interval between that year and 1867, for which no official figures are available, does that active competition begin which has figured so largely in Philippine sugar exports. The cause of this great increase in American purchases is obscure, but was perhaps in some measure due to the reduction of the heavy war tax on imported sugar which took place about that time. British and American trade is well balanced from 1873 to 1880, and the two countries take very nearly all of the exports. From the latter year the British purchases suffer a decline and for ten years, with the single exception of 1881, they take a subordinate place, while the cargoes for America represent more than half the total exports and amount to over 100,000 tons in most years.

1890 witnesses a transposition of the lead, with a slight reaction in favor of the United Kingdom and a drop to less than forty thousand tons purchased by the United States. This sudden decline was due to the McKinley act of that year, placing sugar on the free list (with a bounty on the domestic product), under which the American importer was free to purchase in all markets at equal terms, whereas he had previously been taxed according to the quality. The immediate effect was that the low-grade sugar of the Philippines, which had enjoyed the quasi-protection of a lower import duty, was abandoned for the superior product of the Dutch East Indies and Philippine sugar lost a market of twenty years' standing and has never since regained it. American purchases were but a paltry ten thousand tons of the 257,389 tons exported in the banner year 1893, and in the first years of the reduced figures of American times took even smaller quantities, though in 1903 and 1904 there was a reaction and the United

States is credited with about a third of the islands' total sugar exports.

The United Kingdom, as has been stated, showed an increased interest in Philippine sugar in 1890 and in the next few years again becomes—as she was in the opening years of the half-century under review—the leading country in the trade, with purchases ranging from a third in intervening years to more than a half of the unprecedented exports of 1893. Her trade, however, seems to have undergone another decline in the succeeding unrecorded period of the closing years of Spanish rule, and in American times the British purchases of Philippine sugar have virtually ceased. All indications seem to point to the final disappearance of this long established and important market for the islands' product, but without seeking for reasons for this it is enough to say that it is quite in line with the general trend of the British trade. Thirty-five years ago three-fourths of British consumption was cane sugar and the United Kingdom was a power in the tropical trade, but with the development of beet sugar nearer home she seems to have turned more and more from her older sources of supply to the new, and in recent years cane sugar has furnished only about 10 per cent. of her needs.

This shifting of the destination of Philippine sugar from these two countries which formerly took the bulk of it, calls attention to the new market that has been found for it in recent times in the Orient. It has been seen how American tariff legislation operated to disturb the old and established demand in the United States, and probably freight rates have been a factor in the British patronage of European sources of supply. The sugar exports to these countries that have since been taken over by near-by demands in the East is due, it has been said, to a recent and surprising development in a taste for sugar by the oriental. However this may be, the figures show that China was not a direct importer of Philippine sugar with any regularity until the American occupation, and Japan's imports become constant and considerable only after 1890, growing rapidly in importance and showing an average of about 25,000 tons in recent times.

Conspicuous among the minor takers of Philippine sugar throughout the past seems to have been Hongkong, though lost under the guise of "British Possessions," or China, according to the system of Spanish classification at different periods. This trade, however, does not assume, any relative importance until 1885. From that year down to the present, amid the various changes and declines of American and British trade, these shipments have presented a very constant figure of about 35,000 tons annually, and amounting to 28,605 tons in the present year are the leading feature in the total. There is reason to believe that the most of this sugar was simply in transit for Chinese consumption, as these exports, together with those for Japan, and the direct shipments to China have made up the great bulk of the trade during American occupation, though to a less degree in the past two years owing to the increased shipments to the United States previously referred to. Thus it may be said in general terms that from 1885 Philippine sugar has been strengthening its position in the Oriental market, and with the decline of the older Anglo-Saxon demand, has intrenched itself in recent years nearer home.

Of the exports of the present year the United States is credited with slightly less than a third, Hongkong with a little above a third, while the remainder is nearly equally divided between Chinese direct shipments and Japan. Two-thirds of the sugar trade is therefore Oriental at the present time, and it was even more largely so prior to 1903. The increased shipments to the United States in the past two years seem to have been of the nature of experiments, and unsuccessful experiments, as brought out in the recent hearings before the Ways and Means Committee of the House. But with this large field and rapidly increasing demand for sugar in the East, it seems probable that freight rates and the already established use there of the lower grade Philippine sugar will become factors in the continuance of the present current of exports to these newly-opened and near-by markets. The experiments above referred to are too recent for statistical inferences to be ventured upon with much confidence, but it may be worthy of note that in the data available for only two years United States imports in the present year show a slight decline from those of the first year under tariff concessions in total sugar exports that show a slight increase, and such evidence as this offers goes to confirm the above statement of the unsuccessful character of these recent shipments to America, as well as the probability that Philippine sugar is destined for the future to find its best market in the Orient.

The future of the Philippine sugar industry, in spite of the discouraging figures presented during American occupation, is not without its encouraging aspects. It is quite probable that the industry will never again figure as the leading source of the islands' export wealth, as it did prior to the last decade of the Spanish occupation. The lead taken from time to time by hemp, which has since grown to represent two-thirds of the total exports of the islands, is too strongly rooted in the exceptional nature of the commodity to ever again suffer serious rivalry from sugar. But that there will be a reaction, and that it will ultimately be placed on an even more prosperous basis than during the closing years of the Spanish regime, is not only a matter for hope, but for reasonable anticipation. The recovery of the industry from its present unfortunate condition may not be until many years and a hard struggle, especially if no aid is extended to it, but so long as cane flourishes in Negros, Panay and Batangas as it does, the extinction of the industry by force of untoward conditions in the face of its natural advantages seems scarcely possible.

A very encouraging factor in the situation is the result of the Brussels Convention in putting an end to the artificial advantages given beet sugar under the bounty system of Europe. This does away with the disadvantage under which cane sugar has labored for many years, which arrested the development of the Philippine industry in the latter years of Spanish rule and which paved the way to its collapse in present times. At no time since the competition of beet sugar became a factor has the outlook of the cane industry of the world been brighter than it is at present.

It is a well-known fact that the tropical cane sugar producer, under the disadvantages of cruder methods, but with the benefit of a cheap labor market, is in a position to meet the beet sugar manufacturer with his highly organized art and asks only for a fair field and no favor. The Brussels Convention would have given a great impulse to the Philippine industry in the eighties and nineties, but, as has been previously said, conditions are no longer the same. The cheap labor market has undergone a change in American times, and may be expected to show further advances under the influence of the higher American ideals and standards of living more and more down among the people. For this reason the changes produced by the Brussels Convention seem scarcely adequate even to put the industry upon a basis to exist under its new conditions, still less to stimulate it to the measure of its former productiveness. A realization of this by the friends of the islands and those with a keen sense of our national honor being pledged to see that the archipelago and its industries fare at least as well as under Spanish rule has led them to turn elsewhere for a further stimulus to rehabilitate the suffering industry.

As has been previously stated, this rehabilitation can only come through a reorganization of the industry on modern lines that will save present waste to meet advancing wages. The burning of a large part of the yield in the bagasse, and the production of one of the most inferior sugars of commerce, when care and additional capital would transform it into a superior quality, are things that must end in the face of wages that are beginning to cease to be tropical and oriental. For this reorganization a large outlay of capital is necessary. Much must be discarded, and a general remodeling take place in an industry that under modern conditions requires an excessive capitalization for economic production. This need of capital was a constant cry in Spanish times, and the rates of interest exacted from an industry so precariously situated absorbed what should have been its legitimate profits. This seems to be the condition today. We hear of short loans at enormous rates, and of long loans for improvements practically unobtainable for an industry that is at present in such a precarious condition.

The relief for such a state of affairs is to be found in measures for the restoration of confidence in the industry, and thus far the only adequate method offered lies in the extension of further tariff concessions to Philippine sugar, thus granting it an assured profit in the world market, interesting the capitalist, reassuring the money-lender and making possible the payment of higher wages by the planter, and the installation of improved machinery and inauguration of economic production.

The plan seems to meet with general approbation, apart from the American sugar producer, whose supersensitiveness of the results in a sharing of the protection he enjoys, and whose fears at the shadow of a possible competition are the natural consequence of the special privileges he has long enjoyed. But while it is not necessary to inquire into the merits of his overdrawn apprehensions of the pressure of the Philippine product upon American sugar, it may be noted that the present United States consumption of foreign sugar is more than six times the total exports of the archipelago in its best year, and about twenty times the present exports, while on the other hand, there is the reasonable assumption that under further tariff concessions the demands of the oriental market will still be a factor in the appropriation of the islands' exports, but with the benefit of higher prices to the producer. With every reasonable allowance for an exceptional development in the Philippine sugar industry as the outcome of tariff favors extended to it, it is difficult to conceive how it could increase its output so as to take the place of present American consumption of foreign sugars and begin to press upon the domestic product within the generation which has been set as the probationary period of American occupation, and to the next generation, who will have to pass upon the ultimate destiny of the islands, it seems we may leave the present fears of the American sugar interests.

In the meantime, the figures under review raise an immediate question. Many criticisms have been made of the Spanish policy in the islands, and one has been of that policy which operated to discourage their industrial development and the growth of manufactures that would militate in any way against those of the mother country. In the face of these export figures in American times and the above-mentioned opposition, the question is whether with American responsibility for the welfare of the islands, it will be American policy, at the demand of powerful domestic interests, to sacrifice these rich natural possibilities of the islands to the vague fear of these interests, and let the sugar industry sink still farther below the moderate degree of prosperity and productiveness enjoyed under Spain.—From Louisiana Planter.

SUGAR IN CUBA.

About half of all our sugar comes from this island. We paid Cuba $42,000,000 for short sweetening last year, and we shall pay more in 1905, as the prices are higher. Cuba produces about half of all the cane sugar made upon earth, and she has some of the biggest sugar plantations. For the past two weeks I have been traveling through the interior and have had a chance to get an idea of this great industry.

Cuba has several hundred million dollars invested in sugar plantations. She has in the neighborhood of 200 which are now in active operation, and along the line of the Cuba railroad the forests are being cleared and cane set out. About Nipe bay, the new harbor at the northeastern end of the island, a syndicate of Boston capitalists has purchased more than a hundred thousand acres of land and is about to build what I am told will be the biggest sugar factory ever constructed. It will cost in the neighborhood of $2,000,000 and it will have a capacity of about 3,000 bags of sugar per day. A bag of sugar weighs a little more than 300 pounds. It will just about fill a barrel, so that 3,000 barrels will give you some idea of the mill's capacity. There are at present a number of mills here that are turning out a thousand bags per day, and there are many plantations worth $1,000,000 and upward. Indeed, a big sugar estate, including its mill, lands and houses, is a $2,000,000 proposition, and the modern sugar mill alone as it is in Cuba costs from $500,000 to $1,000,000. The machinery of a mill that will make 1,000 bags a day will cost half a million dollars, and the buildings, yards and other things two or three hundred thousand dollars more.

Sugar is now being grown in nearly every province of Cuba. About half the land cultivated is devoted to that crop, and there are vast areas, which will yield cane, yet to be set out. I have before me a list of the working plantations. Beginning at the west is the province of Pinar del Rio, which is noted as having the best tobacco lands upon earth and which produces the famed Havana cigars. It has only seven sugar plantations, and it will make about 100,000 bags of sugar this year. One of its plantations belongs to Americans, four are Cuban, one French and one Spanish. In Havana there are 20 plantations, chiefly owned by Cubans and Spaniards, and in Matanzas, from where this letter is dated, just east of Havana, there are 52 plantations, of which six belong to Americans. One of the American companies annually produces 60,000 bags, another 80,000, and another 125,000 bags. Matanzas has some of the best sugar territory, but its lands have been worked for generations and may be surpassed by the new estates now being cut out of the woods. The total output of these provinces will be in the neighborhood of 3,000,000 bags, or, in round numbers, something like 900,000,000 pounds of sugar. Santa Clara province which lies east of Matanzas has 70 plantations, of which 17 are American, three British, 18 Spanish and 32 Cuban. Most of these plantations are very large, and some of the largest belong to Americans. The Emilo Terry plantation, which is Cuban-American, will produce 210,000 bags this year. The Colonial Sugar company will produce 175,000 bags, and there are several other American estates which will yield from 80,000 to 150,000 bags each. In the eastern end of the island there are other American plantations, and along the northern coasts are the Boston Central estate, belonging to the United Fruit company, which will have an output of 170,000 bags, and the Chaparra estate, which will turn out 250,000 bags. In the central province of Puerto Principe there are only four sugar plantations now opened, but one of these belongs to an American, and it will produce all told about 27,000,000 pounds of sugar this year. There are altogether more than $25,000,000 of American money invested in sugar mills and working cane lands in Cuba, and this is to-day probably yielding a bigger profit than any other American money abroad.

The sugar which we now get from Cuba comes from old plantations, and the greater part of it is from Santa Clara, Matanzas and Havana. The increase in the crop of the future will come from the eastern part of the island, which has been opened up by the Cuba railroad, built from Santa Clara to Santiago, by Sir William Van Horne, and running along Cuba's backbone. This country is now covered with forest. One rides for miles through nothing but woods, woods, woods, but the woods cover land as rich if not richer than any now devoted to sugar and land which has the virtue of never having been farmed. In going over the road I saw a number of places where new sugar plantations were being cut out of the woods. The largest is at Jatebonico, where something like 3,000 acres have been cleared and planted in cane and where a sugar mill is now building. A few months ago this was nothing but forest. The Cuba company put in its men, and cut down the trees. A couple of months later the ground was burned over and the cane is now growing among the stumps and logs left from the fire. By the time it is ready for cutting the mill will have been completed, and the cane will be carried on little plantation railroads direct from the fields. It is the intention to put in about 6,000 acres of cane for this mill alone. Similar mills will be built at other places along the road, and one especially is soon to be constructed to supply the sugar estates of a Michigan syndicate which has bought a large tract of land a short distance from Camaguey along the line of the railroad. As it is now, not half the lands fitted for sugar have been reduced to cultivation, and it has been estimated that the sugar product of Cuba might be quadrupled and not use all the available sugar lands.

Cuba can produce sugar cheaper than any other country. The plantation at Jatobonico, which I referred to, will continue to produce cane for fifteen or twenty years without replanting. There are plantations here which have produced for twenty-five years from one setting out, and it is said that cane has grown forty and even more years on the same ground, being cut off year after year and sprouting up again from the old stalks. No one thinks of replanting cane here for five, ten or fifteen years after the plantation has been first set out, and on this new ground all that is needed is to plant and keep out the weeds, and the crop goes on for years without other cultivation.

In many other countries the cane has to be planted every-third year, and I know of no place where it will last as long as in this. I have made some inquires as to what it costs to produce sugar in Cuba, and the estimates are about a cent or a cent and a quarter a pound. Beet sugar costs in most places two or three cents a pound, and such sugar will have to be sold at three and a half cents a pound to make a fair profit. Now, inasmuch as there is more beet sugar in the world than cane sugar, this means that the price must be fixed by the former, and that it cannot be less than the amount above mentioned. At that rate Cuba can make sugar and pay dividends on its plantations. At the present prices it is receiving more than ever before. The crop for 1905 will be worth $30,000,000 or $40,000,000 more than ordinary, and as a consequence the sugar industry is booming and there is likely to be an overproduction. The chief trouble here is the lack of labor. This year they have not had enough men to harvest the crop, and in some places it has rotted on the ground. The most of the labor on the sugar estates is done workmen, and a considerable immigration is now coming in from the Canary islands and the northern part of the Spanish peninsula. These men are thrifty and industrious, and Cuba is doing all she can to encourage their coming. Wages are good. About Havana they are a dollar a day, or $15 and upward a month, with house rent, and sometimes with a certain amount of food. On many of the new plantations the men work at piecework or by contract. A man will keep so many acres clean at so much per month per acre, and they will be paid by the day for cutting cane or other work in addition. I know of one plantation where the men make $30 or $40 a month in this way, and the plantation is one of the best kept on the island.

Every one of these big sugar estates is a little community of its own. It requires the labor of from 1000 to 3000 men or more. This means two or three thousand families, or a population all told of about 10,000 souls. These people live about the mill or scattered in little settlements here and there over the estate. Every plantation has one or more stores and, as a rule, the workmen are in debt to the stores. Advancements are common, and there is scarcely a man who is not more or less behind. In talking with Mr. H. Dumois, who for years was at the head of the United Fruit company estate at Banes, he told me that the profits of the plantation store there were about $35,000 per year. In such stores the prices are as low as those in the neighboring towns, but the town stores require cash, while at the company stores credit is freely given. Indeed, this plantation store business is one of the important departments on the sugar man's ledger. I know some men here who have several plantations who have big incomes from their stores alone. There is one old Spaniard at Cienfuegos who owns half a dozen plantations. He is one of the richest men on the island. He buys his goods at wholesale in large quantities and distributes them to his various stores, where they are sold at a large profit. These stores have every variety of goods demanded by the Cuban peasant—from face powder and ribbons to gaudy millinery, and from ordinary foodstuffs to fancy saddles, machetes, hardware, wines, and, in short, everything that you will find in a country store of the United States.

Most of the sugar estates bring their cane from the fields to the factories on railroads. In passing through the sugar country one sees cars loaded with cane standing at every depot. It has been brought in from the smaller plantations to be shipped over the trunk line to the mills. The plantation railroads bring the cane from the fields to the mills, from 20 to 30 miles of such roads being often required for one plantation. The United Fruit company, for instance, has 29 miles of such road at Banes, and the Tacajo estate, adjoining it, has 12 miles of track which are connected with the lines of the United Fruit company. There are in Cuba altogether more than 800 miles of railroad track on the sugar plantations alone, and this has a value of more than $11,000,000. The most of these roads are equipped with rolling stock from the United States. They use Baldwin locomotives largely and some of them buy their steel rails of Krupp.

So far the sugar estates have but few electric railroads, and Cuba has no electric railroad system, such as is fast gridironing the United States. This would seem to me one of the possibilities of the future. Each big plantation, with its population of several thousand, will eventually have its railway connection with its neighbors, and the roads will carry sugar cane to the mills as well as other freight and passengers. Many of the sugar planters are studying cheap railroad transportation. They are considering the use of automobile engines made after the present gasoline pattern operated with alcohol as fuel. Alcohol here is much cheaper than gasoline. Indeed, it is a by-product of the sugar mills, being made at so little cost that it is sold in hundred-gallon casks at 12 cents per gallon. It has, it is said, about 98 per cent. of the heat generating power of commercial gasoline, and it can be used with a little gasoline to start it. I understand that German engineers have been making experiments with alcohol as fuel, and that they are now using alcohol engines for small electric light plants in some Havana stores. At the agricultural experiment station at Santiago de Vigos the pumping and lighting is done by means of alcohol, and there is an establishment in Havana which has 160 electric lights run by alcohol motors.

It will surprise many of our American farmers to know that much of the sugar cane here is raised without plowing. In the new plantations, which are set out in the woods, no plows can be used on account of the logs and stumps. None is necessary, however. After the wood has been burned the land is perfectly clean. The men then dig holes at intervals along the rows and put in sections of sugar cane a few inches long and cover them up. In a few days the cane begins to sprout at the knots, and a day or so later the blades, which are much like those of corn or grass, come through the ground. A young cane field looks much like a corn field. The crop grows rapidly, and all that is necessary is to keep down the weeds. It sprouts up in bunches of several stalks to a bunch. The cane is ready for cutting in 18 months, after which it can be cut every year. It is cut close to the ground, the tops trimmed and the leaves stripped off. It is then loaded on the great ox carts, which carry it to the railroad. On the best plantations the carts and cars are loaded and unloaded by machinery, steam cranes being sometimes used for this purpose. Good sugar lands will yield as much as from 20 to 30 tons of cane to the acre, and a not uncommon yield is two tons of sugar per acre. The harvesting goes on through all the months from December to May, and the mills are usually supposed to grind about 100 days to the season.

Cuba has produced 11 or 12 hundred thousand tons of sugar this year. This is about one-tenth of the world's total sugar product, and fully one-fourth of the cane sugar product. Beet sugar leads the cane sugar in quantity by more than 1,000,000 tons. The world's product from beets amounts altoether to 5,000,000 or 6,000,000 tons, whereas the cane sugar crop is usually not more than 4,000,000. Most of our best sugar comes from Europe, the United States producing only about 200,000 tons.

The great cane sugar countries are Cuba and Java and the Sandwich Islands. Several hundred thousand tons of cane sugar are raised in Louisiana, 85,000 tons in Porto Rico and 80,000 tons in the Philippine Islands. Including our beet product, we raise altogether just about 1,000,000 tons of sugar, which is less than two-fifths of what we consume, the balance being imported.

The United States has, in fact, a sweeter tooth than any other nation except England. We eat on the average more than 70 pounds a year for every man, woman and child in the country, while Europe averages only a little more than 27 pounds. The English sugar consumption is 91 pounds per capita. That of the Swiss is 60 pounds, of the Danes 54 pounds, and of all the other nations much less. The Germans each eat 34 pounds of sugar every year, the Dutch 32, the Greeks and Bulgarians, 7, and the Turks, although notably fond of candy, only 8 pounds. We eat altogether about 5,000,000,000 pounds of sugar annually, or a pound and a half per week for every man, woman and child in the country. We consume three times as much now per capita as we did when Andrew Jackson was president, and we are eating more and more from year to year.—Frank G. Carpenter, in Deseret News.

PORTO RICO.

The sugar crop of 1903-4 yielded 116,000 tons, the heaviest ever recorded in Porto Rico. It is the result of the great development of the sugar centrals in the last few years now arriving at their proper condition of efficiency. The value of the crop was £786,245 more than that of the previous year.

Two new centrals came into work during the year, one at Juncos and the other at Naguabo, while a third is planned for next year at Fajardo. Nearly all the old factories of any importance have improved their plants and systems, and great activity is shown all around in opening up new cane areas to supply the growing capacities of the mills.

According to the annual report of the Central Aguirre the result was satisfactory, and although the average price at which the crop was sold was only 13s. 9d. per 100 lb., a net earning of £51,800 was obtained, giving a dividend of £26,700, or about 6.67 per cent. on a capital of £400,000. The crop of this factory was taken off in 131 working days, at an average run per day of twenty and a half hours; the average amount of cane per day was 1,216 tons; average extraction of juice was 80.43 per cent. of the total weight of cane. They have under cultivation for next year about 7,500 acres of cane, and expect a yield of about 20,000 tons.

A French company under the name of "Compagnie des Sucreries de Porto Rico," with headquarters in Paris, has been incorporated with a capital of about £180,000. They have bought five plantations in this district, in all about 2,500 acres, and have built up a central factory which they call "Central Fortuna." The factory is situated about 5 miles from Ponce. The capacity of the mills is about 600 tons of cane per twenty-four hours. The novelty about this factory is that they are putting up a new system of diffusion of bagasse, which, it is asserted, will increase the extraction from canes fully 2 per cent. This is the first time that this system of diffusion has been undertaken on a large scale, the inventor himself, a French chemist by name H. Manoury, being the general director of the central factory and of the Compagnie des Sucreries de Porto Rico in this city. The first crop under this new system will be taken off next year.—Consular Reports.

TRINIDAD.

The pamphlet containing "Statistics of Trinidad Trade," specially compiled by Professor Carmody for the Colonial and Indian Exhibition, contains the following interesting information on the colony's trade in sugar products:

Sugar is prepared exclusively from the sugar cane in the large central factories of the colony. The largest of these factories has an output of over 150 tons a day. In these factories sugar can be produced polarizing 98 to 99 per cent. of pure sugar. The sugars are purposely now manufactured below this standard, in order to avoid the heavier rates of duty by Cubans and Spaniards. The Spaniards make excellent which an unfavorable tariff imposes on sugars equal in quality to refined sugars. None of the yellow or white crystals of similar quality require refining. The refining process removes the greater part of the characteristic agreeable flavour of cane sugar. Beet sugar is quite unfit for consumption until the characteristic disagreeable flavor is removed by refining. Herein lies the chief difference between cane and beet sugars. It is admitted that the sweetening power of cane sugar is greater than that of beet sugar, and its flavour immensely superior; but the superiority of cane over beet sugar is seen especially in: (1) Sweetening aerated drinks, liqueurs, cordials, champagne, etc.; (2) fruit preserving; (3) brewing; (4) cooking; (5) the preparation of any product in which flavor is of importance.

Great Britain is our best customer, but is closely followed by the United States. Very little muscovado sugar is now made, owing to the closing of the small factories which produced this class of sugar.

MOLASSES.

Large quantities of molasses are produced as a by-product in the manufacture of sugar. Present prices are very low. The molasses from cane sugar are very superior to those from beet, which contain an excessive quantity of alkaline salts. Molasses are used for: (1) Making rum and other spirits; (2) cattle feeding; (3) making golden syrup, treacle, etc.

Trinidad molasses contain about 45 per cent. of cane sugar and 20 per cent. of glucose.

More than half of last year's exports went to Great Britain. In previous years the bulk went to Canada, Portugal, or Martinique.

RUM.

This is made locally from molasses, and about 300,000 gallons are consumed annually in Trindad. Among the liqueurs made from it, rum shrub and falernum are the best known. Bay rum is another local groduct. The rum made here is usually of a strength of 40 over proof, but 60 over proof is obtainable. Present export prices are unremunerative. The bulk of our exports goes to Great Britain.

BITTERS.

The world-famed Angostura bitters are made in Trinidad from rum of the finest quality produced in the colony. The other ingredients are a trade secret. These bitters have been frequently imitated, but never successfully. They were originally made at Angostura (now Ciudad Bolivar) by Dr. Siegert as a medicine, but since 1830 have been used both medicinally and as a beverage. Since 1875 the bitters have been manufactured in this colony. They are one of the principal ingredients in the West Indian swizzle or cocktail. The United States and British markets are regular and nearly equal in extent; the German market fluctuates considerably.—Agricultural News.

SCIENCE AND THE SUGAR INDUSTRY IN QUEENSLAND.

It is especially satisfactory to note that there is a probability that the sugar industry of this state will receive further strengthening in the course of no distant time. The *Sugar Journal* was originally established for the special purpose of advocating the scientific and technical progress of the sugar industry in this state, and we venture to think that something has been accomplished during the thirteen years which we completed last month. The greatest progress has been made in connection with the work of the factories, though here, as will always be the case, there is room foı further improvement. Our factory work may yet be simplified, and the labor bill may be further reduced, but on the whole our methods are not behind those of other parts of the world, though generally we work upon a smaller scale than our foreign friends, where advances have been made. In the field the application of science to any considerable extent, either in our methods of cultivation, or the class of machinery we employ, has only just begun. The first distinct step forward was the formation of the Sugar Experiment Station Bureau, and the employment of Dr. Maxwell to direct its operations. It concerns us but little that there should be many who declare that the work of the Experiment Station is worthless. Some of the detractors of the work of science speak as they do because they do not understand what scientific work means. The story is told of a director of a central mill who, on being advised to put a chemist into a mill, demurred, saying there were two chemists in town and if anyone got sick they could telephone to them. The story may not be true, but is apt enough to illustrate the difficulty which must always be experienced in endeavoring to induce a certain class of people to accept the aid of science. We do not pretend to say that all progressive measures in the fields, during the last three or four years have been due to the work of the Sugar Bureau, but it is certain that in many cases the cultivation has been improved, that better classes of manures have been used suited to the requirements of each situation, that the practice of irrigation has been extended, that some sixty varieties of cane have been scientifically tested, and their relative merits, both from the farmer's and the factory's point of view, determined, and above all, that a complete analysis has been made of all the soils in districts growing sugar. This latter will prove a *vade mecum* practically for all time, and its value must not therefore be estimated by the mere opinion of someone today, who does nat happen to want the information himself. On the other hand it must be admitted that we have so far made no progress in the matter of dealing with insect and other pests, while our knowledge of the different diseases which attack our canes in Queensland is woefully deficient. It is stated that this side of the question is now to receive attention. There is some expectation that a capable entomologist will be appointed as an officer of the Sugar Bureau. We hope the appointment will be made. It is high time that what Dr. Maxwell has done for our soils, an entomologist should do for our predatory insects, the doings of which affect our industry. By gross carelessness we once imported the New Guinea borer in Queensland, and not so long ago we shipped to Honolulu canes which proved to have with them a very serious insect pest. Our Hawaiian friends, so soon as they discovered the kindly present from Queensland, at once set their entomologists to work to find a remedy. They visited Queensland, found the natural enemies of our exported pest, and despatched them over to Hawaii to do in the islands there, what hitherto they had been doing in Queensland. Already the prompt action thus taken is reported to be bearing good fruit, and what might have cost the Hawaiian Islands hundreds of thousands of dollars will be remedied at a cost not exceeding a hundredth of that amount. Entomology is a science, just as agriculture should be, and we are quite prepared to hear the usual condemnation of any effort made to increase the scientific staff of the Sugar Bureau. However, we must keep abreast of the times, especially if we look forward to the day when we shall have so improved our methods and extended our industry as to be able to export sugar from Australia, and bring it into direct competition with the sugar from other countries of the world, where the highest scientific and technical skill is considered indispensable to the conduct of the growth and manufacture of sugar.—Queensland Sugar Journal in Louisiana Planter.

Sugar Plantations, Cane Growers and Sugar Mills.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	G. F. Renton	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers.	Waimanalo
Oahu Sugar Co.	x	F. K. Bull	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Paia Plantation	x*	D. C. Lindsay	Paia
Haiku Sugar Co	x*	H. A. Baldwin	Haiku
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paauilo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	**	Geo. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	**x	Jas. Webster	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. H. Campbell	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	Wm. G. Ogg	Pahala
Hutchinson Sugar Plantation Co.	**	Carl Wolters	Naalehu
Union Mill Co.	*x	H. H. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
Honokaa Sugar Co.	x**	K. S. Gjerdrum	Honokaa
Olaa Sugar Co.	xx	J. Watt	Olaa
Puna Sugar Co.			Kapoho
Halawa Plantation	x*x	T. S. Kay	Kohala
Hawi Mill & Plantation	††	John Hind	Kohala
Puako Plantation	††	W. L. Vredenburg	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	*x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	A. Moore	Kilauea
Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.		G. H. Fairchild	Kealia
Grove Farm Plantation	x	Ed. Broadbent	Lihue
Lihue Plantation Co.	x	F. Weber	Lihue
Koloa Sugar Co.	x	P. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x*	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.	HONOLULU AGENTS.	
*	Castle & Cooke	(5)
**	W. G. Irwin & Co.	(8)
***	J. M. Dowsett	(1)
x	H. Hackfeld & Co.	(9)
*x	T. H. Davies & Co.	(8)
**x	C. Brewer & Co.	(6)
x*	Alexander & Baldwin	(7)
x**	F. A. Schaefer & Co.	(2)
x*x	H. Waterhouse Trust Co.	(2)
††	Hind, Rolph & Co.	(2)
xx	Bishop & Co	(1)