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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	E. K. Bull	Waipahu
Honolulu Plantation Co.	°°	J. A. Low	Alea
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
Maui Agricultural Co		H. A. Baldwin	Paia
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	Paaullo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	°x	E. Madden	Paaullo
Ookala Sugar Co.	°°x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	°x	C. McLennan	Papaaloa
Hakalau Plantation	°x	J. M. 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
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Hawi Mill & Plantation	††	John Hind	Kohala
Puako Plantation	††	Jno. C. Searle	S. Kohala
Niulii Sugar Mill and Plantation	°x	Robt Hall	Kohala
Puakea Plantation	°x	H. R. Bryant	Kohala
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Makee Sugar Co.	....	G. H. Fairchild	Kealia
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McBryde Sugar Co.	°x	W. Stodart	Elcele
Hawaiian Sugar Co.	x°	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	°	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.

	Castle & Cooke	( )
°°	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	(6)
x°°	F. A. Schaefer & Co.	(2)
x°x	H. Waterhouse Trust Co.	(2)
††	Hind, Rolph & Co.	(2)
xx	Bishop & Co.	(1)

HONOLULU AGENTS.

THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION

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SUGAR PRICES FOR MONTH ENDING JUNE 14, 1907.

	Centrifugals.	Beets.
May 17	3.86¢	9s 10½d
May 24	3.92¢	9s 11¼d
May 31	3.91¢	9s 11¼d
June 7	3.86¢	9s 11¼d
June 14	3.73¢	9s 9d

Messrs. Willett & Gray in their Weekly Statistical of June 6 report:

Raws.—Sellers made the first movement for a change of quotations from the former quiet and steady market.

The continuation of circumstances against them led to the legitimate result of a pressure to sell and decline in quotations irrespective of future values when the abnormal condition of strikes, bad weather, and reduced demand for refined product has passed by. In the meantime spot and nearby sugar must be sold and refiners being greatly hampered in their receipt and caring for sugars bought long ago, could only take on new purchase at prices forced upon them.

The business of the week in the sugars pressed for sale was mainly at basis of 3.86c. for 96° test with final sales at 3.84c., showing a decline of .06c. per lb. from the spot quotation of 3.90c. last week.

A cargo of Cuba Centrifugals, for shipment last half June, was placed with the Federal at 2.53c. c. & f., 96° test, equal to 3.89c. landed. There are sellers at 2 9-16c., basis 95°, for July, equal to 3.95c. duty paid.

At the close the position is still unchanged, the pressure to sell continues, and the ability to buy and take delivery is still less than before.

Longshoremen's strikes, bad weather and limited demand for refined still govern the position without indications of any let up in either direction.

Hence further depression is likely to result for awhile, notwithstanding that Europe does not sympathize or participate in the tone and tendency of the markets here to any extent.

Europe has fluctuated with ¾d. for the week, opening at 10s. and closing at 9s. 11¼d. for beet sugar (parity of 4.09c. for 96 test Centrifugals) and even gaining ¾d. for the next month deliveries.

The European weather is cabled to us by Mr. Licht as unfavorable for the growing crop.

Cuba Centrals working are now reduced to seven as against 68 last year. Week's receipts 7,000 tons against 16,000 tons for corresponding week last year. Visible crop to date 1,350,000 tons against 1,075,000 tons at same date last year.

The weather in Cuba is now favorable for some recovery of the damage done to the next crop by the recent drought.

Buyers are showing no disposition, at the moment, to engage further supplies of Java sugars, consequently sellers refrain from making any offerings and, the recent asking price of 10s, 9d. c. & f. (equal to 4.08c. landed for 96 test) remains nominally unchanged.

NOTES.

CUBA QUARANTINES AGAINST INSECT PESTS AND PLANT.—Professor J. T. Crawley, Director of the Agricultural Experiment Station of Cuba and formerly of Hawaii, is urging upon the Government the necessity of establishing an efficient quarantine against the introduction of insect pests and plant diseases from other countries.

Professor Crawley is giving his employers the benefit of experience acquired in Hawaii and has called the attention of the Secretary of Agriculture to the vast amount of damage done by pests imported into Hawaii, notably the cane leaf hopper, and to the efforts now made to prevent the introduction of other injurious insects and plant diseases. He recommends, among other things, that all plants be inspected before allowed a landing, and that no canes be brought from any country whatever except through the Experiment Station.

The Cuban Government will be wise if it adopts Mr. Crawley's suggestions, as they are derived from an experience which has caused losses of some millions of dollars to the sugar planters of Hawaii.

DENATURED ALCOHOL.—Consul A. Gaulin, of Havre, reports that according to official statistics the total quantity of denatured alcohol consumed in France during the year 1906 was 14,409,547 gallons, against 12,475,186 gallons in 1905, showing an increase of 1,934,361 gallons.

Initial shipments of denatured alcohol have been made from distilleries at Peoria, Ill., to New York, where it is quoted at 37 cents a gallon in single barrels and 36 cents in lots, the equivalent of 31 cents in Peoria, package included. The price of wood alcohol has dropped from 75 cents to 45 cents.

QUEENSLAND.—For several seasons large sums have been expended by the Mossman Central Mill Co., Ltd., for the destruction of cane grubs and bettles, but without any apparent diminution of the pest. When in Melbourne last year, two of the company's directors interviewed Mr. French, the Victorian government entomologist, who advised a trial of carbon bi-sulphide, injected into the soil at the root of affected stalks for the destruction of grubs. A quantity of this chemical and the necessary injector were procured and experiments gave such encouraging results, that taking also into consideration the shortage of labor, considered it unwise to continue the payment for bettles, until the new method of coping with the pest had received a thorough trial. Different cane growers have recently treated several acres of grub-infested cane with carbon-bi-sulphide and are so satisfied with the effort that they have decided to operate more extensively, as soon as a further supply of the chemical can be procured from Brisbane. If the expectation of the growers are fulfilled, it will most considerably prove the value of this method for the eradication of our most destructive cane pest.

A chemical weed destroyer has also engaged attention, the tasks made showing it to be both an effectuate and economical method for clearing the tram lines. A quantity of the preparation has therefore been ordered.

[An excerpt from the Annual Report of the Mossman Central Mill Co., Ltd., copied by the Queenslander, April 21, 1907.]

WORK IN QUEENSLAND.—An experiment is now being made by the Queensland Government in offering free passage to farm laborers willing to work on sugar farms. Employment is guaranteed for at least one year at full wages current in the State. The government takes charge of emigrants from the moment of landing until they are on the farms where work has been arranged for them. Information may be obtained from Agent General, i Ancer-Victoria street, S. W. London. Assisted passages are also offered to approved families with a capital of £50, on payment of £5 for each adult.—From the London Weekly Times, May 5.

PHILIPPINE SUGAR. In a recent report on trade opportunities in the Philippine Islands furnished by Special Agent W. A. Graham Clark, it is said in reference to sugar growing and exporting in the Philippines:

"Next to hemp sugar is the largest export crop. Only parts of certain lands are adapted to sugar cultivation, but the area is large enough to produce tenfold what is now produced, and some of the land is as suitable for sugar cane as any in the world. to one who has seen the thoroughly up-to-date way in which the cultivation of sugar cane and the extraction of the sugar is carried on in Hawaii the Philippine methods seem crude and antiquated. This is mainly due to lack of capital. So far there is practically no outside capital invested in this great industry. Many steam plows, and cane-crushing machinery, could be sold here if there were money to pay for them. Of the $5,073,233 worth of raw sugar exported in 1905, $2,102,023 went to the United States and $1,960,025 to Hongkong. In 1906 the export was $4,554,092, of which $422,111, representing 26,141,252 pounds, was entered at ports of the United States. The sugar exported in the raw state to Hongkong is there refined and shipped up and down the China coast, and quite an amount of it reshipped to Manila. Labor conditions are much more favorable at Hongkong than at Manila, but it is probable that a sugar refinery at Manila would pay, and the sugar shipped at an enhanced value would also help the balance of trade."

SUGAR IN BRITISH GUIANA. Vice-Consul Mitchell of Georgetown, reports as follows concerning the sugar trade of British Guiana for 1906:

"Sugar, 119,780 tons, of which 62,895 tons were sold to Canada, 40.454 tons to the United States, and 16,141 tons to England. There remained on hand at the close of the year 11,000 tons, almost all of which was sold to Canada in January and February, 1907, at 2⅛ cents per pound, cost and freight. Nearly all the sugar sold to Canada goes thither via New York, the freight to that port being from 9 to 10 cents per 100 pounds. It is claimed that only about one-third of the sugar estates, the larger ones, made any profit during the year, the majority losing money, owing to the high cost of labor, packages, etc. The sugar estates of British Guiana are classified as follows: One, of 6,000 acres; 4, of 3,000 acres each; 7, of 2,000 acres each; 24, of 1,000 acres each; 6, of less than 1,000 acres each."

SEEDLING SUGAR CANES IN THE WEST INDIES. From the *Agricultural News* we learn that the cultivation of new seedling sugar canes, as compared with the Boubon and other varieties hitherto grown in British Guiana and elsewhere in the West Indies shows considerable progress in recent years. From re-

turns to hand it appears that 28,801 acres were planted in British Guiana in seedling canes in 1906-7. The area in 1905-6 was 14,743 acres and 1904, 9,518 acres. Amongst the more important seedling varieties are the Demerara seedlings, D. 109 and D. 625; while two Barbados seedlings, B. 208 and B. 147, are also largely cultivated. It is pointed out that an editorial note which appeared in the *International Sugar Journal,* in May last (pp. 219-220) discussing the "Identity of Seedling Canes in Demerara" and stating that it was "an ascertained fact" that the seedling cane B. 208, cultivated on the well known Diamond plantation in Demerara "was not the original seedling of that variety," is absolutely without foundation. Samples of B. 208 from Diamond plantatin have since been submitted to a critical examination by the Imperial Department of Agriculture for the West Indies, and it is stated that they are identical with the original seedlings of that variety raised at Barbados.

IMMIGRATION AND LABOR NOTES.

Consul A. Winslow, at Valparaiso, Chile, has mentioned, in a recent report, the gravity of the labor situation in that country, where the scarcity of labor is a prime cause in retarding the industrial development of the country. The laborers have come to think they have the matter entirely in their own hands, and both in town and country they are demanding very high wages, and are very independent as regards the quantity and quality of the work they perform. There is no union among the laborers, but workmen are so scarce that each man who cares to work realizes that he can demand, and obtain, his price. From 8 to 9 piastres per day are now being paid to ordinary laborers, the usual wages being from 5 to 6 piastres per day, and the employees try the patience of the employer in proportion. Even at these high prices, it is impossible to obtain sufficient laborers. The Government has accepted the project of M. Ciro Fantini to bring into Chile 30,000 French, Italian and Spanish immigrants. Beside this, a syndicate of Italian capitalists have asked the Government to authorize the bringing into the country of 5,000 Italian families of immigrants, under the condition that the State guarantees the cost of transportation and will supply the initial necessities of the immigrants upon their arrival Another movement is on foot to bring in about 600 French immigrants in the very near future. It has often been claimed that the nitrate cyndicate of Chile experienced much difficulty in finding sufficient laborers, and it is hoped that with the projects now under way, these difficulties will be diminished.

The Chilean Government has placed 550,000 pesos, $165,000 United States gold, at the disposal of the President to be expended in securing immigrants for this republic. It is proposed to pay their passage to this country and to find them employment on arrival. Of this sum, $15,000 United States gold is to be expended to provide a home for immigrants at Valparaiso, where they can be temporarily provided for. This is a very important move and means much for the future Chile, as nearly every undertaking in this Republic is suffering for want of workmen. It is proposed to bring in from 5,000 to 10,000 men this year if possible, and if the scheme proves successful the appropriation is to be materially increased.

Liberal land grants have been made to corporations with the understanding that a certain number of immigrants shall be located thereon within a certain time. This scheme is meeting with fair success.

IMMIGRANTS FROM SPAIN.

Mr. P. San Mateo, a native of Spain and for eighteen years a resident in Chile, has presented to the Government a proposal to bring 5,000 of 10,000 Spaniards to work as skilled and unskilled workmen. The conditions are that each man shall sign an agreement before the Chilean consul in Spain before emigrating to Chile, setting forth the particulars of his trade, etc.: the immigrants are to arrive at the end of eight months and to be received by a commission named by Mr. San Mateo on their arrival in Valparaiso; each man to be free to work for whom he will, the same as any other person; expense of transit of immigrants and their families (if any) is to be borne by the Government. It is further proposed that Mr. San Mateo and his wife shall be returned to Spain and given a bonus of at least $3 for every accepted adult immigrant introduced into the country. In order to secure the fulfilment of his promises Mr. San Mateo agrees to erect a bathing establishment at Valparaiso for the convenience of the immigrants at an expense of $6,000.

IMMIGRATION INTO ARGENTINA.

A Buenos Aires dispatch to the London Times says: Immigration into Argentina during 1906 totaled nearly 260,000, the highest figures yet reached in he hisory of he country the year highest figures yet reached in the history of the country, the year was due to the existence then to subsidized lines granting free passages. According to estimates of the National Immigration Office, 1907 should surpass last year, as it is calculated that over 100,000 immigrants are due to arrive up to March 31. The year 1906 was an exceptional one for the enormous amount of business transacted in real estate, which amounted monthly to

tens of millions of dollars, and during the past couple of years land rose in value all over the Republic an average of 35 per cent. The limit, however, appears to have been practically reached, as for some time back there has been noticeable a certain falling off in the volume of sales, and prices are more or less at a standstill.

FERTILIZER NOTES.

FERTILIZERS IN INDIA.—The demand for fertilizers of all kinds in British India slowly increases with the development of the culture of sugar cane and jute by European agriculturists. The area given over to the raising of sugar cane is about 2,570,000 acres, and that devoted to jute is approximately 2,940,000 acres. The principal local fertilizer used is ground bone, but only the foreign farmer will use it, as the religious scruples of the natives, both Hindoos and Mohammedans, oppose its employment. Something over 100,000 tons of ground bone fertilizer were exported from India the past year, which is 33 per cent. more than in 1905. This exportation represents just so much loss to the soil of India, which has great need of plant foods.

Since January, 1905, there have been organized in Chili, 32 new companies for the production of nitrate.

ADDING HUMUS TO THE SOIL.—There are two principal ways of adding humus to the soils, says Prof. Clinton D. Smith in *Country Gentleman*. First by plowing under barnyard manure, and second by growing green crops and plowing them under. It is apparent at once that if the greatest amount of humus possible is to be made from barnyard manure, it should be hauled to the fields without rotting and plowed under, so that the rotting may take place in the soil itself. From this point of view, therefore, the manure should be hauled to the field as fast as made. It should be plowed under, also, not to too great a depth, but far enough to insure the continuous presence of moisture throughout the season.

Experiments and observations made at the Michigan college have shown that where the manure was hauled on the snow and spread there, the water from the snow, when the thaws came, did not carry away the plant food from the manure, except in the very smallest degree. The losses from this source were small. It was also shown that, as far as immediate effects on the next crop were concerned, the earlier in the winter the manure was applied, the better.

The importance of humus in preventing the drying out of the soils cannot be too strongly impressed. Note that in the sand

little water remained after three days' exposure, while in the muck and sand mixed there remained 20 parts out of 65. This indicates that where the humus is present in our clay loams, they will withstand droughts. Commercial fertilizers will supply the plant food, but they do not directly supply humus. They may be used to aid in this matter if they are applied to crops to be plowed under. Commercial fertilizers should therefore be used with barn-yard manure, not to replace it.

ANALYSIS OF THE PER CAPITA CONSUMPTION OF SUGAR.

The increase in the per capita consumption of sugar in the United States, as shown in recent statistics, is a matter of greater significance to the sugar industry than may appear to the casual reader. In 1822 the consumption per capita was a little less than 9 pounds, while in 1906 it amounted to 76 pounds, an increase of 67 pounds in 84 years, or about four-fifths of a pound per year; but this increase was not constant during the period mentioned—on the contrary it has been steadily growing. Thus while the per capita increase in the first years of the period was about one-half pound a year, and the average increase of the entire period was but four-fifths of a pound a year, the increase for the decade between 1880 and 1890 was an even pound a year, for the decade between 1890 and 1900 it amounted to one and one-fifth pounds per year, and for the last six years it has risen to one and five-sixths pounds per year.

Applying this rapidly increasing ratio of consumption to the advancing numbers of our huge population the future of the sugar industry in America is full of substantial encouragement. Thus, if the population in 1920 amounts to 100,000,000, a conservative estimate, and the increase in per capita consumption of sugar is as great only on the whole fourteen years as it has been in the last six years, the present annual consumption of sugar in the United States will be practically doubled.

The world's total production of sugar in 1906 was 24,276,000,000 pounds, of which our country absorbed a little more than one-fourth, or in exact figures, 6,403,983,935 pounds. Of the amount consumed, 20.3 per cent. was of domestic production, 20.2 per cent. from the islands under our flag, Hawaii, Porto Rico and the Philippines, and the balance, 59.5 per cent, from foreign sources, of which Cuba supplied by far the greatest proportion.

In the best days of the cane sugar industry before the war the domestic production amounted to 57 per cent of the quantity consumed. At the close of the war domestic production dropped to 2 per cent, in 1870 it was 10 per cent, from 1880 to 1890 it

was 15 per cent. and in 1906 it rose to 20 per cent. of the largely increased consumption of the present year. And of this domestic produc more than half, 673,000,000 pounds, to be exact, was beet sugar. How, then, is the very large increase in the home demand for sugar to be met?

If the government of Cuba and the economic position of the planters remain on the present insecure basis we may hardly look for a large increase of production in that quarter . The outlook for the coming year is distincly the reverse. Hawaii and Porto Rico have limited producing capacity and if their shipments to the United States were doubled in fourteen years they would not go far towards meeting the increased demand. Java and the Phillipines have growing markets nearer at hand than the United States, for with the increasing prosperity of Japan and the awakening of China it seems certain that the sugar-producing islands of the Orient will become economically as dependent on the continent of Asia as the West Indies are on the American continent. On another pake we give a brief account of the growth of the sugar refining industry in Japan. Nothing gives so clear an index of the prosperity of a nation as its per capita consumption of sugar, and we may confidently expect to see the per capita ratio increase in Japan during the next few years as rapidly as it is now increasing with us.

In this brief survey of the souces of production we have still to consider the domestic supply, and especially that of beet sugar. It is evident that from this source must come a very large part of the product required to meet the growing demand of our own population. Domestic beet sugar amounted to a little more than 10 per cent, of the total home consumption in 1906. With the practical certainty that this home consuption will be doubled in about fourteen years, by how much must the production of beet sugar be multiplied to furnish its due proportion of the home demand?

It is evident that the amount of capital now being invested in beet sugar manufacture in this country must be largely increased, and the number and the efficiency of the factories must be muliplied to overtake the rapidly growing consumption within our own boundaries. From every point of view it is very desirable that this increase of producing capacity should be made as rapidly as possible. The dependence of our country upon the tropical islands for the major part of a commodity that can be as well produced at home is greatly to be deplored. The employment of many thousands of acres of unprofitable farm land in the production of sugar beets to the great pecuniary advantage of the farmer, and the addition of thousands of working men to the payrolls of the sugar factories would be an economic gain of great importance to the whole country, and American capital and enterprise could not find a more inviting field than the beet sugar industry. [Beet Sug. Gazette.]

HAWAIIAN SEEDLINGS FROM THE SOWINGS OF DECEMBER, 1905.

Mr. C. F. Eckart, Director of the Division of Agriculture, has issued a circular under the above title giving detailed information concerning the seedlings produced from Hawaiian grown seed sown in December, 1905.

The data presented in the circular will be of special interest inasmuch as many of the varieties enumerated will be set out in plantation nurseries during the present planting season to undergo further selection under their changed environment.

The known parentage of these canes, the number obtained from each parent variety, and likewise the maximum weight of the stalk and the richness of the juice in each lot are shown in the following table:

Parent Variety.	Number of Canes Saved	Maximum Weight per Foot. Ozs.	Maximum Sucrose in Juice. Percent.
Yellow Bamboo	99	16.9	18.5
Demerara 1135	68	16.5	18.7
Lahaina	58	15.1	19.1
White Mexican	48	14.4	19.8
Demerara 116	14	13.2	18.0
Queensland 4	8	16.3	18.5
Kokea	7	16.4	18.3
Barbados 306	7	12.2	18.1
Demerara 117	5	15.0	18.3
Demerara 95	4	10.9	20.9
Gee Gow	4	11.1	19.7
Striped Singapore	4	12.1	18.6
Mexican Bamboo	3	11.0	19.3
Barbados 5	3	11.1	17.1
Demerara 115	2	13.5	19.5
"Unknown"	2	11.8	17.2
La. Purple	2	11.6	18.7
Queensland 5	2	11.1	14.5
Altamatti	2	14.9	17.1
Barbados 208	1	8.6	16.6
Demerara 1483	1	10.1	18.3
Queensland 1	1	12.0	12.5
Queensland 8 A	1	7.9	16.8
D. C. Bamboo	1	11.1	16.2
Not known	8	16.4	17.8

The parent variety "Unknown" is a yellow sport from Striped Tip and in Hawaii has always passed under the name designated. Eight seedlings, the parentage of which is not known, constitute the last lot indicated in the table.

The richest twelve canes, arranged in order of the sucrose content of the juice, were as follows:

RICHEST TWELVE SEEDLINGS.

Seedling	Parent	Wt. per Ft. Ozs.	Brix.	Sucrose	Purity
H 374..	Demerara 95.....	9.4	22.5	20.9	92.7
H 384..	Demerara 95.....	8.5	22.8	20.9	91.6
H 238.	Demerara 95	7.5	21.7	20.1	92.4
H 165..	White Mexican	13.3	21.2	19.8	93.9
H 304..	Gee Gow	10.9	21.7	19.7	90.8
H 72...	Gee Gow.....	9.2	20.8	19.5	93.8
H 246..	Demerara 115.....	8.3	21.4	19.5	91.1
H 155..	White Mexican	10.4	20.9	19.4	92.4
H 205..	Mexican Bamboo....	9.7	21.2	19.3	91.0
H 173..	White Mexican.....	10.0	20.4	19.1	93.6
H 154..	Lahaina	10.8	20.8	19.1	91.8
H 395..	White Mexican.....	9.5	20.9	19.1	90.4

The heaviest twelve canes, arranged in order of their weight per linear foot, are shown in the following table:

HEAVIEST TWELVE CANES.

Seedling	Parent	Wt. per Ft. Ozs.	Brix.	Sucrose	Purity
H 306..	Yellow Bamboo.....	16.9	15.5	13.1	84.5
H 294..	Demerara 1135.....	16.5	17.3	15.0	86.7
H 311..	Kokea	16.4	19.5	16.4	84.1
H 309.	Not known.....	16.4	17.8	14.9	83.7
H 290..	Yellow Bamboo.....	16.3	18.1	16.3	90.0
H 321..	Queensland 4.....	16.3	19.7	17.6	89.3
H 2....	Yellow Bamboo.....	16.1	18.6	17.0	91.4
H 37...	Demerara 1135.....	15.9	17.0	15.4	90.6
H 398..	Not known	15.8	18.6	16.6	89.2
H 123..	Demerara 1135.....	15.7	17.8	15.5	86.5
H 247..	Demerara 1135.....	15.4	20.1	18.6	92.5
H 156..	Yellow Bamboo	15.2	16.4	14.4	87.8

The following brief summary is of some interest as affording an idea as to the weight of the canes and the quality of their juice:

Seedlings, the juice of which contained						17%	Sucrose	or	over,	138
"	"	"	"	"	"	18%	"	"	"	57
"	"	"	"	"	"	19%	"	"	"	12
"	"	"	"	"	"	20%	"	"	"	3
Seedlings, weighing			12 oz.	or	more	per	linear	foot	.....	78
"	"		13 oz.	"	"	"	"	"	.....	45
"	"		14 oz.	"	"	"	"	"	.....	26
"	"		15 oz.	"	"	"	"	"	.....	14
"	"		16 oz.	"	"	"	"	"	.....	7

In carrying on this first selection the various points which received consideration and concerning which data were recorded were:

Parent	Length of Canes Sampled
Color	Weight of Canes Sampled
General Appearance	Weight per Foot
Recumbency	Juice Extracted % Cane
Hopper Resistance (1)	Brix of Juice
Canes in Stool	Sucrose of Juice
Internodes	Purity of Juice
Eyes	Milling Qualities
Rind	Apparent Fungus Diseases
Rooting Tendency	*Character of Soil in Which Grown

(1) Determined by Mr. F. W. Terry.

* That is, whether grown in virgin field or old land.

The circular then proceeds to show detailed information under the above heads concerning each of the three hundred and ninety-nine seedlings which were planted and tested.

SUGAR CANE CULTIVATION IN THE IRRIGATED LANDS OF THE GODAVERI DELTA.

(By C. A. Barber, M. A., F. L. S., Government Botanist, Madras, India.)

The following are some of the principal results obtained from the study and growth of sugar cane at the Government Sugar Station, Samalkota. The main object of the farm was to find a means of combating the prevailing sugar cane disease. There can be no doubt that to raise healthy crops it is necessary to select good seed and to treat the canes well all through the period of their growth, and this has been much neglected in the past. But the

local canes, even if well treated, have proved unsatisfactory, and it has been necessary to obtain hardier varieties with good sugar-producing properties. This is, of course, a difficult matter, but the efforts on the farm have met with some measure of success. It is confidently believed that if the advice now given is followed, remunerative crops of sugar cane can with certainty be obtained in the Godaveri delta.

SELECTION OF LAND.—The choice of land for sugar cane cultivation is of prime importance. Any irrigated land with a good water supply may be chosen for rice and a reasonable crop obtained, but this is not so with sugar cane. The land must be good. The cost of cultivation is considerable, and to be content with a poor piece of land is very bad economy. The piece chosen should be easy of irrigation, for the absence of water at critical periods, especially in the first few months, is likely to leave its mark all through the growing season. A cane field making a bad start never fully recovers itself. All low places, where there is a chance of water lying on the surface after heavy rains, or such as cannot be quickly and conveniently drained after irrigation, must be avoided. In almost all cases, when disease has appeared in the canes, it has appeared first and has been most violent in low, ill-drained places.

PREPARATION OF THE LAND.—The ordinary plowing is not deep enough for sugar cane in heavy land. Here crow-barring must be done wherever possible. This has the effect of aerating the soil and allowing the roots to penetrate deep, thus building up strong plants, not easily affected by drought. It also helps to clean the land of weeds, especially after rice cultivation, or in such places as have *Imperata* grass on the bunds. The sods should be completely inverted in crow-barring.

Immediately before crow-barring a liberal dressing of compost, of at least 1,000 head-loads to the acre, should be spread over the land. The bunds and outskirts of sugar cane fields are usually covered by a very luxuriant mass of grass and weeds. These must be kept in check by clean cultivation, and if properly treated may become a very valuable compost. They should be frequently cut and thrown into large pits with layers of earth a few inches thick at intervals. The grass may be cut by the owners of cattle and taken away from the field, but if this is done two head-loads of weeds should be brought in exchange for each head-load of grass. If the weeds are thrown into these pits from May till December—the period of greater growth—and then covered with earth, most of the compost will be ready for the next preparation of the land. Where cattle are available the addition of urine and manure to the weeds will be of great benefit. A convenient size for the weed pits is five feet deep, four feet across and twelve feet long; but the depth will depend on the nearness of irrigation channels, as water should not lie in the bottom.

SELECTION OF SEED CUTTINGS.—Cuttings for planting should not be taken from ratoons, as they are usually more diseased than plant canes. The sets must be carefully examined when cut, and any one with the least trace of red color should at once be thrown away. Such are diseased and will not grow into good, healthy canes. Tops should be used whenever available and when they are insufficient, the upper part of the cane should alone be used. The lower part of the cane is more valuable than the upper for sugar making and, the joints being closer in the upper part, the latter should be kept for planting. Many of the buds in the lower halves have also been injured, and germination has always been worse in the lower than in the upper halves of canes in the experiment on the farm. Some varieties, such as *Seema,* will only grow from tops.

NUMBER OF CUTTINGS PER ACRE.—This varies in different districts and with different kinds of canes. As a rule 10,000 per acre is sufficient for heavy lands. In some cases cultivators plant from 25,000 to 50,000 sets per acre, which is a very wasteful proceeding. In the West Indies, where the soil is in better condition and there is no irrigation, 4,000 sets to the acre are sufficient to yield a full crop. The object of sowing an excessive number of sets is to secure a full stand, but this may be easily managed with a little care by a method described below. Experiments are being tried on the farm with 5,000 cuttings per acre, and the results are thus far promising. If the number of sets per acre can be reduced, much greater care can be exercised in their selection, and this is a matter of great importance n fighting the disease.

PLANTING.—Great care must be exercised in this operation. The sets must be carefully covered by at least 2 or 3 inches of earth. It is of special importance that the irrigation of newly planted land should not be excessive, as many sets are annually destroyed in this way. The first roots and leaves are very tender and must be treated very gently. They do not need much water, and it will suffice to keep the land moist instead of thoroughly wetting it.

The sets should always be planted in rows. It is the custom in the Godaveri Delta to broadcast the seed, and this tends to much inconvenience in all the subsequent operations. A good deal of labor is saved by planting in rows, and this may be done by stretching a string across the ground and moving it along for successive rows. In hoeing with hand hoes, the workers should walk backward between the rows, as there is no danger of trampling the plants. The appearance of a field hoed backwards is very much better than one done forwards, in the ordinary country method. Trenches are much easier to dig, and no plants are injured in trenching if the plants are in rows. It has been found by experiment that when forty men are required to wrap the canes

in a piece of land sown broadcast, only thirty are needed when the canes are in rows, and this proportion of labor-saving holds good for all the operations during cultivation.

SUPPLYING.—In spite of every precaution in the choice of seed and in planting, it has been our experience that some of the sets fail to germinate and vacant spaces are the result. These must be supplied. This may usually be done inside the plot itself by lifting young plants from the denser parts and planting them in the vacancies, but it has been found useful to plant a small outside strip of the field quite closely, from which the needed supplies may be obtained. The supplying must not be delayed beyond six weeks from the time of planting the field. Supplying must be done on dull days if possible, but this is not absolutely necessary. It has been found inadvisable to supply vacancies by putting fresh cuttings in, firstly because the treatment of the cuttings is different from that of young and growing plants, and secondly, because the sets thus put in rarely catch up with the other plants and are smothered by them.

RATOONING.—This is the term applied to the growing cane for a second year on the same land. It should be in all cases avoided for the present. Even good *Yerra* plants, which have given an excellent crop, have failed miserably as ratoons. This is due to the fact that the disease enters the cane from the soil, and it is always much worse even on good land in ratoons than in plant canes. Sets for planting should not be taken from ratoons for the same reason.

STOOL-PLANTING.—There is one form of ratooning, however, which has given good results thus far. In this the roots are lifted out, cut up and planted elsewhere. The roots of canes have to be dug out in preparing the land for the next crop. If these roots are split into two or three parts and then replanted in fresh land, a very uniform result is obtained. No more than 5,000 to the acre are needed, and thus it will be seen that the roots of an acre of canes will plant up 5 acres under this system. Stool-planting may be done either before the canals are closed or after they are re-opened, and the great advantage of the system is that there are no vacancies and no supplying is needed. (See also paragraph below on Nursery planting.)

IRRIGATION.—This should be done at fairly frequent intervals and with moderation. In heavy land, once in ten days should suffice, but in light soils, it should be done more frequently, and will depend on the locality and whether irrigation is from wells or from channels. In irrigating, the surface of the beds between the channels should never be covered, it will have to be hoed again much sooner. The water in the channels should be at least four inches below the surface of the ground in the beds. It is a good

plan to let the water into the field in the evening and let it out on the following morning, but this will depend on the locality. Water should never, on any account, be allowed to lie in the channels when irrigation is not in progress.

MANURING.—This must be carefully attended to, as it is useless to try to grow sugar cane without feeding the plants. The spreading of compost before crow-barring is not manuring. It is intended to lighten the soil and to prepare it for the manure to be applied later, but it cannot replace manure. The best manure for heavy soils with plenty of water is oil-cake. This varies a good deal in value with the different plants from which it is prepared. Ground-nut and castor cakes are the best, but they are costly; Margosa and Pungam are not so good and Bassia is very poor. But it sometimes happens (as in the Godaveri Delta) that it is more economical to use the cheaper cake. It should at the outset be decided how much to spend on manure, and Rs. 30 to Rs. 40 per acre has given very good results on the farm. With this amount 10 bags of castor may be purchased, but 30 to 40 bags of mixed Margosa and Pungam. The latter has been found to give a better result. Rs. 30-40 worth of mixed Margosa and Pungam cake is the most economical form of manure yet observed on the farm. This should be supplied when water is abundant and when the plants are beginning to grow strongly, and the best time is after the re-opening of the canals. It is better to apply the manure in two doses with an interval of two months. Artificial manures such as ammonium sulphate, sodium nitrate and bone-dust have given very poor results indeed on the heavy delta soil, and the local "cattle manure" is of no value at all as a manure.

JACKALS.—The canes, when approaching ripeness, must be carefully protected against jackals. These cause much damage, and help in the spread of disease. Throwing mud on the lower part of the canes is a local practice and is very good, as the jackals do not like the taste of the mud. This may be done when digging the trenches and when cleaning them out. A pan of jaggery water may also be placed in a convenient place and the jackals shot one after the other as they approach. As many as ten in a night have been destroyed on the farm in this way. It has been found that when a number of jackals are killed in this way the rest desert the field.

PLANTING FROM NURSERY.—In heavy land where there is only nine months' irrigation and the cane requires twelve months to mature, it would appear to be impossible to grow sugar cane. The following plan may, however, be adopted in such cases with fair prospects of success. Plant cane cuttings in seed-beds so close together side by side as to touch one another. The beds may be of any length and about 3 feet wide and should be separated by water channels a foot wide. The seed-beds (reminding in many ways

of paddy seed-beds) should be near a pond or well and must be regularly irrigated, although they do not require so much water as fields of growing cane. They need not be manured specially if the land is good. The seed-beds should be laid down after reaping the crop and when the water in the canals is failing, and the plants should remain in the seed-bed until water is again available. When the canals are reopened the young plants may be carefully lifted and planted out in the field. They may be put in a couple of feet apart and treated in the ordinary way. It is calculated that 8-10 cents of nursery will plant up an acre of cane, and an advantage of this method is that an even stand is obtained and there need be no supplying. The canes must now be made to mature as rapidly as possible. Excess of water must be avoided as also too much nitrogenous manure, as both of these, while increasing the growth and weight of the canes, retard the ripening process. Ten bags of castor per acre is perhaps a little too much in this case, but this matter has not been fully worked out. Wrapping the canes should be dispensed with, as the exposure of their surface to the air helps on the ripening process. Towards reaping time the supplies of water must be restricted. Provided the surface is kept stirred, no water need be given at the end of growth, and the canes may be reaped as soon as ripe. Care should be taken finally in the selection of the canes. *Sunna Bile, Bonta, Ashy Mauritius* and *Striped Mauritius* appear to ripen quickly.

VARIETIES OF CANES.—This selection of canes is one of the chief pieces of work being carried out on the farm. A great number of canes have been brought together and these are constantly being added to. There are about 45 varieties now growing on the farm. These have been obtained from all parts of the Presidency, from Bombay, Bengal, Mauritius and Barbados. In all cases the local Madras canes, subjected to a long course of disease, have been found inferior to the imported varieties. The new canes are being rapidly propagated on the farm and year by year distributed to the ryots. A smaller cane garden has now been established in the South Arcot district at Palur Farm. It is, of course, quite impossible with these two small farms to supply all the canes asked for, but where possible a few canes at least will be sent to all applicants for experimental growth in the Presidency. These are charged for at the ordinary rates and carriage will also have to be paid. This year Red Mauritius and Striped Mauritius are being distributed, and the canes will be ready for distribution towards the end of January.

SUGAR CANE DISEASE.—A word in passing as to disease. When a cane field has been diseased, the fact should not be forgotten. In the first place replanting canes there should be avoided for some time. Then the water which has passed through the field should

not be allowed to irrigate other canes. It is very possible that the disease is usually spread largely by drainage water. The old dried pieces of canes should be carefully removed and burnt, for the spores of the fungus carrying the disease multiply in them to an enormous extent, and it is the height of folly to allow the dead canes to lie on the land again to be planted with sugar cane. Dead or sick canes should never be thrown into the irrigating channels as is often done.

JAGGERY MAKING.—In conclusion, a few hints may be given as to the manufacture of jaggery, although this is not the main purpose of the present article. There is much room for improvement in jaggery-making; but it is useless to apply general rules for its manufacture without considering the market which it is desired to supply. The jaggery made for the local bazaar is a very different article from that which is intended for export. The bazaar jaggery, unless it is immediately used, is very liable to be spoiled, and an expensive system of smoking is adopted when it is necessary to keep it for some months. With a little care, a jaggery of good color may be obtained which will not turn soft for months. The secret of this is first, to boil the juice as soon as possible after expression, to wash the mill carefully every day, to wash the pots out after using each time with lime and water, and to leave a little lime water in them before pouring in the juice. More lime should be also added to the boiling pan. The jaggery obtained from different canes varies a good deal. That of *Yerra* is turned brown by the rind of the cane, that of Red Mauritius remaining colorless. The jaggery of *Sunna Bile* is extremely soft and will not readily form a cake, while that of White Mauritius and Seema is noted for its bright crystalline character, and so on. This difference in jaggery should be considered in choosing your cane. The jaggery needed for refining by local factories or intended for export is a very different article from that required for the bazaar. It must be hard and crystalline and capable of withstanding much knocking about without becoming bad. Such is only to be obtained by very great care in all the points noted above and using an excess of lime. This turns it very dark in color and it will be quickly stocked and the surplus must be sold to the merchants for export. It will be well then always to make the jaggery as good and as hard as possible, as otherwise considerable loss will be experienced in good years. The merchants will not buy jaggery that is at all soft.—*The Agricultural Journal of India.*

SUGAR CANE IN PORTO RICO.

D. W. May, special agent in charge of the Porto Rico Experiment Station, in the annual report of the Station for 1906, which is a review of the agricultural progress in Porto Rico last year, writes in part, as pertaining to the sugar industry of the island:

"The planting of sugar cane in the island has been largely increased during the year. This increase in the area under sugar has taken place almost entirely in the low ground skirting the coast line. There is, however, an extension also among the first range of low hills; and in sections where the rainfall is abundant, and the soil fairly fertile, very good canes are produced on such lands.

"The 'central system' is growing, and new mills of large capacity have been installed, while those already established have increased their machinery. Several lines of experiment should be carried out with cane, but as this crop is an expensive one to deal with, and the funds of the Station are limited, not much can be undertaken. The Station is planting some improved canes of the island, and has also introduced the most promising canes of the Imperial Department of Agriculture at Barbados, kindly sent by Sir Daniel Morris, Commissioner-in-charge. It is estimated by the British Department that the yields from these improved canes have increased the output of sugar on the same area by about 25 per cent.

"Doubtless an equal increase can be obtained by planting improved canes in Porto Rico. A collection of the best canes from experiments carried on at the Louisiana Station, Audubon Park, has been very kindly sent by Professor R. E. Blouin. Some of these canes have proved very good indeed for Porto Rico conditions, and a number of them, as well as other canes, have been sent out to representative planters in various sections for further tests. Each planter must study for himself the proper manuring of sugar cane, as there is quite a variation in both the chemical and physical composition of the soils planted with this crop.

"A scheme for testing the requirements of the cane by a system of 1-20 acre plots has been outlined by the Station, and a number of planters in different sections of the island have taken it up, and are making an extended study of its requirements. A number of more progressive planters have a small portion of their estates devoted to experiments in cane production, this proving of great interest and value.

"The diseases and insect pests of sugar cane are not causing the planters any serious trouble. There are, however, a number of borers which will in the future cause serious trouble, as cane is being planted on the same land year after year. This constant playing tends to increase disease. Experiments are now under way to determine the best methods for combating these insects. The insect that is causing the most damage to cane is the large borer, *Diatraea saccharalis.*

"In planting new fields of cane, planters are advised to soak their seed cane for twenty-four hours in lime water in order to kill all borers they may contain. Some excellent results have been obtained by this method in reducing the number of insects, even on land that has already been infested. The canes that are to be planted are placed in a tub or tank, water is turned on, and several shovels of lime are thrown on top. This is allowed to stand twenty-four hours when the canes are taken out and planted. Not only is the borer destroyed, but in comparative experiments made at the Station, seed so treated sprouted more quickly, and the number of sprouts sent up was greater."

THE ORIGIN OF NEW SUGAR CANES BY "BUD-VARIATION."

By C. A. BARBER, M.A., F.L.S., Government Botanist, Madras.

One of the most striking facts connected with sugar cane cultivation is the enormous number of varieties which, though easily separable, have the greatest botanical similarity. It is frequently possible to distinguish two varieties without being able to put down clearly wherein the difference between them exists. The difference may be in the form of the joint, in the tinge of color, in the habit of the plant in the field, in its thickness or height, in the richness of the juice expressed. Again, with no external differences at all, there may be such a difference in constitution that, whereas one cane grows clean and healthy and yields a certain crop, the other is swept out of the fields by disease.

Even after prolonged study it is difficult to decide how all these varieties have arisen. There is no doubt as to the ancient character of sugar cane cultivation. While it is probable that the cane was first cultivated in a certain Asiatic region, yet nowhere can we lay our hands on a *Saccharum*, now wild, which presents any probability of being the progenitor of the cultivated forms. The matter is not rendered easier by observing how peculiarly susceptible the sugar cane is to any change in its environment. We cannot tell beforehand in what direction changes are likely to occur, but certain it is that if two canes are taken from one part of the country to another, their characters under the new condition differ, whether in color, form, or sugar-making properties. The pet cane of one region quickly assumes a very second rate character in another, being left behind by a cane which could in no way be considered its rival in the land of its origin. Some improve in their juice and others deteriorate, some change their color and others do not, while some really good canes dwindle to the size of the local "reeds" which are everywhere to be found where sugar cane has long been cultivated.

With these obvious facts before us, there is an entire absence of a good connected series of observations, and we have to confess that we know next to nothing as to the way in which the countless varieties of sugar cane at the present day have arisen.

From this point of view a study of the striped canes, or those which have two main colors alternating in their stems, appears most likely to lead to interesting results. And the first subject for investigation is to try and find out how these varieties have arisen. In all likelihood the yellow or green canes were the first obtained and cultivated, and the others arose as subsequent varieties. The assumption of a red color by the rind of plants under cultivation is by no means an uncommon phenomenon. The striped canes would probably be the last formed, and there is some reason for supposing that each striped cane has for its parents two canes, a red and a yellow one. Such striped canes may have arisen in several ways. Firstly by seminal crossing. While seedling canes appear to be very rare in India, they are not at all uncommon in certain tropical islands; and it is fair to assume that in past times this seminal reproduction was much commoner than it is at present. The practice of growing canes of different varieties in the same field is probably very ancient, and we have a ready means by which the striped canes may have originated. That they have arisen late, among canes already cultivated, appears to be also probable from the fact that the striped canes as a whole are ones of good character from the milling point of view, and while there are numerous yellow and less frequently red canes of a reed-like primitive nature, such canes are hardly ever striped. But there is just sufficient evidence to render it possible that these striped canes have arisen from the apposition of two canes of different colors by natural grafting, and it is possible that some at least of the striped canes are in reality graft-hybrids. The general absence of grafts among monocotyledons renders this less likely but not impossible, and exhaustive experiments are called for to determine whether we may not by this method hope to raise new varieties. But the strongest argument in favor of the origin of striped canes from parents of two different colors is the not infrequent reversion of these varieties into canes of single colors. Such "sports" are by no means infrequent and form the subject of the present paper.

It is a matter of common knowledge among the Godavari ryots that in a field of *Namalu* (striped red and yellow) canes, sooner or later the number of *Keli* (yellow) canes increases. And when we take the Namalu and Keli canes and compare them from a botanical and chemical standpoint, it is difficult to find any real difference between them excepting in their color. There is then a strong presumption that the Keli is a natural sport from the Namalu. And it may be at once asserted that the tendency in the striped canes is always to produce yellow rather than red sports, a fact which seems natural when we consider that the yel-

low canes are probably the older and nearer to the original cane of the primitive cultivation.

The following canes have been noted in the short life of the Samalkota Sugar Station in the Godavari district. The cane known there as the *"Striped Mauritius"* has been seen frequently to sport into green canes and less often into canes of a pure red. There are now good plots of all these canes, and they have been submitted to analysis for two years. There is no doubt that the three canes have sufficient differences, besides their color, in the richness of their juice and in their habit of growth, to constitute well-marked varieties in the ordinary sense of the term. It is quite in accord with what has been suggested above, that the green is the hardier, bunches more readily, and has inferior juice; that the red cane, on the other hand, is little inferior, if indeed it is not superior, to the striped, which otherwise holds an intermediate position between the other two.

The thick striped cane, called on the farm the *"Dark Striped Mauritius,"* has also been identified as the parent of the yellow *"Ivory Mauritius,"* but no red cane has yet been obtained from it. The long striped cane obtained from various parts of South India, called by some the *"Striped Singapore,"* has sported into both red and yellow, but the characters of these have not yet been determined. Finally, the striped cane growing in Mr. Abraham Paudither's garden at Tanjore (which cane may be identical with the last named) has given rise to a new ashy cane which appears to be well worth cultivating.

This mode of origin of new cane varieties has been termed "Bud-variation." After observing the facts described above on the farm at Samalkota three years ago, my attention was drawn to an article in the *West Indian Agricultural Bulletin,* where the subject was exhaustively dealt with. No analyses were, however, published of the different canes arising from bud-variation. As in the cases noted above, it was always a striped cane which showed this phenomenon in the West Indies, Louisiana and Mauritius. It is worthy of note that this bud-variation does not consist in certain buds growing out to form new canes of one color, but isolated buds show *variability* and give rise to shoots of different colors, sometimes, indeed, to a shoot whose base is striped, but which becomes yellow in its upper part. The idea that a bud in the red part of a striped cane gives rise to a red cane, whereas one in the yellow part produces a yellow, is apparently not correct. The canes thus arising appear to retain their characters, and have remained constant for three or four years already.

Now this fact, that the striped canes have alone been observed to "sport," may be explained in two ways. On the one hand they may be true hybrids which have arisen from the crossing of the two one-colored canes, and consequently may have a greater tendency to vary than the one-colored canes. But on the other hand the frequency of the phenomenon in striped canes may be due to

the fact that, while such changes in color are very readily seen in them, they would require very careful observation in the case of ordinary canes. And I think that the latter is more likely to be the explanation. If such is the case, it behooves us to study our fields with much greater care than heretofore. Whenever, in a uniform field, canes appear which show any marked differences from the rest, they should be carefully segregated, cultivated, and analysed. A certain amount of work has been done in this direction at Samalkota, but the results thus far obtained have not been satisfactory. Chance differences which have been observed have not been maintained. But this is no reason why the subject should be dropped, and observations will be continued as opportunity offers.

With reference to the *Striped Mauritius* and its *"sports,"* the more impotant figures in the two years' analyses have been reproduced in the table. The *Green Sports* may be classed as a cane distinctly inferior to the other two, whereas the *Ivory* appears to be distinctly better than the *Dark Striped*. The *Red Sports* during the first year showed such good results that it was thought that a new cane of great value had been discovered. It was accordingly named the *"Gillman,"* after the Collector of Vizianagram, through whose energy and forethought these Mauritius canes had been introduced into Madras. These canes and others obtained in the future will be multiplied, and, in due course, valued and added to those on the farm, or rejected, according as they turn out.

ANALYSIS OF STRIPED CANES AND SPORTS IN THE GOVERNMENT SUGAR CANE FARM, SAMALKOTA.

VARIETIES.	JUICE.	JUICE.	JUICE.	JUICE.	BAGASSE.
	Corr Brix.	Per cent. Sucrose	C.-P.	Per cent. Sucrose	Per cent. obtained by crushing.
Striped Mauritius, 1904-1905	20.44	19.33	94.57	.30	37.23
" " 1905-1906	21.31	19.94	93.57	.67	37.53
Green Sports, 1904-1905	20.29	18.66	91.96	.60	33.92
" " 1905-1906	18.57	16.61	99.45	.93	34.79
Red Sports, 1904-1905	21.35	20.23	94.75	.30	39.67
" " 1905-1906	20.16	18.88	93.65	.67	34.48
Dark Striped Mauritius, 1904-1905	17.06	13.98	81.94	1.54	36.87
" " 1905-1906	16.98	13.95	82.15	1.95	36.86
Ivory Mauritius, 1904-1905	18.67	16.11	86.29	.75	38.96
" " 1905-1906	17.87	15.37	86.01	1.34	40.41

(Agricultural Journal of India.)

RECENT PROGRESS IN THE PRACTICE OF GREEN MANURING.

Though "green manuring" has been practised from very early times it is only comparatively recently that advances in chemical, agricultural and bacteriological knowledge have afforded an explanation of how the beneficial results long known to accrue from "green manuring" are brought about.

The following are the principal ways in which green manures may improve the soils to which they are applied:

(1) The addition of vegetable organic matter to soils deficient in this constituent.

(2) The improvement of the mechanical condition of the soil by the action of the roots of the plants and of the gases evolved when the vegetable matter decomposes in the soil.

(3) The vegetable matter in decomposing gives rise to acids, which act as solvents of the soil constituents, and thus render more material available for plant nutrition.

(4) The fixation of atmospheric nitrogen (i. e. its conversion into nitrogenous compounds) by leguminous plants (e. g. clover, alfalfa and beans), a change which cannot be as cheaply effected by any chemical or electro-chemical process yet devised.

Of these actions the last is probably the most important. Great improvements have been made recently, however, in the production of nitric acid by electrical means, and it is perhaps possible that in the future atmospheric nitrogen may be "fixed" by this means even more cheaply than by leguminous crops.

Many theories as to the actual mode of fixation of nitrogen by leguminous plants have been advanced, but until 1886 the true explanation was not known. In that year Hellriegel and Wilfarth found that while most plants, when grown in sand free from nitrogen, ceased to flourish when the reserve nitrogen contained in the plant itself had been absorbed, leguminous plants sometimes overcame this "nitrogen starvation" and grew well. In cases where growth did occur, nodules or swellings were always found on the roots. It was further found that leguminous plants grown in sterile sand soon ceased to grow well, but that if a little water extract of some ordinary cultivated soil was added the plants recovered, formed nodules on the roots and also became capable of absorbing nitrogen. These nodules upon examination were found to be full of organisms which could only have been derived from the water extract of the cultivated soil which was added. From these results it is obvious that the assimilation of free nitrogen by leguminous plants takes place after the formation of root nodules which are caused by some organism present in cultivated soil.

Different species of organisms were at first thought to be associated with different leguminous plants, but it has since been shown that the different forms described are all physiological

modifications of one organism to which the name *Pseudomonas radicicola,* Beyerinck, has been assigned, and are produced by variations in the conditions and environment.

Various theories have been advanced as to the actual way in which the organisms cause leguminous crops to take up nitrogen. One of these theories was that the bacteria fixed the nitrogen in the soil, from which the plant then assimilated the nitrogenous matter through its roots. Another theory held that the bacteria acted as a stimulus to the plant and caused the plant itself to assimilate the nitrogen from the air. As it has been proved, however, that the organism itself in certain forms can take up nitrogen and store it up in itself as nitrogenous matter even when it is isolated from the plant nodule, there seems little doubt that the organism in the nodule also absorbs nitrogen in this way.

The present view of the case briefly stated is that, firstly, the bacterium in its minute form enters the root of the plant, and secondly, in the root this minute form changes to the rod-like form, multiplies, and fixes nitrogen, and then, thirdly, in the nodule it changes to the branched form which is finally destroyed by an enzyme secreted in the plant, and the nitrogenous matter is dissolved and absorbed by the plant, whilst the nodule gradually diminishes in size.

Although green manuring is occasionally practised with other than leguminous plants, the use of such plants can only increase the organic matter in the soil, whereas leguminous plants not only do this but also increase the nitrogen content of the soil by the direct absorption of atmospheric nitrogen, and consequently it seems that the use of non-leguminous plants is much less advantageous. Leguminous green manures are, moreover, of great value, as they may often take the place of other and more expensive nitrogenous manure such as sodium nitrate, ammonium sulphate, guano, etc.

By the use of leguminous crops such as alfalfa *(Medicago sativa),* clovers *(Trifolium* sp.) or cowpeas *(Vigna Catiang),* poor or exhausted soils may be readily improved. Such plants will generally grow upon these soils, if supplied with the requisite amount of phosphoric acid and potash, which constituents are of small cost compared with that of the nitrogen in nitrogenous manures.

As an example of this it may be stated that the United States Department of Agriculture in 1888 commenced some experiments in the Jack Pine Plains of Michigan where the soil is light, sandy and almost barren. Green manures were principally used together with cheap fertilizers, and in three years an improvement was effected, both in the physical character of the soil and in the yield of the crops grown on it.

From the experiments of Hellriegel and Wilfarth and others it is evident that if leguminous plants used as green manures are to

fulfil their purpose of the fixation of nitrogen, it is absolutely essential that the specific organism should be present in the soil.

It appears that while many soils contain the necessary bacteria, some do not, or only contain it in a form which has lost its activity and cannot produce the desired effect. The first remedy suggested for this deficiency was to inoculate the sterile soil with some soil known to contain the organism. This method involves the disadvantage of the cost of transport and labor as well as the danger of simultaneously introducing insect or fungoid pests and objectionable weeds. In order to obviate these difficultes many attempts were made to prepare cultures of the organism on a large scale.

Of these preparations the "nitragin" of Nobbe was probably the most important, which was a culture of the organism in nutrient agar solution and was said to give good results in Germany, but did not meet with much success in the United States of America.

A complete scientific investigation of the nature of the organism and its action was, therefore, undertaken by the Laboratory of Plant Physiology of the United States Department of Agriculture, the results of which are published in a pamphlet entitled "Soil inoculation for legumes" (Bureau of Plant Industry, Bulletin No. 71). In the course of these investigations many very interesting facts have been brought to light and the conclusions arrived at are of great importance. The most interesting information to the practical agriculturist, however, is that dealing with the inoculation of the soil and the effect produced upon the crops grown. The materials necessary for inoculation as originally issued by the United States Department of Agriculture consisted of three small packages, one of which contained a mixture of sugar, magnesium sulphate and potassium phosphate, another contained some ammonium phosphate and the third a pad of cotton wool which had been soaked in a pure culture of the organism and afterwards carefully dried. In this state the organism retains its activity for some months, while if kept in nutrient agar, it looses its activity in a few weeks. It has, however, been found that the dried cultures on cotton are not wholly satisfactory, and further investigations on the subject have resulted in a modification in which the pure cultures of the organism are issued in hermetically sealed tubes. Full particulars of the new method are given in Farmer's Bulletin No. 240, "Inoculation of Legumes," 1905, published by the Department of Agriculture, U. S. A.

The method of inoculation is as follows. The contents of the first package are dissolved in a certain quantity of clean water and in this nutrient solution is placed the bacterial preparation. The liquid is allowed to stand in a warm place for twenty-four hours, being protected as far as possible from dust and the ammonium phosphate is then added whereby a further growth of bacteria is induced. After standing for another twenty-four hours the solu-

tion becomes cloudy from the growth of the bacteria, and is then ready for immediate use.

Either the seed or the soil itself may be inoculated. In the former case inoculation is effected by thoroughly moistening the seed with the liquid and then drying it in the shade; the seed may then be kept for several weeks before sowing without deterioration. Inoculation of the soil is carried out by moistening some dry soil with the liquid, thoroughly mixing this with a further quantity of soil, and then distributing it over the field. In order to test the efficiency of these methods of inoculation, 12,490 packages of material were distributed free by the United States Department of Agriculture between November, 1902, and November, 1904. In this way some 12,500 tests were obtained in almost all parts of the United States and in many other countries also. Out of 2,502 tests with various leguminous plants only 26 per cent. of failures were recorded, and many of the latter were due to the experiments having been made in places which were obviously unsuitable for the method of treatment.

The following conclusions may be drawn from the results of these experiments. Inoculation is not likely to produce any beneficial effect upon soils which already contain the necessary bacteria or upon soils rich in nitrogen, or again upon soils which on account of their acidity are unsuitable for the growth of leguminous plants. Inoculation is undoubtedly of value where the bacteria do not already exist in the soil, or have lost their activity, as indicated by failure in the growth of leguminous crops and absence of root nodules.

Experiments have also been carried out by the United States Department of Agriculture with such leguminous plants as are suited to the climate and soil of the districts in which Experiment Stations exist, with a view to discovering their value as green manures and as fodder. The conclusions arrived at from the results of these experiments have been published in a bulletin (Farmer's Bulletin No. 16), and the fertilizing value of some of the plants tested is shown in the following table:

FERTILIZING INGREDIENTS IN 100 LBS. OF GREEN LEGUMINOUS CROPS.

Crop	Moisture	Nitrogen	Phosphoric Acid	Potassium Oxide
	lb.	lb.	lb.	lb.
Red clover	80.00	0.53	0.13	0.46
White clover	81.00	0.56	0.20	0.24
Alsike clover	81.80	0.44	0.11	0.20
Crimson clover	82.50	0.43	0.13	0.49
Alfalfa	75.30	0.72	0.13	0.56
Cowpea	78.81	0.27	0.10	0.31
Serradella	82.59	0.41	0.14	0.42

Crop	Moisture	Nitrogen	Phosphoric Acid	Potassium Oxide
	lb.	lb.	lb.	lb.
Soy bean	73.20	0.29	0.15	0.53
Horse bean	74.71	0.68	0.33	1.37
White lupin	85.35	0.44	0.35	1.73
Yellow lupin	83.15	0.51	0.11	0.15
Flat Pea (Lathyrus sylvestris)	71.60	1.13	0.18	0.58
Common Vetch	84.50	0.59	1.19	0.70

Of these plants the cowpea and soy bean seem specially useful, for if the seeds are allowed to ripen they form a very nutritious food for stock, and as only part of the fertilizings constituents is absorbed by the animals the greater part may be returned to the soil in the manure. The seeds of lupins are exceedingly nutritious and are fed to animals in Europe, but the poisonous constituents must first be removed by soaking and steaming; this renders them less valuable than the cowpeas and soy beans, which need no such treatment.

EXPERIMENTS IN CEYLON.

In 1902 experiments with green manuring plants suited to the climate and conditions of Ceylon were commenced at the Royal Botanic Gardens at Peradeniya, and in August, 1905, a circular was published giving an account of the results obtained up to that time and of the experiments proposed to be undertaken or already in progress.

Experiments have been made with the object of ascertaining the best time for sowing and the species which give the best results in association with different crops, such as tea, cacao, rubber, coconuts and rice. The amount of nitrogen absorbed and the effect of various fertilizers on tubercle activity have also been made the subject of an investigation. Of the plants tried Crotalaria striata and other species of Crotalaria, Erythrina lithosperma, Arachis hypogœa, Vigna Catiang and other species, Phaseolus sp. Albizzia moluccana have been most successful. Crotalaria striata has been found satisfactory in young tea clearings, but does not grow well in association with old well developed tea plants unless sown immediately after pruning and fertilized with some soluble artificial manure. On young tea clearings a crop of Crotalaria amounting to 12,000 lbs. per acre has been obtained between July and December from 10-20 lbs. of seed. A plot of land devoted to cacao has given in a year no less than 14,000 lbs. of green material per acre.

As the Crotalaria plant in the green state contains from 0.73 to 0.99 per cent. of nitrogen, a crop of 14,000 lbs. is equivalent so far as nitrogen is concerned to 1,700 lbs. of castor cake or 700 lbs.

of sodium nitrate. The chief advantages derived from the use of Crotalaria striata are: (1) cover to ground is obtained in two or three months; (2) the plants being one to three feet high check the force of the rain and so reduce "wash"; and (3) they do not twine round the stems of the main crop. The chief disadvantages are (1) cost of planting; (2) cost of weeding for the first two or three months; (3) the plants must be uprooted twice a year or much woody matter is formed, which is not suitable for digging in.

The thornless "Dadap" (Erythrina lithosperma) possesses the advantages of being easily propagated from cuttings; and in five months as much as 4,000 lbs. per acre of fresh green material may be turned into the soil, whilst in twelve months 15,000 lbs. may be available. The leaves and twigs which are lopped off contain 0.85 per cent. of nitrogen in the fresh state, and the equivalent of at least 2,100 lbs. of castor cake per acre per year may thus be grown.

The advantages of the use of "Dadap" are (1) the ground need not be forked before planting as is necessary with those plants such as Crotalaria striata, ground nuts, etc., which are propagated form seed; (2) weeding is simplified as it is impossible to mistake the "Dadap" cuttings for weeds, whilst young Crotalaria plants might be thus mistaken; (3) the arborescent form is convenient in association with some crops on account of the shade it affords; (4) the large roots tend to split up the hardened foot-trodden soil.

The chief disadvantages of the use of "Dadap" are that (1) the force of the rain is not much checked; (2) the larger leaves collect some water and lead to a drip on the soil beneath; (3) less protection is afforded to the soil when Crotalaria is planted.

Of the other plants tried, cowpeas (Vigna Catiang), although suitable for planting with some crops, have the disadvantage of twining round the stems of the main crop. Ground nuts (Arachis hypogoea) are also of value under special conditions, and the Pondicherry variety, which yields a large amount of leaf and stem with but little fruit, seems specially useful as a green manure. Albizzia moluccasa is somewhat difficult to establish as it can only be propagated from stumps or young plants, which have been specially grown; it is, however, a very rapid grower and the cuttings are rich in nitrogen.

The influence of various fertilizing materials upon nodule formation has also been investigated by means of pan experiments, and the results obtained are not in harmony with those of the United States Department of Agriculture; thus leguminous plants manured with such highly nitrogenous materials as sodium nitrate, ammonium phosphate, and castor cake showed very slight differences from unmanured plants in the number of root nodules formed.—*Bulletin of the Imperial Institute.*

DENATURED ALCOHOL OF SLOW SALE.

Reports come from New York to the effect that retail dealers are unwilling to buy alcohol in what they think unnecessarily large packages and therefore they are staying out of the market, and so long as the new alcohol is not offered for sale, of course its consumption cannot develop. It seems that by regulation of the Treasury Department, all retailers must buy their alcohol in original packages and the least package thus far offered in New York has been of the half barrel size, which would make a larger package than the small retail druggists are willing to purchase. It is said that five-gallon cans will soon be offered, but it is thought that the increased cost of this will make such alcohol more expensive than wood alcohol, with which it competes and which is sold without these many restrictions. Wholesalers cannot sell denatured alcohol in less quantities than five gallons, excepting to consumers, and small retail dealers are unwilling to buy even that quantity.

Again, the regulations require that retailers of denatured alcohol shall keep a record of the date upon which they receive the packages, the serial number of the packages, the serial number of the stamps, the wine and proof gallons and the date upon which the packages were opened for retail. The record to be kept by the wholesale merchant is still more complex than this one kept by the retail merchant and these many restrictions thrown around it seem to have rather intimidated the trade, which was anticipating very considerable results from this new product. One party went so far as to say that the reason why denatured alcohol was not reaching expectations was from the fact that it was found to fail in the work expected from it. Others deny this proposition, saying that the red tape all along the line is the chief difficulty. Probably the methods of sale can gradually be smoothed up and much of the red tape matter be entirely removed. On the other hand, many of the industrial devices for the consumption of denatured alcohol have not yet come on the market. The various heating and power devices in which it is expected to use denatured alcohol successfully will soon appear and the demand for it must then necessarily increase. The fact that the demand for it has already reached such large proportions in Europe indicates what we must necessarily expect of it in this country. The report in New York at the Second District office, 150 Nassau St., indicates that applications for permits had been received from 62 retail dealers, 37 wholesale and 19 manufacturers. This district reaches from the Battery to 14th street and west of Sixth avenue up to 23rd street.

Our domestic sugar producers are so profoundly interested in this matter that it will be wise for them to lend a hand as far as

they can in promoting the sale of denatured alcohol. Louisiana molasses has already felt the strengthening effect of an increasing demand for distilling purpose and all of the low grade molasses from cane sugar and beet sugar that is not needed for stock feed, can readily be utilized in this way, and hence the importance of increasing the demand for denatured alcohol and thus rendering it an article of merchandise that will be found interesting to all dealers.—La. Planter.

MINING THE PERUVIAN NITRATES.

Nitrate of soda exists in very great quantities in the province of Tarapaca, in beds from one to five metres in thickness, mixed with marine salt, sulphate of soda, and potash. This composition of nitrate has been formed by the waters of the ocean and the deposit of vegetable and animal remains. The waters of the sea have overflowed this region in different epochs, and lakes of large size were formed, which, upon their slow evaporation, left these deposits of various salts.

It is not, therefore, a mixture of marine salts with the guano of birds which have produced the nitrates, as has been supposed by some writers on the subject, for in that case there would exist a certain quantity of phosphoric acid with the sodic and potassic nitrates.

The coarse or rock nitrate is ground, so as to separate the earthly materials, afterward being treated with boiling water, which dissolves the nitrates and recrystallizes them upon cooling, while the waste water contains muriate of soda in solution.

The nitrates are soluble in their own weight of water, and are great attracters of humidity, absorbing moisture readily from the air. The average content in nitrogen is from 15 to 16 per cent., which is absorbed directly by plants without undergoing any preliminary transformation in the soil.

The effect of nitrogen upon plants is of such a noticeable quality that the farmer daily takes account of its efficacy by the darker green of his crops and their earlier development.

This fertilizant is needed in all lands, but none can retain it well that does not contain some quantity of organic materials, as the water carries it away with great facility, and permeable soils thus sustain considerable loss of nitrates.

To overcome these losses, it is suggested that a smaller quantity of nitrate be employed two or three times, until the plants arrive at a certain height, and thus almost all the nitrogen of the fertilizer will be utilized. As nitrate is an incomplete fertilizer, to obtain the best results in large yields and quality of crops, it is necessary

to give to the soil, simultaneously, phosphoric acid under some form or another (phosphate or superphosphate), and potash, if the soil is poor in these plant foods.

A fertilizer superior in some respects to nitrate of soda is the nitrate of potash, which is also extracted from the salt beds of Tarapaca. The mode of preparing it is different from the former. The salt material is washed with a small quantity of water, until a concentrated solution of 14 to 15 degrees Beaumé is obtained; the nitrates of lime and magnesia are decomposed, the potash saturates the nitric acid, and by evaporation forms the nitrate of potash, whose richness is 45 per cent. of potash and 55 per cent. of nitric acid, which corresponds to about 14 per cent. of nitrogen. As the potash is in excess over the nitrogen, other fertilizers should be employed with it, such as animal and vegetable refuse, which are at the hand of every farmer. The decomposed vegetable and animal matters loosen up the soil, allow the gases and humidity of the atmosphere to penetrate it, and keep the land in a fresh and healthy physical condition.—*El Agricultor Peruano*, Lima, Peru.