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THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

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SUGAR PRICES FOR MONTH ENDING OCT. 19, 1906.

	Centrifugals.	Beets.
Sept. 14	4.09375¢	10s. 0¾d.
Sept. 21	4.125¢	9s. 9d.
Sept. 28	4.0625¢	9s. 8¼d.
Oct. 5	4¢	9s. 3d.
Oct. 12	4¢	9s. 5¼d.
Oct. 19	4¢	9s. 6d.

Under date of Oct. 12, Messrs. Czarnikow, Macdougall & Co. report as follows:

The Cuban crop, according to recent reports, promises to be larger than the last, provided weather conditions are such as to enable planters to begin grinding early in December, and continue without interruption. Should such conditions prevail throughout the season, there is no reason why Cuba should not show an output in excess of that of the crop now nearly closed, which up to date shows a visible production of 1,173,000 tons. All danger of political disturbances interfering with the progress of the crop can now be considered eliminated. The question of scarcity of labor in some sections of the Island might make some difference in the production and compel planters in some localities to pay higher wages, but the effect on the total output would not be of any importance. Since the suspension of hostilities, about 2000 immigrants have landed, and many more are expected before grinding begins.

Recent reports from Europe are that the weather is favorable for the field work and growing crop. Mr. Otto Licht's estimate of the German crop is 2,065,000 tons, showing a decrease of 350,000 tons from last year's output, and Gieseker's first estimate of the crop in Convention countries is 4,665,000 tons, a decrease of 886,000 tons. The same statistician foreshadows a production of 6,400,000 tons for the whole of Europe, against 6,970,000 tons last year.

European beet markets have, this week, recovered part of the decline which followed the restoration of peace in Cuba. This

decline had been accelerated by the selling pressure of operators, who had bought for a rise in the event of continued disturbances in Cuba, and, naturally, as soon as that pressure ceased, the market had a recovery. Today's f. o. b. quotations, which are slightly under the best for the week, are: October, 9s. 6d.; November, 9s. 3¾d.; November-December, 9s. 3¼d.; January-March, 9s. 4½d.; May, 9s. 6¼d.

The following is from Willett & Gray's Weekly Statistical of Oct. 18:

RAWS.

The changes of the week have been confined to the European markets. Quotations here have remained steady at 4c. for 96° test Centrifugals with a tendency to ask more for the few cane sugars offering.

Beet sugar opened at 9s. 6d., declined to 9s. 5¼d., advanced to 9s. 7½d. and declined to 9s. 4½. at the close for prompt delivery with November quoted at 9s. 2¼d. and March 9s. 3¾d.

The weakness which has developed is due to the first estimate of the European beet crop made by Mr. F. O. Licht as 6,570,000 tons, which is some 300,000 tons larger than had been anticipated, although nearly 400,000 tons smaller than last year's crop.

In another column we give a summary of the sugar situation as shown statistically by the latest advices of which please take note as of especial importance in anticipating the future.

We also give our new estimate of cane crops, placing that of Cuba at 1,250,000 tons, which accords with the latest data received from the island and depends largely on an early beginning of the crop season and good weather throughout.

Cable advices today speak of a cyclone which struck the island yesterday, but no particulars of damage, if any to crops, is yet at hand.

Receipts for the week were large, say 53,096 tons against requirements for meltings of 48,000 tons. Refiners are indifferent buyers, although they have made some purchase of beet sugar in Europe during the week for October shipment on basis of 9s. 9d. c. and f., equal to 3.96c. per lb. for 96° test Centrifugals.

WORLD PRODUCTION AND CONSUMPTION.

The new beet and cane sugar crops of the world give promise of a good yield, although estimated to outturn 309,799 tons less than the record crops of last season. In the latter campaign the production was in tons: Cane, 4,906,082; European beet, 6,954,000, and American beet, 283,717; total, 12,143,799 tons, while for 1906-07 the total estimates are: Cane, 4,919,000; European beet, 6,570,000, and American beet, 345,000; total, 11,834,000 tons.

A year ago we wrote: "Prices having declined to normal figures, there seems to be nothing to prevent a full and free dis-

tribution of sugar during the next twelve months, for actual consumption and to fill up the depleted invisible stocks, which should cause the largest visible consumption on record."

On September 1, 1905, the world's visible supply of sugar was 1,572,758 tons, to which should be added the production last campaign of 12,143,799 tons, giving a total supply of 13,716,557 tons from which, by deducting the visible supply September 1, 1906, of 1,686,431 tons, we ascertain the consumption during campaign of 1905-06 to be 12,030,126 tons and being 2,500,000 tons larger than the consumption during campaign 1904-05.

It is not possible for the actual consumption to have increased so enormously in one year. We know that there was a considerable increase in the consumption here and in Europe, also in Eastren countries and this might account for 1,000,000 to $1,500,000 tons, but the remaining 1,000,000 tons increase should be considered as having been used to fill depleted invisible stocks and which may be carried over to the new campaign.

A fair estimate of the world's consumption for the coming campaign of 1906-07 would be the average of the last three seasons apparent consumption, say 10,812,348 tons, plus a normal increase of 5 per cent., say 540,615 tons, or a total of 11,352,963 tons, which is about 500,000 tons less than the estimated production, indicating a visible supply on September 1, 1907, of 2,167,468 tons.

The probability is that any changes in the estimates of the total world's production during 1906-07 campaign are more likely to be reductions rather than increases.

We give below our latest estimates of world's production and consumption:

Visible supply, Sept. 1, 1903 (visible stocks small)..	2,119,277
Production, 1903-4	10,323,631
Total supply, 1903-4.....	12,442,908
Consumption, 1903-4	10,816,550
Visible supply, Sept. 1, 1903 (invisible stock small)..	2,119,277
Production, 1904-5	9,536,769
Total supply, 1904-5.....	11,163,127
Consumption, 1904-5	9,590,369
Visible supply Sept. 1, 1905 (invisible small).....	1,572,758
Production, 1905-6	12,143,799
Total supply, 1905-6.....	13,716,557
Consumption, 1905-6	12,030,126

Visible supply, Sept. 1, 1906 (invisible large).....	1,686,431
Estimated production, 1906-7	11,834,000
Estimated total supply, 1906-7.....	13,520,431
Estimated consumption, 1906-7.....	11,352,963
Estimated visible supply, September 1, 1907.....	2,167,468

NOTES.

Immigration to Southern States.—The efforts in various Southern States to encourage immigration meet with the favor of steamship companies, although one of the oldest steamship agents in New York is quoted by the Journal of Commerce as stating that it is difficult to induce immigrants to go South owing to stories of lynching, peonage, etc., of which they hear more or less. The North German Lloyd Steamship Company has had under consideration the establishment of a new line of steamers between Bremen and the Southern States. Plans have now been completed to dispatch a passenger steamship for an experimental trip the middle of October from Bremen to Baltimore via Charleston and Savannah. It would be a good thing for the South if more immigrants were to settle in that section of the country.

Brazilian Sugar.—The sugar interests in Brazil are endeavoring to force their government to effect a treaty of reciprocity with Great Britain by which for benefits conferred upon Canada by Brazil in the matter of articles imported from Canada, concessions to Brazil, particularly to the sugar planters, shall be made by the Dominion. The necessity of securing wider markets for their products is appealing to the Brazilian sugar men, as it appears that the markets of the United States are being effectively closed against them. A decade or so ago Brazilian sugars went to Halifax and Montreal in considerable quantities and are said to have been popular with refiners. The existence of reciprocal treaties with West Indian provinces, however, has led Canada to draw most of its sugar supply in recent years from that source. Brazilian sugar men believe that there would be a big future for their product if given proper assistance in this and some other lines.

Germany Fears Cuban Competition.—The possibility of enormous production of sugar in Cuba is alarming the beet sugar interests of Europe. Professor Julius Wolf of the German University of Breslau, makes the following estimates and statements:

"He states that the present cane fields of Cuba cover scarcely more than 1500 square miles, and that, despite this fact, Cuba already produces more than half as much sugar as Germany, but that 44,000 square miles of arable land are available in Cuba for

sugar culture. Professor Wolf estimates that sugar can now be produced in Cuba at $1.20 per 100 pounds, which, he says, is very much less than the cost of producing sugar in Germany. He indicates a great fear of the injurious competition of Cuba with the Germans for supremacy in sugar production."

Economic Entomology in Hawaii.—Elsewhere in this issue we publish an interesting paper by Jacob Kotinsky, of the Department of Agriculture and Forestry of this Territory, on the "History of Economic Entomology in Hawaii," read at the eighteenth annual meeting of Economic Entomology held at New Orleans, January last.

There are very many countries that have more reason to thank the science of applied entomology than Hawaii. It is largely due to the efforts of our economic entomologists that the planters are able to grow cane at all in these islands, and it is gratifying to know that this branch of science is receiving its share of recognition by thinking men. The financial support and influential backing that have been enlisted in this scientific work have to a great extent given to economic entomology the standing it has now taken, but this also shows the importance of entomology as applied to agriculture and other human concerns.

Irrigation Congress and Philippine Sugar Tariff.—At the Fourteenth National Irrigation Congress, held at Boise, Idaho, last month, a resolution in the following form was adopted:

"Inasmuch as the sugar beet industry in irrigated America returns to our farmers an annual revenue of over $20,000,000, and as the production at home of the sugar we now import from the tropics would afford our farmers an additional annual market for nearly $100,000,000 of beets, and as it has been urged that the United States Congress further stimlate the sugar industry of the Philippine Islands to produce all or a portion of the sugar we of arid America had hoped to produce,

"Therefore, we protest against any further legislative concessions in favor of Philippine sugar and urge that legislative agitation and attacks on the sugar production of this country cease, that this great industry of arid America may be fully developed."

It is reported that there were in attendance at this Congress nearly 1500.

If this resolution represents the sentiments of all or even a majority of those present we may congratulate ourselves on the entry of another strong element opposed to the granting of further concessions to the Philippines and,—by the same reasoning expressed in the resolution—Cuban, sugar, for it is reported there were in attendance at this Congress nearly 1500 delegates representing forty States and Territories, besides several Governors of States, Senators and Representatives in Congress and many others prominent in the progress and development of the country.

CUBA AND ANNEXATION.

Mr. E. E. Paxton recently published in the Pacific Commercial Advertiser an article on Cuba and Annexation, which is worthy of reproduction. Mr. Paxton, in common with others who keep close watch on affairs in Cuba, prophesies that the annexation of that country to the United States will eventually result; but that this may be postponed by united opposition from those home industries that will be overwhelmed by the admission of Cuban products free of duty.

Mr. Paxton's letter is as follows:

"While annexation may be the ultimate destiny of Cuba, I beg to present a few reasons why, in my opinion, it cannot be consummated in the near future, if at all, under existing conditions.

It is easy for anyone at all acquainted with the sugar industry in Cuba to foresee the result if Cuban sugar should be admitted free of duty into the American market. There are approximately only one-half a million acres of land in sugar cultivation in the island of Cuba, while there are at least five million acres suitable for cane cultivation in the island. According to a recent statement of Professor Julius Wolf of the University of Breslau, one of the greatest European sugar experts, if only the very best cane land in Cuba is utilized the island will be able to increase its present production of sugar five fold. Hon. Victor S. Clark of the Department of Commerce and Labor, who has made a careful study of Cuba, says in Commercial Cuba, 1905:

"'Even were only choice lands used we suppose that ten per cent. of the entire area, or five times the present acreage, may be planted in cane.'" This would be six million tons, or more than double the present consumption of the United States.

With the present unscientific methods, sugar is produced on modern Cuban plantations at a cost of not over a cent and a half a pound. The Nipe Bay Company, recently organized, controlling 130,000 acres of land, with a 500-ton mill under construction, based its prospectus on a cost of a cent and a quarter a pound.

RESULTS OF ANNEXATION.

Such cheap production, together with low marketing charges, nearness to American capital and the labor supply of Europe, would, in a very short time, double production under the stimulus of annexation as has been the case in Hawaii, under far less favorable conditions.

America would then export sugar to Europe instead of importing beets and New York would dictate the world's price instead of Hamburg.

The annexation of Cuba would mean disaster to production in the vast territory of the United States now devoted to tobacco, beets and sugar cane.

There is absolutely no question about it; but that very fact is our sheet anchor of safety.

CONSUMPTION OF FREE SUGAR.

The actual consumption of sugar in the United States during the year 1905 was 2,632,216 long tons.

Of this amount there was admitted free of duty:

	Long Tons.
From domestic beet	220,722
From domestic cane (Louisiana, Texas, etc.)	334,522
From Hawaii	376,497
From Porto Rico	124,928
Total	1,056,669

The total amount of sugar admitted free was about forty per cent. of the total consumption.

The total value may be safely placed at $75,000,000.

AMERICAN BEET SUGAR INDUSTRY.

At the present time the production of beet sugar is carried on in thirteen States of the Union. There are at present in operation fifty-five factories with twelve new plants in course of construction for the coming campaign. Much of the late development in beet sugar is in the irrigated regions of the west on desert lands reclaimed at great expense.

The operation of these factories gives employment to a vast number of growers, constituting a considerable proportion of the population of the States where the industry is carried on. The average profits of the beet business are moderate, under normal sugar prices, but have been sufficient to encourage a steady development of the industry during the past several years.

The output has increased from 72,944 tons in 1900 to 350,000 tons estimated for 1906. This shows a steady growth although not alarming for Hawaii as it has not kept pace with the increase of American consumption.

EFFECT OF CUBAN TREATY.

When the Cuban treaty went into effect the industry received a great set-back. Eighty-six new factories were projected at that time, representing a total investment of $50,000,000, all of which but six were abandoned.

If the reduction of twenty per cent. in the Cuban tariff had so detrimental an effect on the industry, it is easy to conceive what the result would be if the entire duty was removed.

DOMESTIC CANE PRODUCTION.

The bulk of the 334,522 tons of cane sugar produced on the mainland in 1905 was grown in Louisiana—at a cost of not less than 2½ cents per pound. While Louisiana production has about reached its limit there are great possibilities in Texas and Florida, especially in the latter State with the proposed draining of the Everglades.

But domestic production can never begin to compete in cost with Cuba.

Porto Rican sugar was admitted free of duty into the United States on the ground that the state of the industry was such that it could not be continued without the benefit of the American tariff.

THE DUTY OF CONGRESS.

Now the annexation of Cuba would mean the annihilation of all of these interests in the course of a few years. It would be a question of life or death to the cane and beet sugar and tobacco industries carried on extensively in at least twenty-six different States and Territories of the Union, having a representation of over half of the United States Senate and a large representation in the lower house.

Is it possible that these representatives in Congress will sit idly by and let their constituents be utterly ruined in order to give protection to Cuba as the result of a revolutionary farce instigated by a few planters and speculators?

TOBACCO INDUSTRY WOULD BE PARALYZED.

In addition to the above enormous interests is the tobacco growing industry of the United States extending over twenty-five States of the Union, of which twelve do not produce sugar. The present annual production of tobacco in the United States is about four hundred thousand tons, representing a value for the raw material of $55,000,000, to say nothing of the great cigar industries at Key West and other points on the mainland.

This industry would probably be paralyzed to a greater degree than sugar by the remission of the heavy tariff existing at the present time and direct competition with the tobacco fields of Cuba.

ENORMOUS LOSS OF REVENUE.

Another very serious problem which would confront Congress would be the loss of revenue incident to Cuban annexation. The total revenue collected by custom houses in the United States during the fiscal year ending June 30, 1905, was $262,060,528. The total revenue collected from sugar imported from Cuba was approximately $33,000,000 during the calendar year of 1905. The total amount collected from all foreign sugars was, in round numbers, $50,000,000, or 19 per cent. of the entire revenues from import duties of the United States.

The annexation of Cuba would, at one blow, wipe out $33,000,000 or 12 per cent. of the present revenue from imports. In a very few years, Cuban production would equal American consumption. No foreign sugars would then be imported, resulting in a loss to the treasury of the total amount now derived from sugar importations.

This would, of course, be offset to some extent by duties on foreign imports into Cuba, but it would fall far short after paying governmental expenses.

Such a disturbance in the fiscal system of the United States would mean a complete revolution in present tariff legislation and open up this subject anew with all its political consequences.

NEW YORK PRICE DECREASED.

It may be argued that the price of sugar will not fall in proportion to reduction of the Cuban duty. The experience thus far under the reciprocity treaty proves directly the opposite.

As a matter of fact while the Cuban crop is being marketed, the difference between the Hamburg parity and the New York price of 96 centrifugals closely approaches the differential in duty on Cuban sugar.

By actual computation during the years 1904 and 1905 the Cubans should have received over $8,000,000, which was intended to be given them under the reciprocity treaty, but which went into the pockets of the American refiners.

CONGRESS MUST FACE ISSUE.

It will, of course, require an act of Congress to annex Cuba or to change the existing treaty relations of that country with the United States which expire in December, 1908. Before such an act can become a law it will have to run the gauntlet of the tobacco, the beet and the cane sugar industries, representing an approximate annual output of $150,000,000, in addition to the sentiment of anti-expansion which has been growing ever since the United States has been burdened with the Philippine problem.

HAWAIIAN AND CUBAN ANNEXATION.

There is hardly a parallel to be drawn in the annexation of Hawaii and that of Cuba.

Hawaii has possibly 300,000 acres of arable land—that of Cuba is estimated at fifteen million.

Hawaiian sugar was already free when annexed—that of Cuba is subject to a duty of $26.96 per ton.

The increase of Hawaiian sugar production has been so small since annexation that it is not perceptibly felt in the American market—that of Cuba would be overwhelming.

Hawaii was necessary as a strategic point, while in Cuba the United States already has the right to take free of cost all necessary naval and coaling stations.

Revenues from Hawaii have increased with annexation, while those from Cuba would be vastly diminished.

I do not mean to belittle the danger of agitation for Cuban annexation or the necessity of the most vigorous opposition by our representatives in Congress, for when the day of free Cuban sugar comes it will be a dark one for the industry in these islands; but I do mean to say that with concerted action of all the interests which would be overwhelmed by free Cuban production the evil day can be postponed for many years to come.

DESCRIPTION OF THE HYDRO-ELECTRIC PLANT OF THE KAUAI ELECTRIC COMPANY AND THE ELECTRICALLY DRIVEN PUMPS OF THE McBRYDE SUGAR COMPANY.

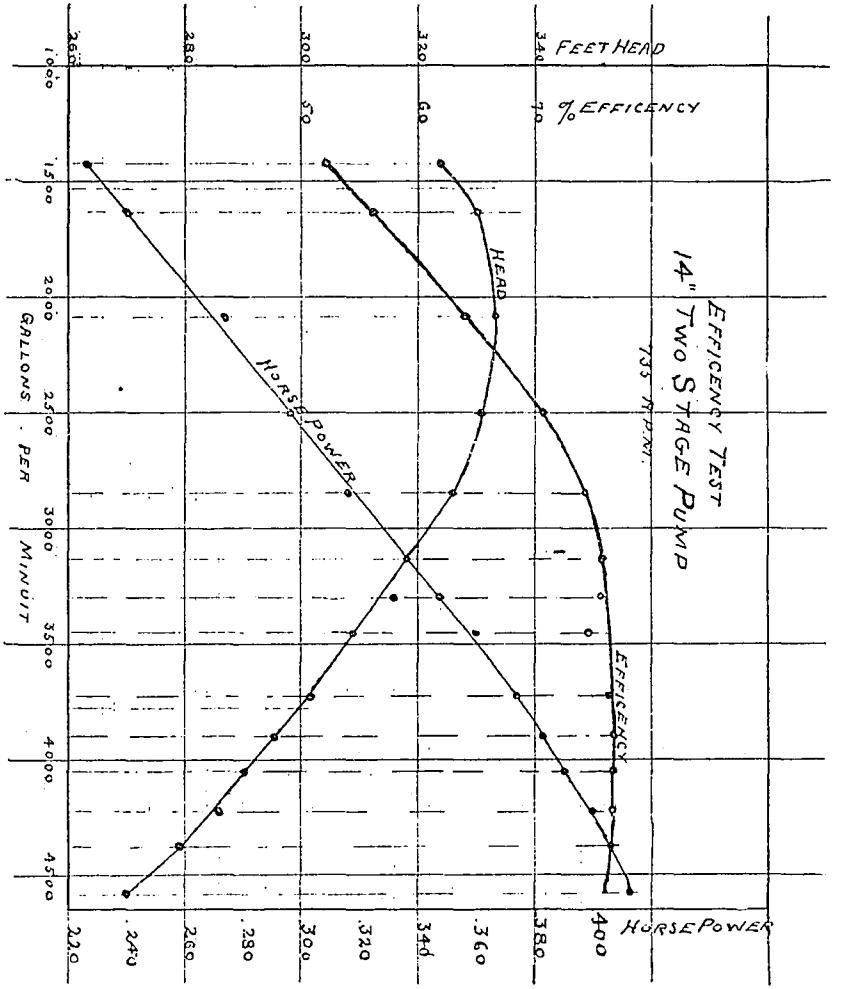
By A. Gartley, *General Manager, The Hawaiian Electric Co., Ltd.*

Read before the Hawaiian Engineering Association, at its October, 1906, meeting.

In presenting this paper to the Engineering Association I shall not go into the details of the organization and promotion of the Kauai Electric Company, but will adhere strictly to a description of the technical details.

The object of the promoters in building an electric plant was to generate power from a mountain stream in Wainiha Valley on the northwest side of the island of Kauai, and to utilize the same in operating pumps at McBryde Sugar Plantation on the south side of the island. It was estimated that about 2500 horse-power would be required by the McBryde Sugar Company.

Preliminary surveys of the water, power-house site, pole


EFFICENCY TEST
14" TWO STAGE PUMP
735 R.P.M.
FEET HEAD
% EFFICENCY
HEAD
HORSE POWER
EFFICENCY
GALLONS PER MINUIT
HORSE POWER
1000
1500
2000
2500
3000
3500
4000
4500
260
280
300
320
340
50
60
70
220
240
260
280
300
320
340
360
380
400

line, ditches, etc., were made in the latter part of 1904. Contracts were placed for conduit, power plant and transmission line in March, 1905, and the plant was completed and formally opened early in August, 1906.

Wainiha Valley is a deep valley which cuts into the heart of Waialeale, a mountain approximately 6,000 feet in height. The valley is about fifteen miles long and receives the under drainage from a large plateau of an elevation of from four to five thousand feet. The Wainiha stream is said to have the most constant flow of any stream on Kauai.

When operations were commenced at Wainiha there were absolutely no facilities for receiving freight, housing the men or transporting the machinery. It was necessary to build a wharf on the beach and connect this wharf with the power-house by a light railroad of 30" gauge and 14-pound rails. Warehouses were built near the wharf to receive the freight, houses were built at the power-house site to accommodate the men and trails were made into Wainiha Valley for the transportation of stores and the material for the tunnels.

WATER CONDUIT.

Water is taken from the bed of the Wainiha stream through the head gates at an elevation of 710 feet and carried through a conduit consisting of tunnels and ditches, there being 32 tunnels and 8 connecting ditches having a fall of .2 per 100 feet.

The tunnels are 6 feet wide, 4 feet high with an arched rise of 2 feet and comprise 17,400 feet of the total length of the conduit.

The ditches are 5 feet bottom, 9 feet top and 6 feet deep and 5-foot berm, the slope on the high side of the ditch being ¾ to 1. The combined length of the ditches is 5,600 feet.

All tunnels are through solid rock and considerable difficulty was encountered with what is known as "Kanaka" rock, it being necessary during construction to install power drills on two of these tunnels.

During the construction of the conduit a careful record of the progress of work on the tunnels was kept and plotted on a tracing from month to month showing graphically the exact conditions.

The head gates are just below a bend in the bed of the stream and advantage was taken of the deflection to construct a large overflow. There is a sluice gate immediately below the overflow to take care of sand and debris deposited in the ditch above the screen. A screen grating placed at an angle of ½ to 1 intercepts any floating debris and is placed immediately above the head gates. There are three 3-foot head gates

operated with a rising screw stem. It was found necessary above the head gates to throw an arch across the ditch and build a stone-wall about three feet above the level of the top of the ditch to deflect the flood water which is at times two to three feet above the level of the top of the ditch. At several points along the line of the conduit where streams cross the ditches or where the tunnels break out into gulches, aprons have been built over the ditches and across the tunnel entrances to carry the storm water, provision being made, however, to receive into the conduit the normal flow of water from these various small streams. One large stream, the Maunahena stream, supplies a daily flow into the ditch of from eight to ten million gallons. There are sand traps, spillways and flushing gates at several points along the line of the conduit, the largest and most important spillway being between the last two tunnels.

Water is received at the lower end of the conduit into a fore-bay of substantial size and construction. The conduit ends in a tunnel on the backbone of a ridge and the fore-bay is excavated out of the solid earth, the total depth being 12 feet. The excavation is lined with a concrete lining 18 inches thick on the walls and 6 inches on the bottom.

There is a 42-inch sluice gate level with the bottom of the fore-bay and, immediately in front of this, and extending entirely across, there is a wall two feet six inches high, the object of which is to act as a baffle to retain the sand which might be precipitated into the fore-bay. This wall also acts as a support for a screen which extends the entire width. This screen is 20 feet long by 11 feet high and is made up of 3-16x3 inch flat iron bolted together and separated with pipe thimbles ¾ inch long. It is placed in the fore-bay at an angle of about ½ to 1 in order that it may be readily cleaned with rakes.

In the front of the fore-bay there are three 42-inch outlets, two of which connect with two pipe lines and the third to be connected to a future pipe line. These outlets are closed with rising screw stem wooden gates. Just outside of the fore-bay there is a riser pipe on each pipe line to admit air into the pipe line when the valve is closed.

A spillway 12 feet wide is provided on one side to take care of the rise of water in the fore-bay which might be caused by the inertia of the water should the pipe line be suddenly shut off.

The level of the water at the fore-bay is 655, the level of the center of the pipe line is 648. This depth of immersion, together with the ample screen area, it is believed, will insure a full pipe of water at all times.

PIPE LINE.

Two pipe lines lead from the fore-bay to the power-house immediately below, a distance of 1700 feet.

The first section of pipe is 42 inches, tapering to 34 inches at a distance of 20 feet, the thickness at this point being 3-16". The 34" 3-16 pipe extends for 880 feet where it is reduced to 30 inches, the remainder of the pipe being 300 feet 30-inch diameter ¼ inch thick; 280 feet 30-inch diameter 5-16" thick; 220 feet of 30-inch diameter 3-8" thick.

The two pipe lines are covered throughout their entire length and are anchored in the trenches at intervals of 150 to 200 feet. The anchorage consists of an angle iron riveted to the underside of the pipe, this in turn having a piece of steel plate riveted to it, the steel plate bearing against two 35-pound steel rails about 6 feet long laid crosswise of the ditch and embedded solidly. This method of anchoring seems to have been very successful. There are three man-holes in the length of each pipe for access to the pipe should stoppage or leakage occur.

There are no air valves or relief valves in this pipe line as only a complete stoppage of the pipe or a complete stoppage of the water wheel nozzles can throw an excessive strain on the pipe. Should the pipe be suddenly emptied a small riser pipe, referred to previously, would be depended upon to supply air.

POWER HOUSE.

The power-house is a substantial iron building supported on a concrete wall, 64x40 feet and has an L constructed of concrete for the transformer house.

There is a traveling crane of 16 tons capacity, carrying two 8-ton Yale & Towne blocks. This crane travels over the entire length of the power-house and has a capacity sufficient to lift any piece of apparatus.

The transformer house has an alleyway 11 feet wide extending down through the center and on each side of this alleyway there are three entirely enclosed fire-proof cells each containing one transformer. The alleyway has a traveling crane of sufficient capacity to handle the transformers and is used as a storage space for an extra transformer. This house is constructed entirely of concrete with an iron roof. Its floor level is 6 inches below the level of the main station, to prevent accident from fire should the transformer oil become ignited or boil over.

Foreign Steamer Time Table.

STEAMERS TO ARRIVE.			STEAMERS TO DEPART.		
Date.	Name.	From.	Date.	Name.	For.
January—			January—		
" 22—	Coptic	San Francisco	" 22—	Coptic	Yokohama
" 22—	Sierra	Colonies	" 22—	Sierra	San Francisco
" 23—	Ventura	San Francisco	" 23—	Ventura	Colonies
" 29—	America Maru	Yokohama	" 29—	America Maru	San Francisco
" 31—	Hongkong Maru	San Francisco	" 31—	Hongkong Maru*	Yokohama
Feb. 1—	Alameda	San Francisco	Feb. 5—	Siberia	San Francisco
" 5—	Siberia	Yokohama	" 6—	Miowera	Victoria
" 6—	Miowera	Colonies	" 6—	Alameda	San Francisco
" 9—	Moana	Victoria	" 9—	Moana	Colonies
" 12—	China	Yokohama	" 12—	China	San Francisco
" 12—	Korea	San Francisco	" 12—	Korea	Yokohama
" 12—	Sonoma	Colonies	" 12—	Sonoma	San Francisco
" 13—	Sierra	San Francisco	" 13—	Sierra	Colonies
" 19—	Mongolia	Yokohama	" 19—	Mongolia	San Francisco
" 20—	America Maru	San Francisco	" 20—	America Maru	Yokohama
" 22—	Alameda	San Francisco	" 26—	Nippon Maru	San Francisco
" 26—	Nippon Maru	Yokohama	" 27—	Alameda	San Francisco
" 28—	Siberia	San Francisco	" 28—	Siberia	Yokohama
Mar. 5—	Ventura	Colonies	Mar. 5—	Ventura	San Francisco
" 6—	Aorangi	Colonies	" 6—	Aorangi	Victoria
" 6—	Sonoma	San Francisco	" 6—	Sonoma	Colonies
" 7—	China	San Francisco	" 7—	China*	Yokohama
" 9—	Doric	Yokohama	" 9—	Doric	San Francisco
" 9—	Miowera	Victoria	" 9—	Miowera	Colonies
" 15—	Alameda	San Francisco	" 15—	Mongolia	Yokohama
" 15—	Mongolia	San Francisco	" 16—	Coptic	San Francisco
" 16—	Coptic	Yokohama	" 20—	Nippon Maru	Yokohama
" 20—	Nippon Maru	San Francisco	" 20—	Alameda	San Francisco
" 26—	Sierra	Colonies	" 26—	Sierra	San Francisco
" 26—	Hongkong Maru	Yokohama	" 26—	Hongkong Maru	San Francisco
" 27—	Ventura	San Francisco	" 27—	Ventura	Colonies

* Calling at Manila.

U. S. A. Transports will leave for San Francisco and Manila, and will arrive from same ports at irregular intervals.

EQUIPMENT.

The station as at present equipped has two 1200 kilowatt generators direct connected to Pelton water wheels, two 70-kilowatt exciters, a switchboard and seven 500 K. V. A. transformers. Allowance has been made for an additional 1200-kilowatt unit.

HYDRAULIC PLANT.

There are two units of 1200 kilowatts each, duplicates in every respect. Each unit is a two bearing, double wheel unit of the overhung type and consists of two Pelton disc wheels, one pressed on each end of the generator shaft. Upon this shaft the rotor of the generator is mounted between the bearings of the wheel. The revolving element is carried in two water cooled, self-oiling bearings. These bearings, the water wheel housing and the generator are carried upon a massive cast iron bed frame rigidly secured with heavy anchor bolts to a massive concrete foundation. The wheel discs are heavy castings carefully balanced and fitted with the necessary number and size of steel buckets to have combined maximum capacity of 2500 H. P. The buckets are cast semi-steel. The shaft is a hollow forged nickel steel shaft 11 inches in diameter at the generator hub and 9¼ inches in the bearing. The bearings are 9¼ inches in diameter, 30 inches long, ring oiling ball and socket type babbited with a high grade babbiting metal thoroughly peaned in and scraped. Each journal barrel is exactly concentric with the machined ball joint and fitted in the concentric machined cast iron ball socket of the pedestal. The shell of each bearing is provided with oil compartments of large capacity and with water cooling compartments through which a constant stream of water is supplied. Oil is carried to the journals with heavy bronze parting rings. This construction insures perfect alignment, the uniform bearing of the shaft and a constant flooding with cool oil.

Water is brought to the wheels through a heavy Y casting bolted to the flanged end of the pipe line (each unit has an independent pipe line). The branches of the Y have attached thereto gate valves of the outside screw yoke, rising stem, Pelton type with nuts and seats of phosphor bronze. They are provided with worm gearing and roller thrust bearings to facilitate operating under pressure. Each gate has a suitable by-pass. There are two water nozzles to each main unit of the needle deflecting type, mounted on cast iron sole plates and provided with forged steel trunion pins working in gun metal bearings. The ball joints are packed with

leather rings to prevent leakage when the position of the nozzle is changed. The nozzles are provided with hydraulic counter-balances and are connected throufh levers and rocker shafts to an automatic governor. A flanged nozzle tip is secured to the end of each nozzle, admitting of renewal. Tips of varying size are furnished from 5¼ to 6¼ inches in diameter. The quantity of water issuing from each nozzle is controlled by a bronze needle which centers accurately with the center of the nozzle tip. This bronze needle is mounted on the end of a steel shaft and is operated with a hand wheel from the power-house floor. The needle end is so constructed as to always give a parallel flow of water concentric with the nozzle tip.

To provide for very accurate speed regulation a Lombard type Q, oil actuated governor is connected to the two deflecting nozzles with a set of levers and rocker shafts and the speed is regulated by throwing on and off the full stream of water. The governor itself is belted to the main shaft of the water wheel unit and receives its actuating oil under pressure from a storage oil tank having an air reservoir on top. This oil is kept under pressure by an oil pump operated with an independent water wheel. Each governor has a small motor mounted upon it which is operated from the main switchboard. The speed may be altered within narrow limits with a push button control. Should the governor become inoperative the governor may be disconnected by throwing a clutch and an auxiliary hand-control device then thrown into mesh enabling one operator to control the nozzles.

The exciters are driven with independent water wheels and on these exciters there are no governors provided. These wheels are mounted directly on the ends of the generator shafts and are covered with suitable housings. The speed of the Pelton wheels is controlled with rigid needle nozzles operated by hand and suitable gate valves. Water is supplied to these wheels with a 6″ pipe connection from the two main 30-inch pipe lines.

GENERATORS.

The main generators are 1200 kilowatt, 2200 volt, 3-phase, 25 cycle, 375 revolutions per minute, rotating field, engine type machines built by the Westinghouse Electric & Manufacturing Company. The rotating part is a solid steel casting pressed upon the water wheel shaft and carries the field coils. The outside frame carries the armature winding and is of the slotted type. The core is built of laminated steel of high magnetic quality built up and pressed upon a cast iron frame. The coils are ribbon wound coils held in the slots by

overhanging teeth of the laminated steel core. The field current is carried to the field coils on the rotating part through cast iron rings. These generators are of extremely good regulation and efficiency and they require but 15% greater current in the fields when operating at 90% power factor than when operating on a non-inductive load. The efficiency at ½ load is 92.75%; at ¾ load 94½%; and at full load 95¾%. They are arranged so that the frame can be moved parallel to the shaft for access to the winding and field coils.

EXCITERS.

There are two 70-K. W. Westinghouse type "S" 125 volt, compound wound, 575 revolutions per minute, exciting generators. These generators have considerable excess capacity for lighting and small power in the machine shop.

SWITCHBOARD.

The current is controlled from the generators to the transformers through a six-panel blue Vermont marble switchboard.

The switchboard has a double set of bus bars and is so arranged that either bank of transformers can be operated from either generator or the generators can be run in parallel. Each generator switchboard is provided with ammeters, poly-phase indicating watt meter, direct current field ammeter, field switch and two non-automatic oil circuit breakers for connecting either set of bus bars, also a synchronizing outfit and volt meter receptacle.

The exciter panel has the necessary volt and ammeters, rheostat mountings and switches.

The transformer panels are each provided with one ammeter and two single-throw automatic circuit breakers.

All the wiring from the generators to the switchboard and from the switchboard to the transformers is carried underground in 4-inch vitrified tile conduits.

TRANSFORMERS.

In order to take care of the output of the station and increase the voltage from 2200 volts to 33,000 volts there are two banks of three transformers each, the capacity of each transformer being 500 kilovolt amperes, with another transformer as a spare. These transformers are known as the Oil Insulated, Water Cooled type, and in addition to the main leads there are auxiliary leads which permit of the use on the low tension side, of 1900, 2000, 2100 volts and on the high tension side of

28,500, 30,000 and 31,500 volts. They are so arranged as to be connected in groups of three, from delta on the high tension voltage to delta on the low tension voltage.

The transformer windings are flat coils, separated from each other by heavy insulation, wound upon a laminated core. The core has sufficient oil ducts through it to permit of efficient cooling. The transformer windings and core are enclosed in a boiler steel case and surrounded with oil. The oil is cooled with two sets of cooling coils made of seamless brass tubing spiral in form. Each transformer is mounted in a compartment by itself and a pipe is carried from the transformer into the tail race to drain off the oil should the transformer take fire or the oil boil over. The valve stem of the valve controlling this oil is brought out into the alleyway to insure safe operation.

The cooling water for the transformers is taken from the main pipe line into a tank placed at a slight elevation above the power-house and is then piped into the main generator room. It is here controlled by a set of valves. Independent connections are taken to each transformer and the overflow from each transformer is brought back to the generating room and discharged into an open funnel, thus enabling the operator to see that each transformer is getting the proper supply of circulating water. Thermometers are fitted into each transformer and have an electric connection so arranged as to make contact and ring a bell should the temperature of the transformer rise to a dangerous point.

HIGH TENSION SWITCHES AND ARRESTERS.

After the current is stepped up to 33,000 volts at the power-house it leaves the transformer house, passing through two sets of high tension switches. This arrangement is made in order that the high tension current may be cut off from each bank of transformers. These two circuits then united and are carried to the main transmission line. Horn type lightning arresters with eight-foot horns and three-inch gap are tapped off the main line and the dead legs are carried to earth through a water resistance.

A set of choke coils consisting of 24 turns of No. O bare copper wire coiled in the shape of a spiral upon a 10-inch circle with 1-inch gap, are interposed in the main line between the lightning arresters and the main switches.

POLE LINE.

The line then extends through Hanalei Valley to the McBryde Sugar Company, passing over mountain ridges and through deep valleys for a distance of 35 miles.

The poles are 30-foot round cedar poles with 10-inch butts and 7-inch tops, buried 6 feet in the ground. The butts are protected by giving them two coats of crude oil before erection and again coating them at the ground line after erection.

The wires are carried in a triangle five feet apart and no transposition is made. The top pin is mounted on the top of the pole and the pole reinforced with an iron band 1½x¼x6″ in diameter. Two other wires are carried on crossarms 6 feet long, 5″x6″ in cross section and slightly rounded on top. These crossarms are bolted directly to the pole with a ¾″ bolt and braced with 1½x3-16x 30″ braces. Where excessive strain is placed upon these crossarms, a double construction is used, that is two crossarms mounted opposite each other on each pole and two blocks are bolted to the top of the pole. The insulators are No. 316 Locke insulators 11 inches in diameter by 11 inches high, the larger part of them being porcelain throughout; some, however, are porcelain tops with glass petticoats.

At some points where sharp turns were made in the line and where the spans are 200 feet or more two poles are used instead of one, the poles being separated from each other by about 8 feet in a line at right angles to the pole line. Two 14′ crossarms are placed on the poles and the wires carried on the same level at a wider separation.

The pins used on the line are of wood made from specially selected eucalyptus stock. The eucalyptus is cut into 3-inch squares and air dried for two years before being used and then turned up and treated with a special paraffine compound. They are 14 inches high, have a 5-inch shank 2 inches in diameter and are driven securely into the tops of the poles and into the crossarms. Where long spans are made and at bad corners a special pin of wood, iron and porcelain is used, the pin being a ¾-inch bolt with a special head and a thread for the insulator of wood. The base of the pin is of porcelain.

WIRE.

The main line wire is seven stranded aluminum cable of 103,850 circular miils, equivalent in conductivity to No. 2 B. & S. gauge copper wire. The wire is secured to the top of the insulator with special soft drawn No. 3 B. & S. solid aluminum tie wire, a special sort of fastening being used.

The wire was received in lengths of 1500 to 3000 feet and splices were made by the use of a special aluminum sleeve. The ends of the wire were inserted from opposite directions through the sleeve, and with the aid of special tools the sleeve was then given three turns, thus twisting the wires together. The seven strands extending from each end of the sleeve were then expended neatly around the wire itself.

The use of aluminum wire on this line has been brought into question by some, but the concensus of opinion of those who have used aluminum wire seems to be, that due to improved methods of manufacture the product now furnished is reliable and that no trouble is experienced when aluminum wire is used due to breaking down or crystallization. The cost of stringing it is less on account of its weight, the joints now used are entirely satisfactory without the use of solder, and there is no appreciable disintegration of aluminum wire from ordinary atmospheric influence. Under usual conditions even on the sea coast aluminum is a durable metal as it protects itself with a thin impervious coating of oxide and in a test made on the Pacific Coast six years' exposure near the sea coast shows a deterioration of less than 4-10 of one per cent.

The weight of aluminum wire is only 47% of the weight of copper of the same length and resistance. Conductivity is from 61 to 63 per cent. that of pure copper. Aluminum is a highly electropositive metal and it is therefore necessary to use aluminum ties and where other metal than aluminum is joined on to it great care should be taken to protect the joint from atmospheric influences with tape or insulation, otherwise the aluminum wire will be damaged by galvanic action.

The spans used on this line are mainly 130 to 140 feet, but in the mountain districts there are several spans over 300 feet and a maximum span of 470 feet.

The expansion of aluminum is nearly double that of copper, but as the strength is not as great it is necessary to give an aluminum line a definite amount of sag corresponding to the temperature observed at the time of erection. A set of curves were drawn and a set of instructions issued to linemen to insure proper erection.

TELEPHONE.

On the main line poles there are two No. 12 copper telephone wires carried on deep groove double petticoat insulators supported on brackets, the upper wire is four feet from the cross-arm and the lower wire on the opposite side of the pole five feet. Transposition is made every tenth pole. One telephone is installed on each end of the line in a specially built booth, the operator standing on a platform insulated from the ground with high tension insulators. Two 1000-volt transformers are connected in series between the telephone wires and the center connection between these transformers is thoroughly grounded, thus freeing the line of all static. The operator experiences no difficulty in communicating over this line.

The construction of the pole line presented many obstacles and the preliminary surveys were made with great difficulty.

The line passes over high ridges between the valleys of Wainiha and Lumahai and between Lumahai and Waikoko, then across and through rice fields to Hanalei valley; it is then carried up a ridge to an extensive table land back of Kalihiwai to the mountain divide between Kalihiwai and Wailua, this section being through a densely wooded country swampy under foot. It then passes along the divide and down the ridge to Wailua and along the base of the mountain range to a gap between Haiku and Lawai. It is then carried over the plantation lands and across several gulches to Hanapepe.

Trails were cut, and roads and bridges built to enable the contractors to take in materials and these were permanent in character to enable the patrolmen on the line to keep the line constantly patrolled. Where streams were crossed a sort of cable suspension was erected carrying a platform so arranged that patrolmen might cross.

HANAPEPE RECEIVING STATION.

At the McBryde end of the line, at what is known as No. 2 pumping station, is built the receiving station of the high tension line. There is one set of high tension switches, choke coils and lightning arresters similar to those at the power house. Four cells built of concrete contain the receiving transformers. These transformers are connected in a bank of three delta to delta with one transformer as a spare, the current being stepped down from 33,000 to 2200 volts. These transformers are Oil Insulated, Water Cooled type of 875 K. V. A. capacity. The low voltage current is carried to a set of bus bars in an adjoining room to a switchboard which controls the distribution on McBryde plantation.

PUMPING MACHINERY.

At the present time there are installed and in operation on this service four large pumping units consisting of:

Two 500 H. P. motors, each connected to a two-stage high-lift centrifugal pump of 5,000,000 U. S. gallons daily capacity against a head of 341 feet operating at 735 revolutions per minute.

One 500 H. P. motor direct connected to a two-stage high-lift centrifugal pump of 6,500,000 U. S. gallons daily capacity against a head of 260 feet operating at 735 revolutions per minute.

One 150 H. P. motor direct connected to a high-lift centrifugal pump of 3,500,000 U. S. gallons daily capacity against a head of 168 feet.

The three first mentioned pumps were built by the Buffalo Steam Pump Works at Buffalo, New York, and the last by the Byron Jackson Machine Works at San Francisco, Cal.

All of the motors were supplied by the Westinghouse Electric & Manufacturing Company.

Current is also taken to the mill, a distance of three miles from the receiving station, and used there on small motors and for lighting.

PUMP EFFICIENCIES.

The pumps which are used on McBryde are of the high-lift turbine type. A complete description of the pumping apparatus built by the Buffalo Steam Pump Company appeared in the Louisiana Planter on September 8th, on page 157. There is also an article in the July number of the Engineering Magazine which covers several makes of this type of pump, the McBryde pumps being included. On page 519 there is an illustration showing one pump arranged for test with motor attached. Figure 7, page 511, and figure 3, page 507, show the internal arrangement of these pumps.

I do not pretend to be an authority on this class of machinery, but from every indication these pumps promise to give extremely satisfactory results. All the parts are rotating and without valves, the runners are both mechanically and hydraulicly balanced and it is a safe prediction that the absence of valves and reciprocating parts will result in extremely small repair bills.

These particular pumps were tested carefully at the works of the pump maker where electric current in sufficient amount and of the correct number of alternations was readily obtainable. The water was measured and the input of electric current to the motor was indicated by meters, the motors were tested for efficiency at the works of the manufacturer before shipment and rarely has an opportunity been presented for determining with equal accuracy the efficiency of any pumping machinery. The attached curve shows the result of the test of the 14-inch pump designed to deliver 6,500,000 gallons per day against a head of 260 feet including friction.

It will be noted that the efficiency of the pump remains practically stationary between two-thirds of the capacity when pumping against a head of 325 feet to its full capacity when pumping against a head of 260 feet, namely 76 per cent. At a point about seven-eighths of its capacity it shows an efficiency of 77 per cent. This I feel will compare very favorably with a reciprocating pump driven with a motor and belt if we consider the losses due to the belting, counter shafting, the many unbalanced parts, slip in the valves and cylinders and friction in the water cylinder packing.

I am not familiar with efficiencies obtained on reciprocating pumps throughout the islands, but I have a firm conviction that there are many of them not giving the efficiencies shown by this high-lift turbine unit.

I have often been asked what efficiencies applied in an electric plant throughout the entire plant. This efficiency will vary widely, depending upon the construction and the class of apparatus installed. The electric and hydraulic apparatus in the plant of the Kauai Electric Company is of as high efficiency as it is possible to obtain at the present time.

The entire electric machinery was furnished by the Westinghouse Electric & Manufacturing Company and the hydraulic apparatus by the Pelton Water Wheel Company. The efficiencies applying here may therefore be cited.

The guaranteed efficiency of the water wheel is 80 per cent., but this efficiency probably reaches 82 or 83 per cent. when operating under its most economical load with a full stream on the buckets. The efficiencies of the electric apparatus are as follows:

Generator, 95.75 per cent.

Step-up transformers, 97½ per cent.

Line, 92 per cent.

Step-down transformers, 97½ per cent.

500 H. P. motors, 92 per cent.

Taking these efficiencies into account the amount of power which can actually be delivered to the motor shaft at McBryde Sugar Company, 35 miles away, is 80 per cent. of the generator output, 77 per cent. of the power on the water wheel shaft and 61 per cent. of the theoretical power in the water. Accepting an efficiency of 76 per cent. for the pump the total water which can be delivered will be 46 per cent. of the actual water flowing into the pipe line at Wainiha.

From the description of this plant the layman may receive the impression that the entire plant is very complicated. The contrary is the case. The effort has been in making this installation to have all the apparatus and equipment as strong and as suitable for continuous and hard operation as possible. The station may be operated by one man on watch and the pumping equipment is far simpler than the station equipment.

The plant has now been in operation nearly three months without a breakdown of any kind. This augurs well for its capability in all parts to stand hard and continuous use.

HISTORY OF ECONOMIC ENTOMOLOGY IN HAWAII.

By Jacob Kotinsky.*

"KOEBELE" METHODS IN ECONOMIC ENTOMOLOGY.

Entomology is never more fascinating to the interested layman in Hawaii than when presented in the alluring light of fighting pests by means of their natural enemies. In fact, this is the only kind of entomology that appeals to him. To the veteran economic entomologist such methods savor too much of "playing to the gallery" to sanction their adoption. And yet, reflected in sober thought, if by his manipulations man has overlooked the danger lurking in introduced insect enemies, has upset the balance of nature, can we not hope that by further manipulation he can further adjust nature with the balance in his favor? In other words, when plants or animals of a country are suffering unremittent serious injury from an insect pest it is reasonable to suppose, first, that the pest is of foreign origin, and, secondly, that the natural check to that enemy has been in some way eliminated. It is evident, therefore, that given the check species and with the elimination of its enemies we must succeed in creating a balance of nature in our favor.

INTRODUCTION OF INJURIOUS INSECTS INTO HAWAII.

When in 1820 the Boston missionaries came to the Hawaiian Islands they recognized the latent capabilities of the soil for yielding good crops, provided the plants were there. Taro and cocoanuts were good, but many more at least as useful plants were known to grow in other tropical and subtropical countries. There remained but the necessity to import them. And so, from that day to this the crusade of useful plant importation has been carried on in a most energetic fashion. Catalogues of dealers in ornamental and useful plants and seeds from the world over were diligently perused, and whichever pleased the fancy of the individual, and later the Government, was introduced, expense notwithstanding. Until comparatively recent times little was it suspected what evil pests these plant importations brought in their train. Fast as the country was being stocked with useful plants, the best from all over the world, it was equally fast being populated with most troublesome and injurious insects and fungi. Failures directly due to some of these were no doubt attributed

* Paper read at Eighteenth Annual Meeting of the Association of Economic Entomologists, held at New Orleans, January, 1906.

to unsuitable climate, soil, etc. Time came when introduced vegetation, itself profusely inhabited by insect enemies that followed in its train about the world, drove the native flora and fauna into the mountain recesses. Time came also when the growing of one crop on immense areas—sugar cane—became a staple industry of the islands. Other crops were sought, and coffee growing seemed promising. But when their natural food increased the insects, too, began to prosper and multiply. The sugar-cane borer (*Sphenophorus obscurus auct.*) the cottony guava scale (*Pulvinaria psidii* Mask.), both introduced with their hosts, inaugurated a campaign of destruction. To save cane and coffee from imminent ruin some active measures against their insect depredators became imperative. The amount and variety of tropical vegetation adorning his dooryard has been from time immemorial the pride and delight of every resident of Honolulu. But these have of late years been marred by "blight." Cutworm, Japanese beetle, scale insect, aphis, and fungus are all "blight" to the Hawaiian. The streets were lined and yards were full of trees and shrubs dead and dying from the effects of a host of species of scale and other insects. Citrus trees and casuarinas were white with the cottony cushion scale (*Icerya purchasi* Mask.) and unsightly black with the dripping honey dew and consequent sooty fungus. Bad as the plants about some deserted residences still look, they stand no comparison with what they must have looked prior to 1890. The success attained by Mr. Koebele with *Vedalia cardinalis* Muls. was still proclaimed by the press, and about 1889 or 1890 this species was introduced into Honolulu. Here, too, this valuable little ally accomplished its mission and lent enthusiasm to the idea of the new economic entomology. In a note in Nature[1] Mr. Perkins records the fact that *Coccinella abdominalis* Say has been introduced, probably accidentally, from California years ago. It would probably have accomplished its task of execution among the aphis here had not its parasite (*Centistes americana* Riley[1]) unfortunately been introduced with it. On his way to Australia, in 1891, Mr. Koebele released in Honolulu several specimens of *Chilocorus bivulnerus* Muls. Specimens of these he observed, though in limited numbers, in 1894 and 1897. None was seen since. So much for economic insect work up to the last decade of the last century.

THE ADVENT OF MR. KOEBELE TO THE ISLANDS.

Although the sugar-cane industry was yearly growing more prosperous, the people of this Territory always feared the possible consequences of depending wholly upon a single industry. The continual agitation for another industry, which, because of the geological character of the islands, must be of an agricultural

[1] Vol. XV, p. 499, March, 1897.

nature, always brought into prominence now one thing, now another. In the early nineties coffee growing was at the summit. Kona (so named from the district on the island of Hawaii where it was grown) coffee had acquired fame on the market for its exceedingly good flavor, and everybody was planting coffee. No one took into account the prevalence of *Pulvinaria psidii* Mask., which seems by that time to have been an old inhabitant of the island. But the day of reckoning was bound to come, and by 1892-1893 coffee fields were everywhere literally white with this scale. Some strenuous measures were inevitable or the new pet industry was doomed. It was useless to attempt to fight the pest with artificial means, because to every acre of cultivated coffee there were hundreds of acres overrun with wild guava, and much coffee grows wild, like cotton in the Southern States.

The Hawaiian sugar planters had by that time begun to learn the value of securing the best to be had of what they needed. They were ever, and still are, a set of progressive and aggressive men and the guiding spirit in movements of the kind we are considering. Mr. Koebele's work in the introduction of *Vedalia* was an inspiring illustration to them of what could be accomplished by means of natural enemies. And so they were determined to repeat the experiment of the Californians and secure Mr. Kobele to carry it out for them. Thus, conditions having attained a climax, the services of Mr. Koebele, the chief exponent of the new school, were engaged in October, 1893. He began, very wisely, by first shipping to Hawaii consignments of beneficial insects, native and introduced, from California. These consignments included several species of Hyperaspis, one of which, *H. undulata* Say, was observed some ten months later, though never seen here again since then. Many *scymnids* also were introduced, of which *Scymnus debilis* Lec., an enemy of *Pseudococcus* sp., is now fairly common. *Chilocorus bivulnerus* was again sent in large quantities; yet, though observed as late as 1897, it was never abundant, and the writer doubts whether it exists upon the islands at present. *Rhizobius ventralis* Er. and *R. lophantha* Blaisd., which are still here and do valuable service, were then introduced. In his report for 1894 to the provisional government of the islands (pp. 98-104) Mr. Koebele lists the coccids found here and the coccinellids introduced from California. At that time, too, he sent several consignments of the toad, which was established here and, with as much cheer as is in the humor of a toad, performed the task imposed upon him of eating *Adoretus umbrosus* Fab. Much good would have resulted from the toad had not the mongoose proven so destructive to it.

About December, 1893, Mr. Koebele came to these islands and made a hasty tour of inspection to determine the nature and extent of the insect invasion. He reported his findings in the 1894

[1] Now recognized as a synonym of *Euphorus sculptus* Say.—Ed.

report, above referred to, and in March, 1894, sailed for Australia. During this trip "he has visited Australia, China, Ceylon and Japan"[1] and sent from those countries many thousands of coccinellids, comprising some 200 species. More species, no doubt, would have been established then had Mr. Koebele had a competent entomologist stationed here to breed and take care of his consignments. For the same reason Mr. Koebele refrained from attempting to introduce parasites, as he states[2] that he sent coccinellids only, principally because he feared introducing new scale insects with the parasites. A very poorly concocted list of coccinellids, sent by Mr. Koebele during that trip, appears in the 1894 report to the minister of interior, pages 31 to 33. Of these coccinellids, perhaps no other species excelled *Cryptolæmus montrouzieri* Muls. Until this day its work of execution is evident on a good many species of Coccidæ. *Pseudococcus filamentosus* (Ckll.), otherwise a very ugly pest on many varieties of plants, dare not show its face for this useful ladybird. *Pulvinaria psiddii*, once a threatening enemy of coffee, guava and other plants, is now far from a common species. Curiously enough, it will not touch the females of *Pseudococcus nipæ*, though it devours males with avidity. Few species of *Pseudococcus* are immune to it, in fact. The large variety of species of Coccidæ that it preys upon make this coccinellid, it seems to the writer, a more valuable insect even than *Vedalia cardinalis*, *Platyomus lividigaster* Muls. and *Coccinella repanda* Thunb., the two most common and efficient aphis-eating coccinellids here, have alone saved many plants, especially citrus, Hibiscus, and sugar cane, from utter destruction. Unfortunately, the latter is subject to attack by *Centistes americana*. Strange to say, this parasite, while scarce in the city, is fairly common in sugar-cane fields. Additional material to *Rizobius ventralis*, too, seems to have been imported about this time. This useful ladybird is still in evidence, especially during the winter months of the year, upon trees infested with *Pseudococcus nipæ* Mask.

Unfortunately, the entomological reports published by Mr. J. Marsden are of too vague a nature to give one an accurate idea of the exact results of Mr. Koebele's importations. But in his roaming style Mr. Koebele gives, in his report to the minister of the interior,[1] a mine of information on the injurious insects, native and introduced, and their enemies found here. Over two years (1894-1896) seem to have been consumed in that trip of exploration, the results of which are no less a triumph than the original introduction of *Vedalia cardinalis* into California.

The shade, citrus, and coffee trees cleaned of their worst scale insects and plant lice, and the sugar-cane aphis materially checked in its progress, the intrepid fighter and acute observer and collector next turned his attention to Lantana and the hornfly

[1] Rept. Min. Int., Dec. 31, 1895, p. 119.
[2] Rept. Min. Int., 1897, p. 114.

(*Hæmatobia serrata* R.-D.), the two great impediments in the way of the cattle ranchman. Mexico being the native home of the former, and the latter being a common pest in the United States, Mr. Koebele turned toward the American mainland in 1898. California, Arizona, Mexico, and Peru were visited, and numerous insects shipped from there, as related in the entomologist's report to the minister of the interior for 1898, page 105. These comprised principally enemies of cow-dung maggots and parasites of the cabbage butterfly (*Pontia rapæ* Schrank). Some 20,000 specimens of *Copidosoma truncatellum* Dalman were liberated with the hope that they would prey on the larvæ of the numerous lepidopterous enemies here. From California a species of rock lizard (*Gerrhonotus carinatus*) was introduced and liberated on Lihue plantation.

In Morelos, Mexico, Lantana enemies were studied, but apparently none were then introduced. The introduction of plant parasites is always fraught with danger, and having been warned by authorities against such an attempt, Mr. Koebele seems to have refrained from the responsibility.

It is interesting to note that in the report last referred to Mr. Koebele devotes nearly two pages to remedial measures against the hornfly (*H. serrata*). This brings us to an interesting point in the activities of an economic entomlogist in Hawaii. Granting that most of our insect pests, consisting, as they do, of introduced species, are most easily and as effectively kept in check by their natural enemies, we must remember that these are not always to be had at the entomolgist's bidding. Repeated attempts to discover effective enemies of *H. serrata* have not met with success.[1] Ten years have passed in the meantime, and only temporary relief has been gained about barnyards by means of artificial remedies. Accordingly, the work of the official entomologist of Hawaii would embrace the following: (1) Efforts at introduction of specific enemies of the various noxious insects; (2) an all-embracing study of the pests, particularly those not checked by natural enemies; (3) experiments with cultural methods and remedies to be employed against injurious insects not otherwise taken care of; (4) a campaign of education along all lines, of those whose material interests are affected by insects. We must reach the happy medium between the two extremes of exclusively "natural" and exclusively "artificial" fighters of insect enemies. In order to render aid to those whose crops or live stock are afflicted with pests not naturally bridled, we must study and prescribe cultural and insecticidal methods. By means of popular, well-illustrated publications we must acquaint our clientele with their enemies and friends in nature. Take clean culture, for example. In so far as it affects the life of the injurious insect we must advocate it. This, of course, implies a knowledge

[1] Dec. 31, 1897, pp. 105-137.

on our part of the methods of cultivation pursued in a certain crop, though on the face of it such knowledge seems beyond the range of our activity. In the absence of an effective enemy of *Sphenophorus obscurus* we advocate the stripping of cane and the burning of trash as a check upon that pest.

We have, it is true, some enemies of the purple scale (*Lepidosaphes beckii* Newm.) in *Chilocorus circumdatus* Gyll., *Orcus chalybeus* Poisd., and *Aphelinus diaspidis,* How., but their economic value is very slight, and we should doubtless follow in wisdom's course by advising to shake the orange tree in order to expel what ladybirds there may be upon it and then spray it with an effective contact wash. Of course wherever possible we must bend our energies to import the natural enemy of every insect that is injurious. If funds for personal importation of such enemies can not be obtained we must resort to whatever other means are available. But we must bear in mind that the planter wants immediate, effective, and inexpensive means of fighting his enemies.

In autumn, 1899, Mr. Koebele went with Mr. George Compere to Australia and Fiji "to collect beneficial insects and plants for these islands," and the results are published in the report to the minister of the interior for 1900, page 36. *Ceroplastes rubens* Mask., once so common here, has been hardest hit by internal parasites sent during this trip. The report just mentioned also includes observations on fruit flies, on the "Olinda bug" or Fullers' rose beetle (*Aramigus fulleri* Horn), on tineids bred from cotton, on silk culture in Hawaii and Maui. From a scientist's (*Acacia koa*)—insects on Hawaii and Maui. From a scientist's standpoint the last report referred to is perhaps the most valuable of all. From this trip Mr. Koebele returned to Honolulu, April 10, 1900, where he remained some two years. Inspection for insects on imported vegetation, which forms so important a work upon these islands at present, was up to that time either entirely neglected or placed in the hands of incompetents. This work seems to have been attended to by Mr. Koebele personally during these two years, and naturally was performed intelligently.

LANTANA INSECTS.

In 1899 the lantana scale (*Orthezia insignis* Dougl.) was discovered at Wailuku, Maui, by Mr. Gerrit P. Wilder. This discovery seems to have alarmed everybody but the ranchers, whom Mr. Koebele found distributing the insect in order to kill their lantana. Knowing the perniciousness of the animal and its destructiveness in Ceylon, Mr. Koebele, too, seems to have been considerably exercised over the coming of this unwelcome guest.

[1] Since writing the above, *Spalangia hirta*, Haliday, kindly determined by Dr. Wm. H. Ashmead, was bred from *H. serrata* pupæ collected on each of the islands.

Without much delay he rushed off to Mexico in the spring of 1900. His mission there seems to have had a dual nature. First, to find and introduce an enemy of *O. insignis;* second, since the ranchmen are so desperately anxious to kill off lantana as to place all vegetable life on the islands in jeopardy, to forestall an additional importation of this kind by introducing enemies of lantana not likely to affect other plants.

In Mr. Koebele's absence Mr. R. C. L. Perkins performed the functions of port inspector. Moreover, it was realized that the introduction of lantana insect enemies must be guided with the greatest possible caution, first, because of the absolute necessity of introducing species that are certain to confine their attention to lantana, and secondly, because Mr. Koebele had discovered that most of the lantana enemies in Mexico are infested with numerous parasites—primary, secondary, and even, I believe, tertiary. Mr. Koebele's superlative caution on the mainland had to be supplemented by a trained, careful entomologist here. For this work, too, Mr. Perkins was called upon, and he performed it, I believe, without remuneration. The tact, wisdom, and painstaking care he displayed in this trying task is borne out fully by the appearance of lantana everywhere at present.

What was accomplished during that trip is little short of marvelous. Perhaps a thousand species found on that plant in its native home were bred, examined, and their possible effects in their new home carefully weighed and considered. After due deliberation a number of them were selected to fight man's unequal battle with lantana. After eliminating their innumerable parasites they were sent on, and, after a second weeding out, liberated here by Professor Perkins. The result of their work is too evident to require comment. As a result of the combination of seed, flower, and leaf insects the lantana is now everywhere decidedly sick. In the lower places, where the water supply is more liberal, the plant is more resistant, but even there it is doomed. It is not our mission here to forecast the activities of these insects when lantana is no more. The primary object of ridding the country of lantana is well-night accomplished, and "apres nous de deluge."

While in Mexico it would seem Mr. Koebele prepared an article on *O. insignis,* which was published in the report of the commissioner of agriculture and forestry for 1902, page 54. Therein the author delineates the past history of the insect, its habits, plants likely to be attacked by it, and remedies against it, should they become necessary. In conclusion he urges strongly against its dissemination over the islands, although it was already known to exist on Maui and Oahu. Locally it is referred to as the "Maui blight."

THE SUGAR-CANE LEAF-HOPPER.

(*Perkinsiella saccharicida* Kirk.)

In Volume XXII, page 123, 1902, of the Planters' Monthly, Mr. Perkins sounds the alarm to the sugar industry in consequence of the sugar-cane leaf-hopper (*Perkinsiella saccharicida* Kirk.). This insect seems to have been introduced from Australia some time in 1897 and confused with the corn leaf-hopper (*Peregrinus maidis* Ashm.), which occasionally frequents cane fields. Ever since its introduction it has been on the increase, enjoying almost perfect freedom from natural enemies. Upon inquiry Mr. Koebele was informed that Mr. Otto H. Swezey had bred some parasites on leaf-hoppers at Columbus, Ohio. Mr. Koebele, therefore, journeyed thither, and bred and shipped many specimens to Mr. Perkins, who was left in charge here. Meantime, a native parasite (*Ecthrodelphax fairchildii* Perk.) was found attacking the cane hopper on Kauai, and numerous specimens of that insect were bred and distributed. Mr. Koebele also shipped hopper parasites from California, which were bred here and released. In the spring of 1903 the Territorial Board of Agriculture and Forestry organized a division of entomology, with Mr. Koebele as superintendent and Mr. Perkins as his assistant: In August of the same year the entomological arm of this Government was considerably strengthened by the addition of such powerful sinew as Messrs. G. K. Kirkaldy and F. W. Terry.

The introduction from the continent, as well as the native parasite, seemed to avail little, and a journey to Australia, the original home of the small but formidable hopper, was undertaken by Messrs. Koebele and Perkins in the spring of 1904. Many predaceous and parasitic insects of innumerable species were sent during this expedition, which closed about a year ago with apparent success. Several egg parasites (names published in Bulletin No. 1, Division of Entomology, Hawaiian Sugar Planters' Association Experiment Station) were introduced which promise to deal the death knell to the hopper host. In August, 1904, a reorganization of the entomological force took place, the Hawaiian Sugar Planters' Association having determined to fight its own battles by establishing an entomological division in connection with its experiment station. For this purpose they have secured the services of all the former entomologists of the Territory, adding Messrs. O. H. Swezey and F. Muir to the force. The Territory, on the other hand, while retaining the partial services of Mr. Koebele, has re-inforced itself by engaging Mr. Alexander Craw, of California port-inspection fame, for the work of inspection and general supervision of its entomological division. Mr. Jacob Kotinsky was secured as his assistant, and Mr. C. J. Austin to help in inspection work.

Not a little credit for this entomological activity accrues to the Hawaiian Sugar Planters' Association. With a munificent liberality and with intelligent, well-directed efforts, in view of the urgent importance of the work, they have spared no pains to secure the best entomological help available to accomplish the desired ends, namely, the exclusion of noxious insects and the introduction of those which are beneficial.

Our history will be far from complete if we fail to record the creditable work in economic entomology accomplished by Mr. D. L. Van Dine, of the United States Hawaii Experiment Station, since its organization four years ago. A follower of methods pursued by the "fathers" of economic entomology on the continent nearest us, he has done much work of value to the inhabitants of these islands in general and to Honolulu in particular. In one respect he has no doubt excelled all other entomologists here, namely, by his peculiar publications and lectures. Our comparative immunity from mosquito onslaughts is due to his undaunted efforts in organizing a mosquito brigade and keeping the pest in check. With his popular bulletins and numerous lectures he has enlightened the lay mind on various entomological topics of immediate interest to everyone. The most regrettable fact in connection with the twelve-year history of economic entomology on these islands is the scarcity of popular literature, but with the present force at work it is to be hoped that this deficiency will be made good.

SEEDLING CANES IN QUEENSLAND.

(From Report of Queensland Acclimatisation Society.)

During 1905, as already mentioned, the whole of the Society's seedling sugar canes which had been growing in the open at Wellington Point and Bowen Park were removed to the new Lawnton grounds, with the result that over 1000 plants of seedling canes in all, comprising between five and six hundred numbered sort, are now established for the first time under something approaching favorable conditions. With the exception of some ten numbered sorts, imported by the Society from the West Indies, all these are seedling cane raised at Bowen Park by the Society during the past few years.

Had the Society been in possession of such conditions as the Lawnton land has now provided for this class of experimental work, it is almost certain that the number of sorts of seedling canes at present being grown on would by this time have been greatly reduced.

In view of the very unsuitable soils and locations heretofore available, it appeared on the whole unwise to discard quite a number of the seedlings until these had had the chance of at least one year's growth under something approaching normally favorable conditions.

In the coming season a great weeding out is inevitable as soon as the various characteristics of the canes have stood the present test, for a great deal more than mere high sugar content is required before any cane can be regarded as worthy of special attention.

For the first time in the history of the Society's experiments, the overseer felt encouraged to trust some of his seedlings raised in the same season to the open ground.

NORTHERN VISIT.

The Council decided that Mr. Mitchell's previous expeditions to the North should be repeated last year. In view of the heavy extra work involved over the initiatory work at Lawnton, Mr. Mitchell was instructed, so long as he was satisfied that fertile cane arrows of good sorts were being collected, to make his visit as brief as possible, and not to delay, as in the previous year, over the intricate work of purposed cross fertilization. Owing to the poor success met with in the previous year, a somewhat later period was also set for the visit.

In the Propagator's report for the month of September, 1905, Mr. Bick informed the Council that cane arrows sent by Mr. Mitchell from Cairns, Ingham, Lucinda Point and Mackay had been received, and that germination was commencing, 30 plants being up by the end of September, while in December, some 150 plants were ready for first potting. Over 150 healthy plants were the final outcome of the Overseer's 1905 visit to the Northern plantations, a result upon the whole gratifying, for it is to be remembered that in all cases the arrows are not simply sent haphazard, because they contain mature seeds, but are all from specially selected canes and varieties.

Some 33 of these seedlings were planted in the open at Lawnton last month, and the balance have been potted on and established for the coming winter in a spare frame at Bowen Park.

PREVIOUS OPERATIONS.

In last year's report, the writer gave a short resume of the Society's efforts and progress in the raising of seminal varieties of sugar cane, to which members who may desire to trace the experiments from their beginning, are referred.

ANALYSES IN 1905.

Steps were taken with the courteous coöperation of the Government (Department of Agriculture and Stock) to continue the invaluable analyses lacking which only slow progress would be

possible. The services of Mr. Brunnich, Government Chemist, were again made available, and to him were submitted last September some twenty-four varieties from the Wellington Point grounds.

Owing to the repeated enforced removals and the various vicissitudes to which these sugar canes have been from year to year subjected, it has been impossible to send always the same varieties forward for analysis each year, as is desirable and should be feasible in the future.

For instance, a cane that may have shown satisfactory growth in the directions that have to be considered one year, in the next season may have been lacking in some one or more desirable characteristic attributable possibly to an undue bad effect of the season through the plant having been relegated under some enforced removal to some unsuitable position.

However, as comparison will show, it has been possible in some cases to secure consecutive yearly analyses, and these, upon much extended lines, it is hoped can be arranged for now that uniform treatment and growth of the whole stock of seedlings has become possible.

The following was the result of Mr. Brunnich's 1905 analyses of canes grown at Wellington Point:

ANALYSES OF SEEDLING SUGAR CANES FROM ACCLIMATISATION SOCIETY'S GARDENS, GROWN AT WELLINGTON POINT.

No.	Corr. Brix.	Cane Sugar.	Fruit Sugar.	Quot.	P.O.C.S.	Average Weight per Stick.
17	18.20	16.53	.53	90.8	15.70	1.25
30	20.11	19.33	.07	96.1	18.55	1.06
53	20.01	19.06	.13	95.3	18.11	1.46
54	21.81	20.73	.06	95.0	19.65	1.54
64	20.81	19.60	.20	94.2	18.39	1.25
77	21.11	19.40	.29	91.9	17.69	1.12
80	21.01	20.33	.10	96.8	19.65	1.50
102	19.70	19.06	.23	96.7	18.42	1.22
115	21.11	19.80	.14	93.9	18.49	.88
128	20.31	19.76	.15	97.3	19.18	1.0
129	20.28	19.40	.29	95.7	18.92	1.63
116	20.58	20.03	.10	97.2	19.48	2.0
6	21.35	20.27	.19	94.9	19.19	1.22
55	20.55	19.2	.11	93.4	17.85	.85
67	18.87	17.7	.11	93.8	17.53	1.5
96	19.47	18.0	.39	92.5	16.53	1.22
121	21.38	20.17	.08	94.8	18.96	1.29
140	17.86	16.2	.45	90.8	14.54	.79
177	19.47	18.33	.10	94.1	17.19	.83
237	20.88	20.5	.13	98.2	20.12	.94
278	20.58	20.37	.12	99.0	20.16	.58
279	20.57	19.13	.26	93.1	17.69	1.67
290	19.57	18.07	.16	92.4	16.57	.75
372	11.74	6.67	.33	56.8	1.67	1.22

(Signed) J. C. BRUNNICH,
Agricultural Chemist.

Department of Agriculture and Stock, Chemical Laboratory,
14th November, 1905.

COMPARISON.

Inspection of the above series of analyses with those made in the two preceding years shows the following:

Analyses made in	Number of Seedlings Tested.	Number of Canes containing over 17-50 P.O.C.S.	Proportion of high density Canes to Total.
1903	150	23*	Under 1/6th
1904	65	23	Under 1/3rd
1905	24	18	Exactly 3/4ths

*Not 24 as given in error by the writer in preceding reports.

In this relation, comparison of the tables will show that it has not been a question—for the reasons already given—of just testing and re-testing each year the best varieties, under which circumstances a big proportion of high density canes might be expected, but that each season the collection available for the analyst has included quite a number of new seedlings not before tested.

For instance, one half of the total 24 canes tested in 1905 by Mr. Brunnich had never been in his hands before.

These remarks are necessary to show that, outside those regarded as the most hopeful of the seedlings, there are canes coming on which, under the test of the analyst, would appear to be of equal promise.

Taken in another way, as evidence that the apparently improved general standard set up in these seedlings is being well maintained we find that, while in 1903 the best 23 seedlings tested, viz., those yielding above 17.50, gave an average of 18.34 P.O.C.S., in 1904, a similar number gave an average of 18.55, P.O.C.S., and this, although only four of the 1903 lot were re-analyzed in 1904. And in 1905, the 18 seedlings ranging over 17.50 gave the extremely satisfactory average of 18.77, P.O.C.S., and in this case again, 6 of the 18, or one-third of this batch of canes, were being tested for the first time.

To follow some of the best of the canes as tested to date, through all the various analyses, as was commenced to be done in the last report, and we have the following figures representing P.O.C.S. (pure obtainable cane sugar):

	Year of Analysis.		
No. Cane.	1903.	1904.	1905.
80	18.85	18.27	19.65
115	20.0	19.17	18.49
116	18.67	20.11	19.48
237	16.78	20.21	20.12

Next year's results will be watched with very great interest, not only as regards the four canes included in the last figures, but also concerning a fair number of other seedlings the analyses

and other characteristics of which give saatisfactory promise.

It is hoped in the next report that much extended details of a dozen or more canes may be forthcoming. While it would be premature to express any pronounced opinion, the Council feel that, judged to date, the Society has good reason for congratulation upon what has been so far achieved, in which connection the remarks of last year may be repeated and re-endorsed here:

"It must suffice to say that the Society's efforts, like those recorded in the West Indies, have been so far crowned with much greater success than could have been reasonably looked for. As a fact, the Society's efforts, so far as analyses show to date, have been more successful, a greater number of high-grade canes would appear to have been proportionately secured than were obtained in the West Indies. This is no doubt due to our very careful selection of the seedling arrows from high-class sorts."

If it be asked what do the figures in the last table comparatively indicate, it may suffice by way of one comparison to quote Mr. Easterby's analysis made in the same season at Mackay, of which mention is made hereafter.

Mr. Easterby made at that time analyses of the 18 best canes at the show, and it is to be remembered that the season was a good one, and that amongst the varieties were such fine sorts as B. 208, Goru, etc. The highest result of sucrose in juice was in B. 208 at 17.48, and a quotient of purity of 97.1, while the average of these show canes reached only 13.33, with an average quotient of purity of under 84, while the Bowen Park canes in the table, averaged in P.O.C.S., 19.43, with a quotient of purity of over 96, with the highest giving 20.12 of P.O.C.S. and a quotient of purity of 98.21.

OTHER ANALYSES.

A further series of analyses were carried through by Mr. Brunnich last year, dealing entirely with the batch of seedling raised in 1903, and first planted in the open at Bowen Park last season, and none of which had of course been previously available for analysis.

A selection of these canes was sent on to Mr. Brunnich, although it was evident little could be expected in the way of result for the reason that while the canes made a fairly good first growth they suffered so severely when the dry spell came in the early winter, planted as they were in the shallow uncongenial soil at the Park, that it was a question whether any would survive, and indeed a severe frost in the winter, in conjunction with other set-backs, disposed of a number of them.

So indifferent was the growth of these canes that the chemist did not attempt to weigh any and returned against five of the samples the ominous word, "diseased," which, doubtless, they were, judging from the very wretched soil conditions found at the roots when the stools were examined later on.

In a word, the highest content of P.O.C.S. in any of these canes was fractionally over 12%, a return which under normal conditions of soil and growth would have condemned the whole lot to fire or a rubbish heap.

As things were, it was considered quite worth while making a planting of these varieties at Lawnton, and judging by the way the not over satisfactory cuttings which were available are now growing, this course was warranted.

SEEDLING CANES IN MAURITIUS.

In the Annual Report on the Station Agronomique in Mauritius for 1905, the following reference is made to the raising of seedling canes:

"As in preceding years, the station continued to raise seedling canes, and from 1800 to 1900 young plants have been planted out.

"A certain number of cuttings of the previously selected cuttings have been distributed. The varieties distributed have already been cultivated at the station and cut as plant canes, and have been allowed to ratoon where they had given good results; they are worthy of trial on other estates, and under other cultural and climatic conditions. It is only after these further trials, for the above-mentioned reasons, that we can propagate them and extend their cultivation.

"We may mention that persons desiring to obtain these varieties have only to communicate with the station, which will fulfil orders as far as the supply at its disposal will admit."

It might be mentioned that seedlings were successfully raised in Mauritius shortly after the discovery of fertile seed in Java and Barbados, a large number of which were distributed to estates. These seedlings gave such good results that managers frequently started seedling nurseries of their own, with the result that much confusion in nomenclature followed.

Although many of the seedlings have proved to be worthless, and others have shown great variability, a considerable number have been produced, which show, not only a greater saccharine content than the older varieties, but also a greater resistance to disease. In consequence, they have given a larger yield of sugar per acre than most of the older varieties.

SUGAR-CANE SEEDLINGS IN JAVA.

In 1894, Dr. J. H. Wakker, then Director of the East Java Sugar Experiment Station, found that the Cheribon cane bears infertile pollen at the time when the ovary is normal, and may, therefore, be considered a "female" cane, while other varieties produced abundant quantities of fertile pollen.

A description of the method of planting by which natural cross-fertilization is obtained will be found in the *Agricultural News* (Vol. I, p. 146).

This method of planting alternate rows of "male" and "female" canes has been closely followed in Java, and numerous seedlings have been obtained which have given encouraging results.

The *Jaarverslag* for 1905 from the Proefstation Oost-Java shows that in 1905 over 16,000 sugar-cane seedlings were raised. The parentage of 7170 of these was known on both sides, for they were produced by the method above mentioned; 7460 other cane seedlings were obtained from seed collected from the best seedling varieties, the seed-bearing parent only being known with certainty. In all, therefore, something was known of the pedigree of 14,630 out of the 16,000 young seedling plants. The season was very propitious, and this large production of young cane seedlings appears to be a record and is to be favorably contrasted with the production of 580 young plants in 1904, when the season was not so suitable.

DENATURED ALCOHOL.

INVESTIGATION IN EUROPE OF ITS COST AND USE—WHAT MAY BE EXPECTED IN THE UNITED STATES.

Internal-Revenue Commissioner Yerkes and Congressman E. J. Hill, of Connecticut, recently returned from Europe, where they made an examination of the working of regulations for free denatured alcohol in Great Britain, France, and Germany, and have furnished some interesting information on the subject.

Representative Hill says that, spurred on by the keenness of German competition, Great Britain has found it necessary to make much more liberal provision for the use of free alcohol than heretofore. Where a 10 per cent. denaturant had been used formerly, only 5 per cent. will hereafter be used, thus materially reducing the cost. Beside that, the cost of supervision, which has heretofore been thrown upon the consumer, will, under the terms of the bill, be hereafter paid wholly by the Government. The investigators also found that Australia had taken the matter up and that every probability exists for a law being passed very similar to that adopted by our Congress at its last session. France is paying a bounty of 5 cents a gallon on all completely denatured spirit. Mr. Hill says that in Manchester there are two large factories where denatured alcohol is being used in the manufacture of hats. At one fac-

tory the proprietor said that he paid from 30 to 32 cents per gallon for denatured alcohol. They bought their spirit on printed requisition forms and were under bonds to the Government for its proper use. A Government inspector came into the factory whenever he chose to do so. The manufacturers use the spirit, recover it, and redistill the product in their own factory and use it over again until it is used up. The only restriction placed upon them was that they were not allowed to sell either the original or recovered spirit, but aside from that used it as they pleased.

The mixture which was there used consisted of 90 per cent. ethyl alcohol, 10 per cent. methyl alcohol, with 3 per cent. of benzine added. Under the provisions of the new law the 10 per cent. of wood spirit will be reduced to 5 per cent. The benzine is not required to be added except where recovery and redistillation is practiced. Mr. Hill said that they had no trouble in buying completely denatured alcohol as freely as they could buy any other article kept for sale, and he thinks that the same freedom of use should be accorded to the hat and other manufacturers of the United States.

A DENATURING ESTABLISHMENT IN LONDON.

Mr. Hill tells of visiting an extensive establishment near London for denaturing alcohol. On the ground floor were four large iron tanks holding about 2,500 gallons each. On the next floor were 21 casks of spirit which had been brought under seal from the bonded warehouse. On the third floor were the wood-alcohol tanks, and on the fourth floor cans of methylated materials. On the fourth floor the covers to the wood-alcohol tanks were removed (these tank covers were flush with that floor) and the contents gauged and tested. The quantity to be put into the tanks on the first floor was run off through pipes connecting with the first-floor tanks and the upper tanks relocked. Then going to the second floor, each cask of the grain spirit was gauged and tested and the tank covers, which were flush with the floor, were removed and the casks of the grain spirit were run into the tanks below. The mixture was then stirred with long-handled wooden paddles and the tank covers replaced, and the material was ready for sale free of tax. The mixture was 10 per cent. wood alcohol and 90 per cent. ethyl alcohol made from molasses, and was what is known as the ordinary methylating spirit used for manufacturing purposes only and used under bond. The completely denatured spirit is made by adding to the foregoing three-eights of 1 per cent. of benzine.

Mr. Hill said one of the professors at the institution in Germany, known as the Institution of the Association of the

United Alcohol Manufacturers, which is operated and maintained for educational purposes at the expense of the trust, referring to the statement prevalent in America that the use of alcohol in the internal explosion engine resulted in the corrosion of the metal, remarked that that was nonsense, and immediately took Mr. Hill into a distillery where a large engine had been in continuous use with alcohol for the past six years. He admitted, however, that they had not fully overcome the difficulties with regard to the use of alcohol in the high-speed automobile, but expressed entire confidence that it would only be a short time before that would be accomplished.

INDUSTRIAL RESULT OF THE COST OF ALCOHOL.

The strongest alcohol of commerce in the United States is usually 95 per cent. alcohol, and the price varies from $2.30 to $2.50 per gallon, showing that the greater part of the cost is due to the revenue levied by the Government. The greater part of the 60,000,000 gallons of alcohol consumed in the United States is used in the manufacture of whisky and other beverages. The revenue tax prevents the use of alcohol to any great extent in the industries of the country. The bill passed at the last Congress, designed to promote the use of untaxed alcohol in the arts and as fuel, takes effect January 1, 1907. The first effect of free alcohol will be, it is said, to supplant the 12,000,000 gallons of wood alcohol which are used in the manufacture of paints, varnishes, shellacs, and other purposes. Another use that is expected of denatured alcohol is in the manufacture of certain products, such as dyestuffs and chemicals, which can not now be manufactured commercially in this country because of the high cost of alcohol, and which are imported largely from Europe. A very rapid development of the industry of manufacturing chemicals as a result of free alcohol is looked for. In the production of alcohol there is always formed as a by-product a certain amount of fusel oil, which is very useful in manufacturing lacquers which are used on metallic substances, fine hardware, gas fixtures, and similar articles. The industries manufacturing these wares will undoubtedly receive a great stimulus as a result of cheaper fusel oil caused by the increased production of alcohol.

A SAFE FUEL.

The use of denatured alcohol as a fuel has yet to be fully developed. Although alcohol has only about half the heating power of kerosene or gasoline, gallon for gallon, yet it has many valuable properties which may enable it to compete successfully in spite of its lower fuel value. In the first place

it is very much safer. Alcohol has a tendency to simply heat the surrounding vapors and produce currents of hot gases which are not usually brought to high enough temperature to inflame articles at a distance. It can be easily diluted with water, and when it is diluted to more than one-half it ceases to be inflammable. Hence it may be readily extinguished; while burning gasoline, by floating on the water, simply spreads its flame when water is applied to it. Although alcohol has far less heating capacity than gasoline, the best experts believe that it will develop a much higher percentage of efficiency in motors than does gasoline. Since gasoline represents only about 2 per cent. of the petroleum which is refined, its supply is limited and its price must constantly rise, in view of the enormous demand made for it for automobiles and gasoline engines in general. This will open a new opportunity for denatured alcohol. Industrial alcohol is now used in Germany in small portable lamps, which give it all the effects of a mantel burner heated by gas. The expense for alcohol is only about two-thirds as much per candlepower as is the cost of kerosene. Even at 25 or 30 cents a gallon, denatured alcohol can successfully compete with kerosene as a means of lighting.

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	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	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	**	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. B 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	††	Jno. C. Searle	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	* x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	Frank Scott	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.

*	(5)
**	(8)
***	(1)
x	(9)
*x	(8)
**x	(6)
x*	(6)
x**	(2)
x*x	(2)
††	(2)
xx	(1)

HONOLULU AGENTS.

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