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Sugar Plantations, Cane Growers and Sugar Mills.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
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Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers	Waimanalo
Oahu Sugar Co.	x	E. K. Bull	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Alea
Laie Plantation	x*	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Maui Agricultural Co		H. A. Baldwin	Paia
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Kihei Plantation Co.	x*	James Scott	Kihei
HAWAII.			
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Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
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Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
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Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	**x	Jas. Webster	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
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Union Mill Co.	*x	H. H. Renton	Kohala
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Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
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Olaa Sugar Co.	xx	J. Watt	Olaa
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KEY.

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

HONOLULU AGENTS.

THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

[Entered at the Post Office at Honolulu, T. H., as Second-class matter.]

Vol. XXV] HONOLULU, JULY 15, 1906. [No. 7.

SUGAR PRICES MONTH ENDING JULY 17, 1906.

	Centrifugals.	Beets.
June 19	3.50c.	8s. 1½d.
June 26	3.53125c.	8s. 2¼d.
July 3	3.71875c.	8s. 4½d.
July 10	3.71875c.	8s. 4½d.
July 17	3.71875c.	8s. 3¾d.

Messrs. Czarnikow, Macdougall & Co., under date of July 6, say:

The Cuban statistics for the week show receipts of only 1,000 tons, against 5,000 tons last week and 6,000 tons at the corresponding period a year ago. These figures prove that less sugar is now being made than at the same time last year, even though the actual production of the six estates at the outside ports, which are now at work, is not included until the corrected figures are issued at the end of the month.

The world's consumption has increased considerably during the last eight months, the European figures showing 900,000 tons increase over the same period of last year, and when we come to figure the consumption for 1906, it will be found to greatly exceed that of last year. The prime cause for the increase in consumption is that large quantities of sugar have been absorbed by the invisibles supplies which are always increased when low prices prevail and diminished when prices are too high, as was the case last year.

The European beet market has shown a little more strength, presumably due to the rumored sales to United States, but the continued favorable news of the weather has prevented any marked advance in prices, and from now on weather news in Europe will have a very important influence upon both cane and beet markets.

Willett & Gray in their "Weekly Statistical," dated July 12 report as follows:

The advance in value of Cuba Centrifugals to the parity of European beet sugar has brought the anticipated action.

It is now confirmed from London that at least 17,000 tons of beet sugars have been taken for the U. S. at basis of 8s. 4½d. f. o. b. Hamburg for 96° test Centrifugals at New York, equal about 3.74c. duty paid.

Naturally this meeting of prices in competition with Cuba has held in check any further advance in the latter, and in fact, prices are scarcely maintained at the full advance, the latest sales being made at basis of 3.72c. duty paid for 96° test, against 3.75c. at the close of last week. Bids are now out at 1-32c. less than this price, say 2 5-16c. c. and f., basis 95°, equal to 3.70c. duty paid for 96° test, which were accepted to the extent of 75,000 bags. We continue our quotation of 3.72c., basis 96°, as the spot value, as a lot of Porto Ricos were taken today at that figure.

As Europe now fixes values, rather than Cuba, it is worthy of note that European markets have remained steady, but dull, during the week, at 8s. 4½d., except on one day, when the fluctuation touched 8s. 5¼d.

The source of greatest confidence in the market maintenance is in the fact of the very large increased demand for refined sugar for direct consumption.

It certainly is much more satisfactory to all concerned in the sugar trade to do business on rising markets for both raws and refined as is the case this season rather than on falling markets as was the case last season.

Everyone can buy and carry stock largely without fear of loss from declining markets.

The amount of raw sugars which will be required from distant lands will hold the markets steady at least for the remainder of campaign with the certainty that any changes of importance will be on the side of advancing prices.

The general world situation of production and consumption of sugar is thus set forth by F. O. Licht under date of June 15:

The production of beet sugar during the first nine months shows an increase of 2,116,000 tons, against the preceding year. Imports show for Europe and North America together a surplus of 159,000 tons, for Europe alone a such of 189,000 tons, while the stocks on September 1st, in Europe and North America together, were 293,000 tons smaller, in Europe alone 350,000 tons smaller than 12 months previously. From the sum of these 3 groups of figures, there results for Europe and North America together a more of 2,082,000 tons, and for Europe alone a such of 1,955,000 tons. At the end of May the

stocks in Europe and North America together were 831,000 tons, in Europe alone 728,000 tons higher, than 12 months previously, and the consumption, taking into account an increase of 886,000 resp, 887,000 tons in the Exports, showed during the 9 months an increase of 366,000 tons, for Europe alone an increase of 341,000 tons. But for the twelve-month ending end of May, there results for Europe and North America together an increase of 152,000 tons for Europe alone, a such of 130,000 tons.

DENATURIZED ALCOHOL.

The following communication, addressed to the secretary of the Honolulu Engineering Association, was read at their meeting of July 13, 1906:

Mr. E. G. Keen,
Secretary Hon. Eng. Association:

Dear Sir: Several articles have lately appeared before the public regarding the making of denaturized alcohol.

As represented in some of the articles, alcohol will play quite an important role as a product of Hawaiian manufacture. The following questions, which I respectfully put for discussion before this Association, will, I think, not only interest the engineer, but a large number of people who may figure as producers or consumers:

Question I.—From what other materials, besides the waste molasses from our sugar factories, may alcohol be profitably made?

Question II.—What will it cost per gallon of say about 90° strength, to manufacture?

Question III.—How much alcohol may be expected from the waste molasses of one ton of sugar manufactured?

Question IV.—In which way may the alcohol be profitably used or disposed of?

Respectfully submitted,

E. Kopke.

The secretary would be glad to receive answers to the above questions, and any information on this very important subject. Address all communications to Secretary Honolulu Engineering Association, Honolulu.

JAMAICA SUGAR EXPERIMENT STATION.

The Jamaica Board of Agriculture has issued a report on the experimental work of the sugar experiment station there, dealing with manurial experiments on sugar estates, variety experiments, selection and trial of seedling canes, distillery experiments and a report on the manufacture of Jamaica rum. The report as a whole is very interesting, even though the parts referring to distillery experiments and the manufacture of Jamaica rum are of interest principally to the Jamaican sugar growers.

The Jamaica sugar experiment station was established by the legislature in 1903 and an appropriation of £10,000 was made. A scheme drawn up by the island chemist was approved and a start was made in April, 1904, by the provisional appointment of a superintendent of field experiments and of a chemical assistant.

The working machinery of the enterprise was gradually got together and the buildings, equipment and organization of the station were completed and all branches in active operation before the close of the financial year 1904-1905.

In the report are presented the chief results obtained during the year 1905, to which are appended in some cases results previously obtained.

In view of our experiments in raising seedling canes that portion of the report showing what they are doing in Jamaica in the selection and trial of seedlings is of interest to our planters. It is as follows:

"An acre approximating 8 acres in extent at the Experimental Station, Hope Gardens, has been assigned for the use of the Sugar Experiments.

"A grant-in-aid amounting to £50 per annum is made from the funds of the Sugar Experimental Station to assist in defraying the cost of managing this work and particularly the distribution of Canes to Estates.

"About 100,000 tops of selected varieties were distributed during the past year to 90 Estates and there are now to be found in all parts of the island a stock of the best seedling varieties.

"A preliminary report was published in 1902 on the 100 varieties of Sugar Cane then growing at Hope Gardens. These were severely weeded out and finally reduced to 28 first selected varieties which were planted out in 40 hole plots; while 39 varieties (including some recent accessions from Demerara and British Guiana) were planted out for Preliminary Selection in 20 hole plots. Of these 8 of the former and 19 of the

latter have been abandoned and a further eliminating trial to include ratooning powers is now under way.

"The variety that has shown most merit in these trials is the seedling B. 208 which gave a tonnage of 65.5 tons of canes per acre. This cane ratoons well at Hope and has made its mark in all parts of the island under the most variable conditions.

"We recommend this variety to the critical notice of all planters as the most promising seedling cane at present grown in Jamaica.

"D. 1429, B. 316, D. 109 and D. 95 have also done well at Hope and are worthy of some attention.

"Some very fine Seedling Canes resulting from naturally Cross-fertilized Seed raised in Westmoreland in 1903, have been produced. A rigid selection of these is now taking place and no Seedling will be issued to the public until it has been proved to be of sterling merit. The letter 'J' will be only attached to Seedlings issued to the public so that the numbers of Jamaica Seedlings will not soar into tens of thousands to the confusion of planters.

"One Seedling (No. 30) gave an indicated yield of 74.4 tons of cane per acre equal to 20,955 tons of Sucrose.

"Another variety (No. 22) gave a very rich juice containing 2.2 lbs. Sucrose per gallon.

"As we are now able to grow about 3,000 Jamaica Seedlings for a first selection each year, a series of Jamaica Seedlings worthy of trial on Estates upon an experimental scale should be soon available."

CORRESPONDENCE.

ON THE CHEMICAL SUPERINTENDENCE OF SUGAR FACTORIES IN HAWAII.

Editor Planters' Monthly:

In a recent number of the Planters' Monthly, there appeared an article on the "Superintendence of Sugar Factories," by one who is evidently looking for a position as superintendent, or is a labor agitator trying to organize the chemists of Hawaii under the American Federation of Labor, since he considers all other white employes about a factory as "scabs."

In the above mentioned article, reference is made to a report of the "Hawaiian Sugar Industry," written by Mr. K. R. Hamakers, with whom the writer is personally acquainted.

With one exception, that of Mr. Z. S. Spaulding, Mr. Hamakers is the only so-called expert who has visited Hawaii, who could understand the conditions of a factory sufficiently to be able to speak of what could be done with some degree of intelligence, and from conversation with Mr. Hamakers, the writer will wager the opinion that that gentleman was more disgusted with the control of factories in Hawaii by chemists than by practical men, as he states, "The knowledge of most chemists in Hawaii in regard to manufacture is grievously scant."

The writer has had six years' experience in one of the large factories of Hawaii, and has considerable data relative to the work accomplished in that factory and that submitted in reports by the chemical superintendent to the manager.

This factory is one in which the sole endeavor since the first crop was harvested, has been to place all branches of manufacture on a chemical basis, and to insure good results, a staff of three white chemists and three assistants was employed, whose combined salaries represented an aggregate of $600 per month, and an additional expense of $1000 a year was necessary for supplies to keep them busy. One of this staff who affixes no less than eight letters to his name, and who had had twelve years' experience in factories of Germany, Fiji, Java and Hawaii, was superintendent of the factory.

To enumerate all the experiments tried during his regime is entirely beyond the scope of this article, but a few may be of interest to practical sugar men. Liming the juice was the first part of the process to be brought into a state of confusion. Numerous chemical analyses were made to insure his procedure on scientific lines, and it was found necessary to lime the mill juice in the scum press tanks, filter it in the scum presses, run this juice to the sugar room where it was used to melt low grade sugars, which were transferred in dish pans to an elaborately constructed screen. This solution was then pumped through the heater into the clarifying tanks. The kind of juice entering the evaporator will not bear description, and strange as it may seem, the sugarboiler was at fault, for it would not work.

The proper amount of lime to be used was usually decided on Monday, and not looked at again for two or three days, sometimes a week.

To insure the economic use of steam in boiling, sugar was made on the evaporator tubes three-eighths of an inch thick, when the house became blocked. The tubes also became badly coated from the quality of juice being evaporated, and the chemists' analyses proved it to be necessary to use muriatic acid in such quantities to clean the apparatus, that the solution drawn off contained ninety per cent. pure copper. After following such advice, it now becomes necessary to replace these tubes at a cost of $1500 to $2500 a year, a wholly unnecessary expense.

The filter presses received chemical attention also, and the staff worked overtime to get figures on scientific filtration. A description of this part of the process is too ludicrous to print. Will only say that many presses full of juice were emptied in the ditch, but no analyses of these were made for the books. This juice was proved to be impossible of filtration with the presses used. Only presses containing cakes were analyzed for reports.

At the end of the season, the percentage of sucrose in the press cakes was 9.25, and it cost $2000 to replace the broken frames. This was done for the following season.

Boiling was given some attention, but nothing definite was decided on, as none of the chemical staff could boil a strike.

The following year, the same chemical force began operations with renewed energy. Some of the old experiments were tried again, and numerous others. Boiling was given more chemical attention this year, and though theories and literature fouled the air, a practical demonstration could not be made, for they knew nothing about operating a pan.

Report work was also given more careful attention this year, and some figures on the quantity of waste molasses may be of interest. In looking over the figures at hand, the writer cites numerous instances like the following:

4040 gals. measured and run away, appears on the daily report 2790 gals., 6060 gals. run away becomes 3650 gals., 8670 gals. becomes 4310 gals., 6060 gals. becomes 1720 gals., and on days where 8880 gals. and 7150 gals. respectively are run away, nothing appears.

The total molasses for the crop of nearly 20,000 tons of sugar, as measured, amounts to 698,000 gallons and the amount which appears on the reports amounts to 491,560 gallons, making a difference of 207,430 gallons, containing 34 per cent. of sugar, in which there was no loss as seen by the chemical superintendent. These reports were all accepted by the manager with a smile.

The molasses was measured in a steel tank without holes, direct from the centrifugals before being blown up with steam, and was as nearly accurate as measuring will permit. Allowing 25 per cent. for air, which filtration shows blown up molasses to contain, it would be difficult for the ordinary mathematician to strike a balance with their figures. During this season, thirty-one more low grade massecuites were made than during each of the succeeding seasons, and each strike contained 3500 gallons of molasses, which was run away. This record was due to not understanding economic boiling. The juice was of the same purity, and the amount of sugar shipped was the same as during the following seasons. In the filter press room this season, the expense of replacing broken frames was $2000 more, as many as eighteen being broken in twelve hours. Numerous duck suits

were lost to the superintendent from flying juice, and the per cent. of sucrose in cakes was reduced to 6.28.

At the close of this season chemical superintendence at this factory was at ebb tide, and though the superintendent retired in full honor the staff was dissolved, and one chemist was found sufficient to make analyses and reports only of work accomplished the following season.

To bring order out of such a state of chaos, as existed at the close of this season, was not easy; but work was begun on common sense principles, the boiling-house, mill and laboratory being independent departments, and honest work and honest reports were the result.

Half of the filter presses were broken and were not restored to working order till the crop was well along. However, the sucrose in press cakes was 2.98 per cent. for the season, with one less operative than before, and no frames broken.

The following season the average of sucrose in press cakes was reduced to .92 per cent. with the same operatives and equipment as previously employed, and no frames broken. The quantity of waste molasses per ton of sugar shipped was reduced from 35.3 gallons to 29.8 gallons, with a reduction in purity from 33.2 per cent. to 31.6 per cent. But the chemist's report this time, after deducting 25 per cent. for air, showed four gallons more of waste molasses per ton of sugar than that obtained by measuring as employed the preceding seasons. These results were obtained without chemical supervision, and strange as it may seem, not one idea embodied in the two preceding years' work under the superintendent was ever employed afterward in that factory.

The question arises: Is it possible to get anything like accurate reports from chemical superintendents? The writer has been informed on good authority that such reports are not worth the paper they are written on.

It is a strange fact that chemists' reports pass unchecked and unchallenged by both managers and agents. Why not have them examined as are the bookkeepers, since they report on the sole income of their five and six million dollar properties?

Since a good chemist is indispensable in every well equipped factory, this can be avoided by creating three departments: the engineer's, the chemist's and sugarboiler's; each independent of the other.

The chemist making analyses and reports of work accomplished. He will have nothing to gain or lose then by reporting accurately.

Let competent men have charge of these departments. They are not wanting in Hawaii.

It is the check which the sugarboiler is able to keep on the chemists' reports which often makes the unpleasant feeling in factories, and also urges the chemist to strive for superiority.

By far better they would be unfriendly than place the management of these half million dollar factories in the hands of green technical boys and incompetent chemists to experiment with, and sap the hundreds of small shareholders of their hard earnings, many of whom are in need, while the holdings of many have depreciated 50 to 75 per cent.

The mills least superintended are the best paying properties today.

Such a state of disorder in a factory as mentioned by the would-be superintendent in the Planters' Monthly, has not come under the writer's observation, but if such exists it is the manager's, not the chemist's, business to eliminate it, as such employers are not working in the interest of the company. It is the growing demand for low figures on a report that makes the chemical superintendent in demand. As an instance—a manager on one of the large plantations, last year informed his newly imported chemist from a technical school in Germany that if better reports were not forthcoming, he would be discharged. Strange to relate, he lasted only a few weeks, and another was imported. This is the chemist's report of his experience in Hawaii.

These, with numerous others employed in the same capacity, had entire charge of the plants so far as it was possible to give, for they had not had one day's practical experience in any branch of the manufacture.

On one of the islands of the group are six mills in which ten chemists are employed, and with one exception, they have never undertaken to boil sugar. This one has made less than a dozen attempts. Some of these are supposed to direct operations in the house, but the sugarboiler must keep the house from getting blocked, or he forfeits his position. Under such conditions, it is possible for such superintendents to wade through a season. Is it possible for any one to give directions about boiling sugar so that economic results shall be obtained when he knows absolutely nothing of it?

The chemical superintendent has proved that it is possible to make more than 100,000 gallons unnecessary waste molasses for a 20,000-ton crop.

This molasses contained 33 per cent of sugar. If the practical man were allowed to recover this sugar, at $70 per ton, the saving thus made would not only pay the superintendent's salary to keep out of the factory, but leave a surplus of $10,260 to the shareholders, besides the saving in machinery unnecessarily broken, supplies wasted in experimenting and losses incurred by stoppages from a blocked house, as cane cut for grinding deteriorates very rapidly in hot weather.

Are the shareholders going to be led to believe that a few months' course in chemistry is all that is required for the successful operation of these mills? And can they afford to let these green boys experiment with their valuable machinery, when not

one in a hundred ever makes a practical man? They can decide the issue if they will. A little common sense employed in these factories will return them infinitely more money on their holdings, than all the chemical superintendence that ever arrived from Germany or Switzerland, as experience has proved.

The chemical superintendent has demonstrated that he is not only unnecessary in the Hawaiian sugar factory, but a menace to its successful operation. The would-be superintendent deplores the fact that any honor is given the Hawaiian sugarboiler. However, it is gratifying to the practical man to know that honor sometimes falls where it is due.

What practical idea employed in any mill today, can the Hawaiian chemist claim as original, from which economic results are obtained?

This gives rise to another question: What are economic results? The chemist often considers economy what the practical man calls an extravagant waste. As an instance: In a certain mill are installed $60,000 worth of crystallizers, the sole purpose of which is to reduce the sugar content of the molasses. The chemist uses first molasses having a purity of 45 to thin out the low grade massecuites in them. The sugar is then separated and the resulting molasses run in the ditch. What return on the shareholders' investment of $60,000 can such practice give, when this molasses can be boiled blank, run in any discarded tank, and yield one pound of sugar per gallon of massecuite, and with this expensive machinery, no attempt is made to recover it? The twelve-roller mill, the acme of perfection in extraction machinery, the filter press by which the sugar contained in the cakes can all be recovered by lixiviation, and the most economic results in boiling of which there is record, are all foreign to the Hawaii chemist.

The good chemist, however, has aided the practical man by analyses, but the latter has certainly furnished the gray matter.

Mr. K. R. Hamakers, who has traveled in all sugar countries of the world, and is probably as good an authority on sugar as any, visited Hawaii in 1904, and had no reports on results obtained in Java by those efficient chemical superintendents, which showed as small losses either in bagasse, press cakes, or molasses, as some Hawaiian factories not superintended by chemists, and in which honest reports were a natural consequence.

An engineer is employed in one of these large mills, who has spent twenty years in practical work with sugar machinery, and whose ideas are largely embodied by manufacturers in bringing Hawaiian sugar machinery to its present high state of efficiency. In this factory are employed a chemist and a Japanese helper taken from the field a year ago. This Japanese now makes all analyses, except polarizing, for bagasse, juice, press cakes and molasses. The chemist merely filling in the reports with figures thus obtained, and having a good time generally.

Can conscientious and efficient employers stand by and see reports emanating from such sources, accepted by managers with a smile?

By far better resign while there is still some honor left.

If Chinese have acquired the secrets of sugar boiling in Java, certainly Japanese have made remarkable strides with sugar chemistry in Hawaii. It may not be out of place to say a word in regard to labor conditions in Java and Hawaii. The modern boiling house in Hawaii requires thirty to thirty-five men for all purposes, with a wage ranging from 75 cents to $1.50 per day for Japanese. The boiling house in Java requires two hundred coolies at 10 cents per day for the same amount of sugar made; no less than five of these are the personal attendants of the chemical superintendent, employed like cleaning up the mud which drops from his shoes in the mill, and which he is too lazy to remove as he enters.

Uncle Sam is trying to develop Hawaii on "traditional American principles," but it cannot be done by removing the present efficient white men from our sugar factories, and replacing them with coolies in charge of that ornament which styles himself a chemical superintendent.

Let the shareholders demand honest work in these factories, and there will be three departments administered by competent men. Honest reports will be the result.

Let them also demand that chemists' reports be examined by an accountant.

A highly scientific man is not required for this purpose. It is only necessary to remember that figures are not deceptive, but the one who makes them sometimes is.

SPECTATOR.

CHEMICAL COMPOSITION OF FIBER IN CANE.

"The Chemical Composition of the Fiber in the Cane" is the subject of an interesting article by Prinsen-Geerligs in the July number of the Archief voor de Java Suiker-Industrie.

The author was led to make these experiments by the observation, that bagasse from cane with high fiber content contains very much less juice than bagasse from cane with a low fiber content, and that consequently the extraction of sucrose varies—caeteris paribus—with the different varieties of cane.

He also noticed, that the grinding quality of the cane depends not only upon the variety but also upon the weather conditions, under which it is grown.

"I observed," Mr. Geerligs says, "that early during the crop

of 1905 the moisture in the bagasse from most factories was higher than during the corresponding period of the previous year, although the sucrose in the cane stood rather higher than in 1904.

"All the reports I received, agreed that the bagasse of 1905 was not of the same fuel value as the bagasse of 1904. Factories, which had more bagasse than they could burn in 1904, had to bring in dry leaves from the fields to make up the shortage of fuel in 1905. And this in spite of the fact, that there was no noticeable difference in the fiber content of the cane or in the manufacture. The opinion has even been expressed, that the calorific value of the fiber might vary from year to year, and that this value could not be the same for the fibers of the different varieties of cane."

Here follows a long series of analyses of fiber samples collected from a number of plantations.

In the first place the percentage of Xylan was determined; but the differences found were inconsiderable. Next we find a table giving Fiber in Cane, Sucrose Content and Purity of Juice, Dilution, Sucrose, Moisture and Fiber in Bagasse, Loss of Juice in Bagasse per hundred Fiber, and Water, Ash, Silica and true Cellulose in Fiber, and also the weight of the latter per 100 cubic centimeters from 58 samples representing many plantations and different varieties of cane.

The results of these analyses are mostly of negative value, inasmuch as they show us that we must not look to the chemical composition of the fiber for an explanation of the behavior of the bagasse under the rollers, or for a criterion of its value as fuel. This was further borne out by determinations of the calorific values of fibers from different varieties of cane, and by elementary analyses.

One thing, however, appears very plainly from the above mentioned table, and this is the relation between Fiber in Cane and Moisture in Bagasse.*

Mr. Geerligs points out the relationship existing between the specific gravity of the dried fiber and the percentage of fiber in cane. A given volume of the latter (100 c.c.) weighed under exactly the same conditions gave the following values for different varieties of cane:

Cane.	Fiber % Cane.	Grammes p. 100 c. c.
No. 100	9.77	5.45
Black Cheribon	10.38	6.71
White Manila	11.80	6.38
No. 247	13.85	6.97
No. 139	14.16	7.30
No. 33a	15.59	7.23
No. 36	15.72	7.95

*To bring this out more clearly, I separated the results according to the percentage of fiber in cane, and found:

	Number of Determinations.	Average Fiber % Cane.	Average Moisture % Bagasse.
For 9 to 11 per cent. fiber.....	9	10.07	48.09
For 11 to 13 " "	12	12.12	45.03
For 13 to 15 " "	16	14.12	43.85
For 15 to 17 " "	13	15.65	42.19

E. E. H.

In connection with these tests the author says:

"From this it would appear, that the volume of the fiber in the cane is the same whatever the percentage of fiber may be, so that the fiber in cane with a high percentage is of hard woody structure, while in cane with a low percentage it could rather be called spongy. We have here a satisfactory explantation for the difficulty which is experienced in extracting the juice from soft cane, poor in fiber. While the bagasse is being released from between the last two rollers, the spongy fiber will re-absorb much more juice than hard woody fiber.

"How to reduce this re-absorbtion to a minimum is a problem, the study of which might prove profitable to constructors of sugar-mills. * * *

"Another effect of this structural difference in the fiber is the influence of its specific gravity on its behavior in the furnace.

"The difference in this respect between bagasse containing spongy fiber and bagasse containing woody fiber is as pronounced as that between anthracite and lignite, each of which requires an entirely different construction of furnace. These disadvantages are accentuated by the fact that the cane furnishing spongy bagasse contains a low percentage of fiber."

These facts are fully borne out by observations made in these islands. Of our varieties of cane the one which shows the least tendency to re-absorb juice is the Yellow Caledonia. This is very clearly shown by the results tabulated below, of comparative tests made at different mills, with and without maceration:

Mill.	Variety.	Fiber % Cane.		Moisture % Bagasse.		Dilution % Normal Juice.	
A.	Rose Bamboo	12.2		48.5		20.4	
	Yellow Caledonia		14.7		39.2		26.3
B.	Rose Bamboo	11.2		49.0		25.2	
	Yellow Caledonia		14.1		41.8		36.6
C.	Rose Bamboo	11.9		46.7		44.0	
	Yellow Caledonia		15.2		44.3		39.6
D.	Rose Bamboo	11.3		49.0		12.3	
	Yellow Caledonia		12.8		42.7		16.4
E.	Lahaina	11.5		43.7		18.0	
	Yellow Caledonia		14.9		42.5		26.0
F.	Rose Bamboo	12.5		55.6		0	
	Demarara No. 217.....	11.9		48.4		0	
	Yellow Caledonia		14.8		43.5		0

But such large differences in the capacity of holding the juice are not only found between different varieties: the locality, where the cane is grown, has also a large influence on the structure of the fiber. Instances could be cited in these islands, where old, weak mills yielded bagasse with 40 to 42% moisture, while on other districts heavy, modern mills could not—from the same variety of cane—turn out bagasse with less than 45% of moisture.

These comparative tests were made under ordinary working conditions. The low percentage of moisture in the bagasse from Yellow Caledonia is all the more remarkable, as more water was used for maceration, when that variety was ground.

E. E. HARTMANN.

THE PROPER TYPE OF LOCOMOTIVE FOR PLANTATION SERVICE.

By C. A. Musgrave, *Master Mechanic Oahu Railway & Land Co.*

(Read before the Honolulu Engineering Association at its August, 1906 meeting).

An account of the historical development of the locomotive should naturally take for its starting point the first appearance of the steam propelled carriage.

We shall accordingly trace the successive modifications through which the pioneer forms of such carriages, and the earlier examples of the locomotive proper, have been converted into the powerful and highly developed machines of the present day.

In making this survey we cannot fail to observe that even the most advanced types of modern locomotives retain many of the essential characteristics of those first tried nearly a century ago.

A widely spread opinion imagines the railroad to have originated on complete subservience to the locomotive. But this is a common mistake. The locomotive in comparison with the railroad is a relatively recent invention.

The earliest locomotive carriages, indeed, were intended to travel on common roads. The first actual model of a steam carriage of which there is any special mention, was constructed by a Frenchman, Cugnot, who exhibited it in 1763. Six years later, he built an engine intended to run on common roads, which is described as being "put in motion by the impulse of two single acting cylinders, the pistons of which acted alternately on the

single front wheel. It traveled three or four miles an hour; but from the smallness of the boiler it had to stop every fifteen minutes to get up steam."

Cugnot constructed a second engine, which made several successful trials and excited much interest, but an accident put an end to these experiments.

One day, when running at a speed of three miles an hour, the vehicle overturned, and, being considered dangerous, it was locked up by the authorities.

In England the earliest recorded steam carriage was made in 1784, when Wm. Murdoch constructed a non-condensing steam locomotive. The boiler was of copper and was heated by a spirit lamp. The engine worked with high pressure steam, and, being intended for common roads, the carriage ran on three wheels.

Several inventors followed Murdoch with ideas of steam carriages; among these may be mentioned Thomas Allen of London, Mr. Thomas of Denton, and Dr. Anderson of Edinburgh, a friend of Watt, but it was not until the year 1802 that Richard Trevethick patented the application of the non-condensing engine to the propulsion of carriages on railroads.

The first steam carriage made by him was tried on common roads, but the roughness and unevenness of the roads obliged him to abandon his experiments.

Trevethick then turned his attention to the drawing of wagons on railroads, and his efforts were crowned with success. In 1804 he made a second engine to run on the Merthyr Tydvil Railway in South Wales. It had a cylindrical boiler with internal furnace and flue. The cylinder of the engine was eight inches in diameter and of four feet six inches stroke. The wheels were plain and the engine drew ten tons of iron, besides the wagons, at the rate of five miles an hour. This, without doubt, must be recorded as the first successful attempt to adapt a locomotive to service upon a railroad.

The Merthyr Tydvil Railway has, indeed, the honor of being the oldest railway company in the world, the Act of Parliament establishing it having been passed in 1803.

A great trial of this locomotive took place on the 12th of February, 1804, on a railway from Penydarran. This trial was the outcome of a wager of $5000 made between two Welch ironmasters. After some little difficulties had been overcome, the engine and train finally reached the journey's end; but the engine was not yet perfect.

The prevalent belief at that time among engineers—despite Trevethick's partial success—was that the locomotive had not sufficient adhersion to ascend a moderate incline or draw heavy loads unless the wheels were geared to work on a corresponding rack on the rails.

In 1811 Blenkinsop of Leeds, patented and constructed an en-

gine on this plan, which was tried on a railroad running from Middleton to Leeds. The weight of this engine was about five tons; and it was said to convey about ninety tons on a level at four miles an hour, or fifteen tons up a gradient of one in twenty.

The rack rail was used until it was proved by Blackett that simple adhesion on the smooth rail was sufficient.

Blenkinsop's engine had the important feature of two cylinders working alternately on the same shaft.

The next invention brought forward was one by Chapman of Newcastle in 1812. His plan consisted of stretching a chain the entire length of the course to be traversed. This chain passed round a grooved wheel under the engine, by rotating which the locomotive pulled itself along the railway.

In 1813 a remarkable experiment in locomotion was conceived by Brunton. This inventor took out a patent for a machine with legs like a horse, which were worked by a kind of parallel motion from off the cylinders. Then followed the engine of Blackett of Wylam and his colliery inspector, W. Hedley. After many trials and experiments and much perseverance, they found that the weight of the engine properly distributed over the wheels was sufficient to draw eight or nine loaded wagons without any rack or gearing.

The engine as at first constructed did not steam well, not being fitted with a blast pipe.

This was not furnished until after the engine was supplied with a new boiler and cylinders.

The new boiler was of wrought iron and had a return flue. The cylinders were vertical, the piston rods working on beams, from the connecting rods drove a crank on a central shaft. On this was a toothed wheel, whence, by means of intermediate gearing, the four smooth driving wheels were driven. There was in the reconstructed engine a blast pipe from each cylinder, and the noise made by the steam escaping from these pipes into the chimney gained for the engine the name of "Puffing Billy."

In 1814 an engine was constructed at Killingworth by George Stephenson. This had vertical cylinders of eight inches diameter, and twenty-four inch stroke. The boiler was cylindrical, eight feet long and thirty-four inches diameter, with a single flue tube.

The connecting rods were coupled to the spindles of geared

, and wrought iron tires were added to the driving wheels.

In 1825 the Stockton and Darlington Railway was opened, and

this may be called the first public railway. The engine employed at the opening of this line was built by Messrs. Stephenson.

The cylinders were vertical, ten inches diameter and twenty-four inch stroke; the boiler was four feet diameter and ten feet long. This engine could haul a load of ninety tons at a speed of six miles an hour. It was named the "Locomotion."

In 1829 the directors of the Liverpool and Manchester Railway offered a premium of $2500 for the best locomotive which would draw, on a level road, three times its own weight at ten miles an hour.

The weight of the engine, with its completement of water in the boiler, was not to exceed six tons, and the engine was effectually to consume its own smoke.

The trial took place on the Manchester side of Rainhill upon a level portion of the line, and lasted from the 8th to the 14th of October, 1829. Three engines entered for the prize.

The "Rocket," built by R. Stephenson, the "Sanspareil," built by Hackworth, the "Novelty," built by Braithwaite and Ericsson of London.

This contest, known in railroad history as the Rainhill contest, was won by the "Rocket."

The trials were made over a distance of one and a half miles, with an additional one-eighth of a mile at each end for getting up speed. It was arranged that each engine should run twenty times each way, equivalent to a journey from Liverpool to Manchester and back.

The "Rocket" was the first engine tried, and the only one that accomplished the stipulated distance of seventy miles.

This engine satisfactorily performed all the tests required by the judges, and the prize was awarded to Stephenson. The average speed was thirteen miles an hour, twenty-nine miles an hour being the maximum.

It was shortly after the Rainhill trials that the first locomotive was built in America.

There had been a locomotive, the "Stourbridge Lion," imported from England in 1829, which was the first to turn a wheel in America, but Peter Cooper', "Tom Thumb" was the first built in this country, and the first to draw a car.

Its first trip was made on August 28th, 1830, when it drew a car filled with directors of the Baltimore and Ohio Railroad, a distance of thirteen miles to Elliot City, in one hour and twelve minutes against a grade of eighteen feet per mile.

"Old Ironsides" is the first locomotive built by M. W. Baldwin, the founder of the present Baldwin Locomotive Works.

This locomotive did not differ to any great extent in form and arrangement from the English engines of that period.

The Camden and Amboy Railroad had imported a locomotive from England in 1832, and after Baldwin had inspected it, he set to work to build one after his own ideas.

There were no facilities for working on this class of work in the country, nor workmen who knew anything about it, consequently Baldwin had to do most of the work and devise his own machines.

The cylinders were bored with a chisel, set in a block of wood, and similar crude methods were used on other parts.

The trial trip was made in 1832, and three days afterwards it went into active service and ran for over twenty years.

Thus we have the beginning of locomotive building in both England and America.

Today we have in America, plants with a production capacity of thousands of locomotives yearly; the Baldwin Locomotive Works, alone have a capacity of more than two thousand locomotives yearly.

The American Locomotive Company having consolidated the Schenectady, Brooks, Pittsburg, Richmond, Cooke, Rhode Island, Dickson and Manchester Locomotive Works, have a capacity of more than two thousand locomotives annually.

We now have locomotives using coal, wood and oil for fuel, also electric and gasoline locomotives, and will soon see many using alcohol.

PLANTATION LOCOMOTIVES.

The Territory of Hawaii can boast of more than one hundred locomotives, eighty-eight of which are in plantation service. These consist of many types and come from makers in several different parts of the world, but the majority of these engines come from Baldwin's at Philadelphia.

In the ordering of locomotives for plantation service many things have to be taken into consideration, the most important being the condition of track and road bed, sharpness of curves, length and steepness of grades and weight of rail, and number of cars to be hauled per train.

It can be stated that the power of a locomotive to haul a train is dependent upon its adhesion, or in other words, the adhesion of the driving wheels upon the rails must equal the maximum tractive power of the locomotive. The adhesion will depend upon the condition of the rail due to the weather, and may therefore vary greatly in the same locality. The several investigators on the subject give the adhesion as follows:

Under ordinary conditions or on wet, sanded rail, 1/5 } wheel.
Under favorable conditions and without sand, 1/4 } weight on
On dry, sanded rail.....1/3 } driving

In the formula following 4.5 has been used in calculating the adhesion.

The tractive power for the several classes is calculated by the formula $\frac{d^2 \times p \times l}{D}$ in which

d^2 equals square of diameter of cylinder in inches.

p equals mean effective pressure taken at 85% of boiler pressure.

L equals length of stroke in inches.

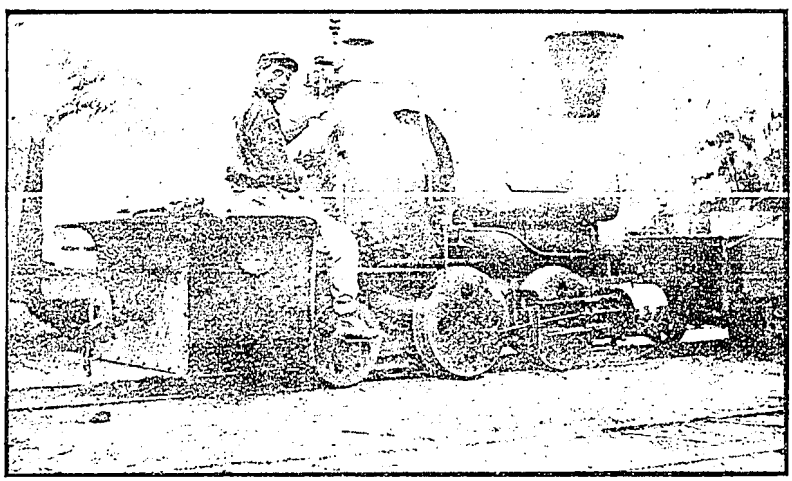
D equals diameter of driving wheel in inches.

Under this a locomotive with cylinders 18″ dia., 24″ stroke, 180 lbs. boiler pressure and 63″ driving wheels would have a tractive power of

$\frac{324 \times 153 \times 24}{63}$ equals 18884 + lbs.

Using 4.5, the weight upon driving wheels should be 84978+ lbs. Calculating the tractive power per lb. of M. E. P., the formula becomes $\frac{d^2 \times L}{D}$.

Using this as an example and the dimensions given in



WAIANAE—Fowler Locomotive.

the preceding, the tractive power per lb. of M. E. P. would be $\frac{324 \times 24}{63}$ equals 123.428 + lbs. Hence for 153 lbs. M. E. P. it will again be 18884 + lbs.

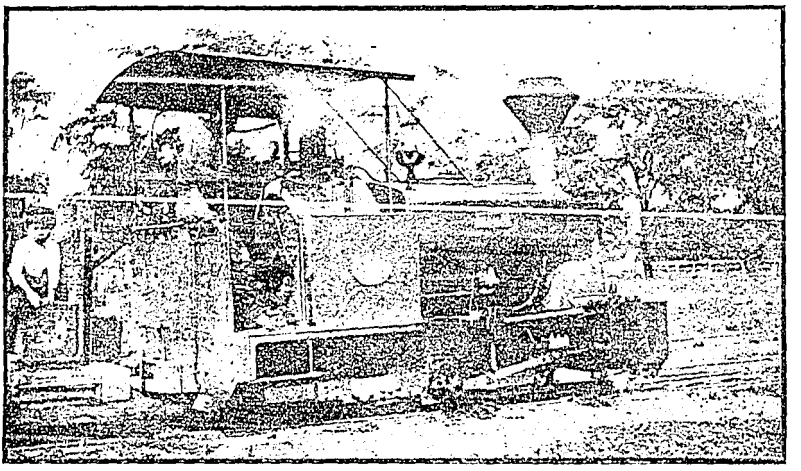
The factors of resistance due to grades are exact and the formula is R equals Gx0.4242, in which G equals grade in feet per mile. Thus for grade of 20 feet per mile the resistance would be:

20x0.4242 equals 8.48 lbs. per ton of 2240 lbs.

The resistance to the power of a locomotive (exclusive of the locomotive itself) is that due to the friction of the car machinery and wheels, grades, curves and speed, to which may be added that due to wind.

The resistance of the car machinery and wheels can be called train resistance, and under that heading will be added the resist-

ance to train movement due to the condition of the rails and road bed and speed. On a road of standard guage of 4′ 8½″ and in fair weather with the road bed and cars in good condition, it can be safely assumed that the resistance per ton for passenger cars and heavy freight cars will not exceed at the speed given, (10 miles per hour), 5 lbs. per ton. In bad weather or with light cars, or with road bed in bad condition, this will be exceeded. With a gauge less than standard on railways other than those of transportation companies, when a light rail is used, it is not expected that the road bed will be maintained in good condition, and on the lines of contractors and around mills and mines the conditions of the lines are so varied that only an approximate coefficient can be given. From the observation of results on such



WAIANAE—Fowler Locomotive.

roads it can be assumed that the average resistance will be as follows:

With light locomotives and cars on 36″ gauge 12 lbs. per ton; and on tramways or roads of 30″ gauge or less, 18 lbs. per ton, at speeds of 10 miles an hour.

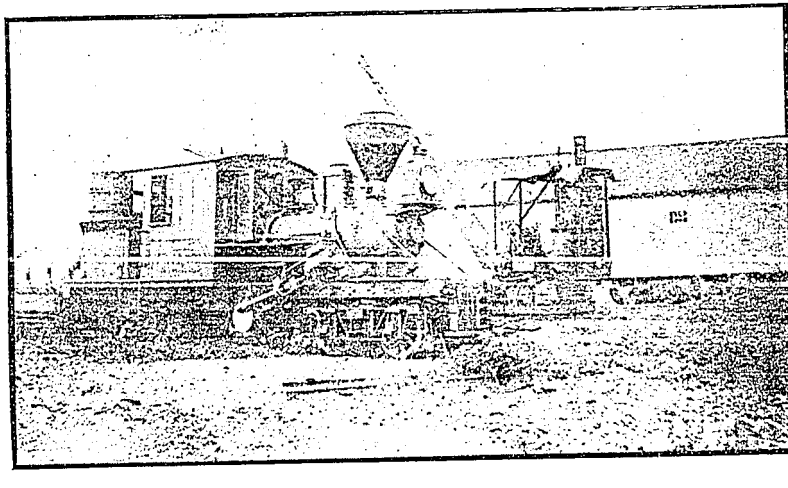
The resistance due to curves will be modified by the same conditions which modify the train resistance and in addition will vary with the length of the train. On railways of standard gauge, operated by transportation companies, the resistance is estimated at ½ lb. per ton for each degree of curvature. The conditions are so simple that nothing further need be said of the rule. But for convenience where the curve is given in radius in feet and requires to be reduced to degrees, the formula D° equals $\frac{5730}{R}$ in which

D° equals curvative in degrees.
R′ equals radius of curve in feet.

Example—To find the degree in a curve of 1435.5 feet radius:

$$D^\circ \text{ equals } \frac{5730}{1432} = 4^\circ$$

The rules for train resistance due to speed given by early authorities have been set aside by results of tests made in actual service and under normal conditions. The tests made by the Chicago, Burlington & Quincy R. R., in 1888, and which were published at the time, agreed with similar tests made by the Pennsylvania and other roads. In the tests mentioned the following results were obtained:



PUUNENE MILL—Climax Locomotive, Corry, Pa.

Weight of Train.	Speed per Hour.	Resistance in lbs. per Ton.
327 tons	50 miles	12.4 lbs.
343 "	44 "	9.5 "
*267 "	39.8 "	10 "
*289 "	44 "	8 "
317 "	41 "	8.4 "
412 "	44 "	9.3 "
*329 "	39.5 "	13 "

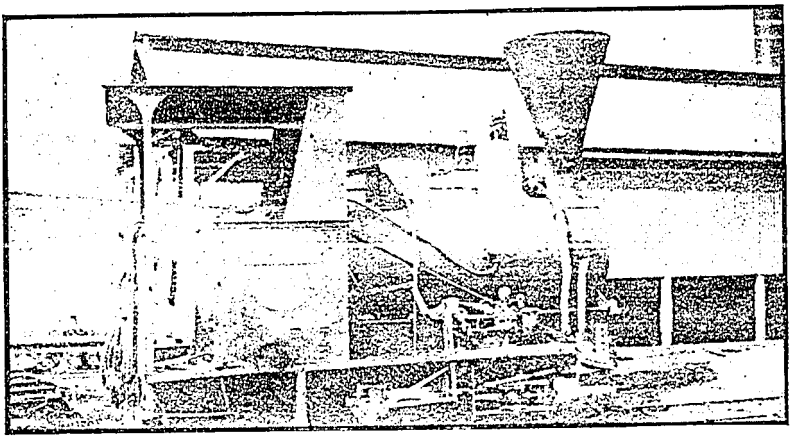
Based upon these tests the resistance due to speed is now obtained through the formula, $R = \frac{v}{5} + N$. N for standard gauge roads equal 2½. The condition of rails and road bed on narrow gauge roads has so great an influence on the tractive resistance that the value of N is difficult to determine. Frequent tests, how-

*Strong Head Wind.

ever, indicate that at a speed of 10 miles per hour on roads of 36″ gauge, N equals 10, and on roads of 30″ gauge or less, N equals 16. These values are but approximately true even for the stated speed, and are to be used with caution.

As an example of the application of this formula to the standard gauge suppose it is required to find the resistance per ton on a level at a speed of 30 miles per hour, then $R=\frac{30}{5}+2\frac{1}{2}$ 8.5 lbs. per ton.

Working under the several rules given above, suppose it is desired to find the tractive power required per ton to run a train at a speed of thirty miles per hour with curves of a radius of 1432.5 feet and grades of 20 feet per mile:



HONOKAA—Krauss Locomotive Works—German.

The resistance from speed equals $\frac{30}{5}+2\frac{1}{2}$ or 8.5 lbs.
" " " grade " 20×0.4242 or 8.48 lbs.
" " " curvature equals $\frac{5730}{1432.5}\times\frac{1}{2}$ or 2 lbs.
Total resistance . . . . . 18.98 lbs. per ton.

The tractive power required with a load of 500 tons would then be 18.98x500, or 9490 lbs.

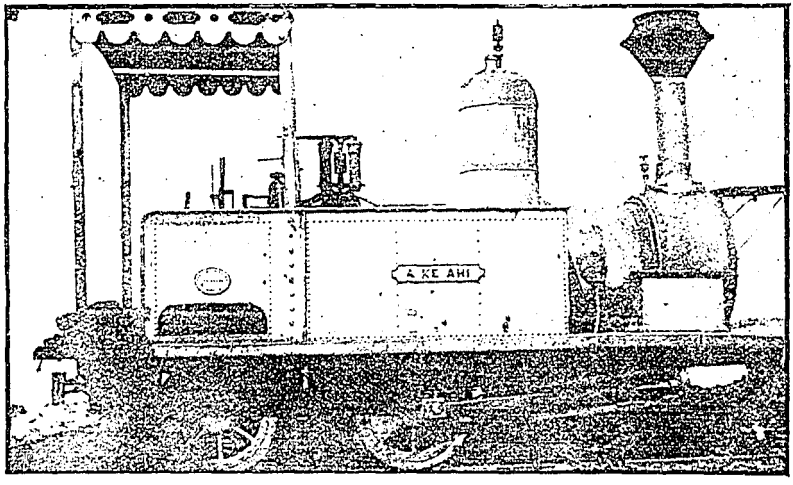
The tractive power of a locomotive depends upon the M. E. P. in the cylinder, will be greatest at low speed and will decrease as the speed increases and the steam can be cut off earlier in the piston stroke. The greatest power exerted by the locomotive will be in overcoming the inertia of the load and will decrease as the speed increases, until acceleration ceases and the speed becomes constant.

The table below gives the M. E. P. in per cent. of boiler pressure with steam cutting off at the different revolutions and points given.

REVOLUTIONS PER MINUTE.

At Points of Cut Off.	Per cent. mean effective pressure of boiler pressure Pounds.							
	50	75	100	125	150	175	200	225
25%	44.9	41.4	39.6	36.1	34.2	32.5	31.3	30.1
30%	49.1	45.1	42.0	40.1	37.9	36.0	34.5	33.2
40%	57.1	53.0	49.9	47.4	44.9	42.8	40.9	39.7
60%	71.6	67.3	63.3	61.8	59.6	57.4	55.7	53.8

At Points of Cut Off.	Per cent. mean effective pressure of boiler pressure Pounds.						
	250	275	300	325	350	375	400
25%	28.9	28.1	27.4	26.6	26.2	25.7	25.3
30%	32.1	31.3	30.6	20.7	29.0	28.7	28.1
40%	38.4	37.1	35.9	35.2	34.4	33.9	33.3
60%	52.4	51.0	49.8	49.0	47.9	46.8	46.2



MAHUKONA—Ransomes & Rapier—English.

Taking as an example a locomotive with 18"x24" cylinder and 63" driving wheels cutting off at 30 per cent. of stroke and with boiler pressure of 180 lbs. running at 30 miles an hour. At that speed the number of revolutions will be 160. By referring to the table it will be found that the M. E. P. for this speed is 37.8 per cent. of the boiler pressure, or 68 lbs. pressure at which the tractive power will be:

$\frac{324 \times 24 \times 68}{63}$ equals 8393+ =tractive power.

Assuming that the locomotive is hauling a train at a speed

of 30 miles an hour on a grade of 20 feet per mile and with a curve of 4°, it has been found in the preceding example that the resistance will be as follows:

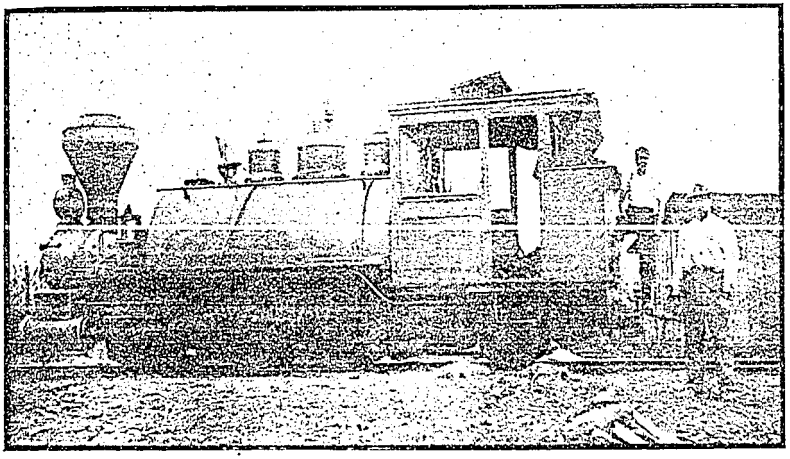
Due to speed, 8.5 lbs.
Due to curve, 2 lbs.
Due to grade, 8.48 lbs.

Total, 18.98 lbs.

Then the locomotive will move under the above conditions:

$$\frac{8393}{18.98}=442.2 \text{ tons.}$$

With the steam cutting off at 40 per cent. of the stroke the tractive power would be 9899 lbs. The resistance remains the same as above, and the locomotive would move 521.54 tons.



WAIALUA PLANTATION—Baldwin 8-18½—D.

The horse power required would be as follows:

$$\frac{8393 \times 30}{375}=671.44 \text{ H. P.}$$

The H. P. of a locomotive can be placed under two classes; first, that of the indicated horse power of the cylinder, which is obtained under the well known formula:

I. H. P. equals $\frac{P \times L \times A \times N}{33.000}$ and the actual horse power which is obtained at the circumference of the wheel. The last is obtained under the formula:

$$\frac{T.P. \times S \times 5280}{33000 \times 60}=\frac{T.P. \times S}{375}$$

in which S=speed in miles per hour.

As am example of above expression, suppose it is required to find the H. P. of a locomotive with clinders 18"x24", driving wheels 63" diameter, at a speed of 6 miles per hour, then

$$\frac{18884 \times 6}{375}=302 \text{ H. P.}$$

Assuming a locomotive with cylinders 9x14, driving wheels 29 inches diameter and 30″ gauge, at a speed of 15 miles per hour and cutting off at 40 per cent. of stroke, the tractive power would be with 180 lbs. boiler pressure:

$$\frac{81 \times 14 \times 80.2}{29} = 3136 \text{ lbs.}$$

The co-efficient for 30″ gauge having been taken at 18 lbs. per ton, then the locomotive would move a train under the above conditions of $\frac{3136}{18} = 174.22$ tons.

Assuming a grade of 1 per cent., with curves of 200 ft. radius and a speed of 10 miles per hour, cutting off steam at 60 per cent., the tractive power would be

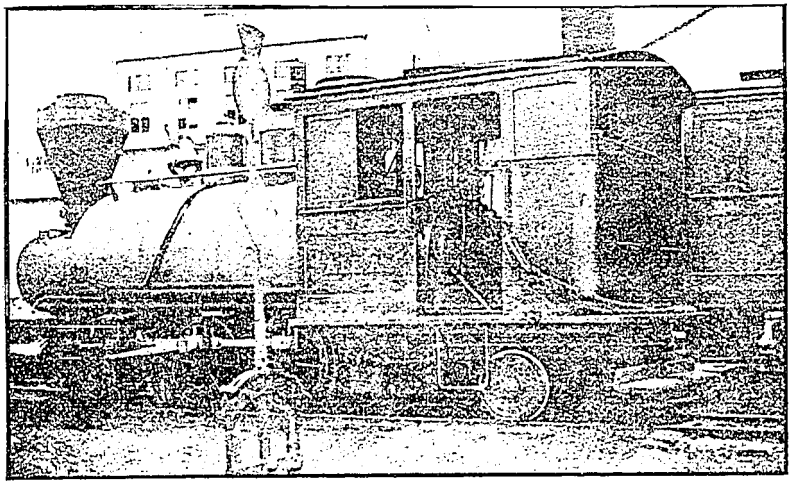
$$\frac{81 \times 14 \times 110.89}{29} = 4333 \text{ lbs.}$$

The resistance due to train would be $\frac{v}{5} + 16 = 18$ lbs.

" " " " curve " " $\frac{5730}{200} = 28.6 \times 5. = 14.3$ lbs.

" " " " grade " " $52.8 \times 0.4242 = 22.4$ lbs.

Making a total of ..... 54.7 lbs.



HONOLULU PLANTATION—Baldwin 8-14½—D.

Then the locomotive will haul a load under the above conditions of

$$\frac{4333}{54.7} = 79.19 \text{ tons.}$$

The horse power required will be:

$$\frac{4343 \times 10}{375} = 115.5$$

The number of driving wheels required is determined by the the rail or permanent way; as an approximate calculation it may the rail or permanent way, as an approximate calculation it may

be assumed that steel rails, properly supported by cross ties, can sustain, as a maximum, a weight per wheel of 225 to 300 pounds for each pound of rail per yard.

A splendid type of locomotive for plantation service is the "Halawa," owned by the Honolulu Sugar Company.

This locomotive is a six-coupled with two wheeled rear truck, cylinders 11x16, driving wheels 33 inches diameter, driving wheel base 7 feet, weight on drivers 36,000 lbs. and has a tractive power of 7978 lbs. with 160 lbs. steam.

This locomotive will take very sharp curves as it only has a rigid wheel base of 7 feet and a total wheel base of 13 feet.

Having a weight of 6000 lbs. per driving wheel it can be run on a rail of 20 lbs. per yard.

The general specifications of this engine are as follows:

Design—As 15321.

Principal Dimensions—Cylinders 11x16, driving wheel 33 inches outside diameter. Centers 28 inches diameter. Total wheel base of engine 13 feet 0 inches. Driving wheel base 7 feet 0 inches.

Gauge and Fuel—Gauge of track 3 feet 0 inches. Fuel, coal.

Weight—In working order; total, about 42,000 pounds; on driving wheels about 36,000 pounds.

Boiler Radially Stayed—Of homogeneous cast-steel 3/8 inch thick, form straight with one dome placed centrally; waist 32 inches diameter at smoke-box end and telescoping back.

Working Pressure 160 Pounds—All horizontal seams, and junction of waist and fire-box double riveted. Caulking done with round-pointed tools. Boiler tested by hot-water pressure to 213 pounds per square inch. Dome base of open hearth forged steel, flanged and radially planed to fit shell of boiler. Dome body and dome ring of seamless open hearth steel, turned, shrunk into place, and hydraulically riveted. Dome cap of forged steel.

Tubes—Of iron, 64 or 66 in number, 1 3/4 inches diameter, and 9 feet 8 inches long.

Fire-box—28 1/4 inches long and 87 5/8 inches wide inside. Of homogeneous cast-steel; side and back sheets 5/16 inch thick; crown-sheet 5/16 inch thick; flue-sheet 7/16 inch thick. Mud ring or foundation ring, machined and fitted in place.

Stack and Grates—Stack Radley and Hunter, same as No. 15321; grates, plain bars.

Frames Placed Outside of Wheels—Of hammered iron; main frames forged solid, and front and back lugs forged on front rails for securing cylinders in place. Pedestal caps lugged and bolted to bottom of pedestals.

Truck—Two-wheeled truck with iron frame, bridges and braces, with center-bearing swivelling bolster. Double plate chilled wheels 20 inches diameter. Axles of hammered iron or

steel with journals 3 1/2 inches diameter and 6 inches long, same style swinging links as No. 15310—6-12 1/3 C. 42.

Cylinders—Of close-grained hard iron; each cylinder cast in one piece with half saddle; placed horizontally or nearly so; right and left-hand horizontal cylinders reversible and interchangeable. Cylinders oiled by automatic sight feed lubricator placed in cab.

Pistons—Pistons of cast-iron, with approved steam packing. Piston-rods of iron or steel.

Guides and Cross-heads—Guides, of steel or wrought-iron, case-hardened. Cross-heads, cast from close-grained hard iron, with suitable bearings.

Valve Motion—Shifting link motion; all parts of hammered iron well case-hardened.

Tires—Of cast-steel 2 1/2 inches thick, front and back pairs flanged 4 3/4 inches wide, middle pair, plain 5 1/2 inches wide.

Driving Axles—Axles of steel or hammered iron. Journals 5 inches in diameter and 6 inches long.

Driving-boxes—Of cast-iron, with brass or phosphor bronze bearings.

Connecting and Side Rods—Of steel or hammered iron, forged solid, and furnished with all necessary straps, keys, and brasses.

Wrist-pins and Springs—Wrist-pins, of best cast-steel. Springs, of crucible cast-steel tempered in oil, extra heavy.

Feed Water—Supplied by one-cross-head pump on r. s. and one injector.

Cab—Of hard-wood, put together with joint-bolts and corner-plates. Step front and back.

Finish—Cylinder casings of iron, painted; cylinder-head casings of hydraulic-forged steel, polished or painted; steam-chest casings of iron, painted; steam-chest tops of cast-iron; dome-casings of iron, painted; hand-rails of iron; running-board nosings of iron; boiler lagged with magnesia and jacketed with planished iron, secured by brass bands.

Furniture—Engine furnished with two sand-boxes, stand for head-lamp.

Minor Details as 15321. Pair Alexander Car Replacers—Bell, whistle, heater, blower, and safety-valves, steam-gauge, cab-lamp, gauge-cocks, oil cans, tallow-pot, two traversing jack-screws and levers, one pinch bar, a complete set of wrenches to fit all bolts and nuts on engine, one monkey-wrench, hammer, chisels, cab-seat, poker, scraper, and slice-bar. Larger whistle and bell than on 15321, 8-14 1/3 D. S.

..... Westinghouse air brake on all driving wheels. Two large head-lights.

Gauges—All principal parts of engine accurately fitted to gauges and templates, and thoroughly interchangeable.

Tank Capacity for 9 Miles Run—500 gallons capacity, carried on boiler.

Grades 2% to 3 1/2%—Coal capacity 40 cubic feet. Name "Halawa."

Curves 16° to 26°, latter S-shape—Coal box right across end. Glass water gauge and lamp. Cars empty weigh 2800 to 3000 pounds and carry 3 1/2 to 5 tons.

A locomotive without a rear or forward truck is liable to bob up and down like a single truck street car, causing a breakage of springs and a wear and tear of machinery and road bed; the advantage of a rear truck is that there can be more cab room and more space for fuel tank.

A BREAKDOWN OF AN IRRIGATING PUMPING ENGINE—HOW THE PUMP WAS KEPT GOING, AND OBSERVATIONS ON SAME.

(Read before the Honolulu Engineering Association at a former meeting.)

Pump No. 6, Station No. 5, on the plantation belonging to the H. C. & S. Co., at Puunene, Maui, was built by Fraser & Chalmers of Chicago, Ill., and has been running very smoothly and economically for some years.

The plant comprises a 3-cylinder, triple-expansion steam engine, having cylinder diameters,

High-pressure engine	19″
Intermediate engine	33″
Low-pressure engine	50″
Stroke of all cylinders	42″

Connected to the tail-rod of each cylinder, is a double-acting plunger pump, plunger diameter 11⅞″; revolutions per minute, normal speed, 56. Engines were designed to deliver 10,000,000 gallons of water to 380 feet head, per 24 hours, at 60 R. P. M., and are fitted with "Corliss" valve gear; cut-off, operated by governor on high pressure engine, and variable by hand in the intermediate, and low-pressure engines.

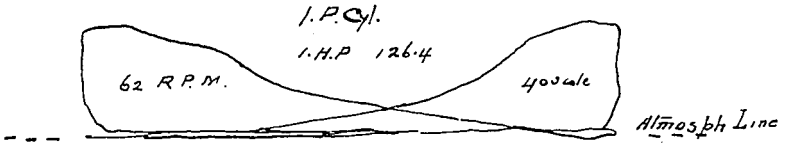
Pump valves operated by the "Reidler" mechanical arrangement for closing, as is usual in this type of pump made by Fraser & Chalmers.

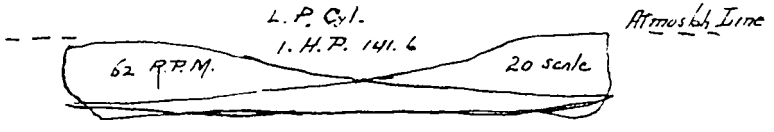
On October 19th, 1905, the pumping plant was running along as usual, delivering water to a ditch at the 180 foot level, when about noon time the key of the cross-head, on the high-pressure engine, got loose, and before the engine could be stopped, it came out, causing a complete wreck of the cylinder cover on steam cylinder, both pump bonnets, steam piston and rod couplings, etc., but the engine was not otherwise damaged.

As the pumping engine was furnishing water for some 1,000 acres of cane, it was imperative to start up again as soon as possible, and after the wreckage was cleared away, and the high-pressure connecting rod disconnected from crank, the by-pass from the main steam pipe, 1½" dia., was connected to the receiver, between the high and intermediate cylinders, the high-pressure cylinder exhaust pipe blanked off, and the engines started up as a compound, using the intermediate cylinder as the initial. Steam in the boilers, 160 pounds gauge pressure, the engines were speeded up to 62 revolutions per minute, and ran this way for 240 hours without a stop, while the necessary repairs and renewals of rods, pistons, covers, etc., for the wrecked H. P. engine were being made.

Advantage was taken of this accident to obtain sundry data as to fuel consumption, compared to water delivered, and other interesting details.

Indicator cards were taken during the time the engine ran as a compound, which are given herewith:





The steam supply pipe to the receiver on the intermediate cylinder is 1½" diameter; when running at 62 R. P M. the valve on this pipe was partly closed, leaving not more than one square inch of area for the steam used by the engine to get through. This steam was at 160 pounds gauge pressure in boilers, and was

reduced in the receiver to about 35 pounds gauge pressure, as shown by the indicator card.

The engines, running as compound, delivered 6,900,000 gallons of water per 24 hours to 183 feet head, including suction lift, and developed 268 horse power.

When running as a triple expansion, the delivery of water reached 10,300,000 gallons, delivered to same point, and horse power developed was 393.

California crude oil was used for fuel.

Fuel consumption, when running as compound, was 1,523.75 gallons per 24 hours; when run as triple expansion, the consumption of fuel oil was 1,599.95 gallons per 24 hours.

This reduced to oil per horse power, per hour, is:

When running as compound..... 1.9 Lbs.
When running as triple expansion..... 1.32 "

Which includes steam used in all auxiliary engines, such as vacuum pump, feed pump, etc.

Assuming that one pound of oil evaporates to steam under the foregoing conditions, 12.5 pounds of water, the water consumption of this engine is per H. P. per hour, when running as compound, 23.75 pounds; when running as triple expansion, 16.5 pounds; inclusive of steam for auxiliaries.

As this plant was designed for a head of 380 feet, the pump economy falls off, when delivering water to a much lower level, as is shown by the comparatively high-water consumption per horse power per hour, as indicated above.

The point of interest connected with this statement lies in the fact that steam sufficient to develop 268 horse power in a compound engine, got through an opening only one square inch in area.

After making a reasonable reduction for the use of steam by the auxiliaries in the plant (say 10 per cent.), it will be seen that the steam passing the small opening in the supply pipe to the intermediate cylinder, amounting to 1.59 pounds per second, (the engine developing 268 H. P.), and at the volume due to 160 pounds, gauge pressure, must have acquired the enormous velocity of at least 570 feet per *second,* and yet the diagram shows that there was comparatively little wire drawing at the point of cut-off in the intermediate cylinder.

The 1½" by-pass pipe reached from above the steam stop valve in the high pressure cylinder, to the flanged head of the receiver, underneath the intermediate cylinder, a distance of about 10 feet. In the pipe was a common 1½" gate valve, and two elbows.

The proportion of diameter to length of pipe, assuming that the friction due to each elbow, was equivalent to 5 feet of pipe, was 1-160. The indicator card shows that there was not much wire drawing, and there can be no doubt about the quantity of steam passing the throttle valve.

The volume of the receiver, between the high pressure and the intermediate cylinders on the engine is 11.5 cubic feet, and this accounts, in part, for the absence of much wire drawing in the intermediate cylinder.

The usual speed allowed by engine designers for the velocity of steam in pipes, and through valves, is 85 feet per second, but it would seem from the above observations that this speed might be increased with advantage, especially for steam of high pressures—for the reasons that the first cost of piping and fittings, is reduced as the diameters are reduced, both for the material and the labor for putting it in place; and that the losses of heat by radiation and condensation are much smaller for small pipes than for large ones.

As the cost of the pipe connections in a large steam plant form no inconsiderable part of the investment, this seems to be a point worth consideration.

J. N. S. WILLIAMS.

H. C. & S. Co., Puunene, Maui, November 27th, 1905.

THE INFLUENCE OF STRIPPING ON THE YIELDS OF CANE AND SUGAR.

[BULLETIN No. 16—Synopsis]

BY C. F. ECKART.

Probably no subject relating to the field operations of the sugar industry in these islands has been more freely discussed by plantation managers than that of stripping, or the removal of dried leaves from the cane stalk. Widely divergent opinions are held as to the economy of this expensive practice, and owing to the radically different conditions under which cane is grown in this country it is natural that the experience of some plantations, in this particular, has not always been in conformance with that of others. The question is largely a local one and the profits or losses from stripping are determined by the conditions under which the operation is performed. These controlling factors have, in recent years, become so involved through the ravages wrought by the leaf-hopper pest and fungus diseases that the most careful judgment is now required to determine whether or not the practice may be employed to advantage in any given instance.

The object of this bulletin is to present such data as have been obtained from carefully conducted stripping tests at the Experiment Station. The results show that under certain conditions,

thousands of dollars can be saved annually by not stripping, and they also lay no little stress on the value of carefully conducted plantation field tests as indispensable guides in the matter of such agricultural practices.

On reviewing the data presented in the foregoing tables (set forth at length in the Bulletin) a number of interesting facts are disclosed.

1—The richest juice was contained in the unfertilized cane.

2—In each of the fourteen plats the percentage of sucrose was higher in the juice of the unstripped cane than in the juice of the stripped cane.,

3—The average density, sucrose, and purity figures were considerably higher for the juice of the unstripped cane.

4—The average percentage of glucose in the juice of the unstripped cane was lower than that of the juice of the stripped cane.

5—The average content of gums was higher in the juice of the unstripped cane.

6—The average percentage of fiber was slightly higher in the unstripped cane.

7—The sucrose per cent. cane was 0.8 per cent. greater in the unstripped than in the stripped cane.

8—The unfertilized unstripped cane yielded 2.79 tons of cane and 0.66 tons of sugar less to the acre than the unfertilized stripped cane.

9—The average weight per acre of unstripped cane was 24.31 tons more than that of the stripped cane and the yield of sugar was 4.38 tons greater.

10—In all of the fertilized plats the yield of stripped cane was less than where no fertilizer had been applied. The largest loss from fertilization was 31.1 per cent.

11—With the unstripped cane, twelve plats out of thirteen showed a gain in weight of cane from fertilization. The largest increase amounted to 24 per cent. One plat gave a loss of 2.4 per cent.

12—The largest loss in weight of cane on the fertilized plats due to stripping was 44 per cent. and the smallest loss 14.5 per cent.

13—In all of the fertilized plats, the yield of sugar in the stripped cane was less than where no fertilizer had been applied. The largest loss from fertilization was 45.7 per cent., and the smallest loss 11.1 per cent.

14—In the case of the unstripped cane seven out of the thirteen fertilized plats gave an increased yield of sugar. The greatest gain was 16.7 per cent. and the largest loss 7 per cent.

15—The largest loss in yields of sugar (from stripping) on the fertilized plats was 49.8 per cent. and the smallest loss, 18.6 per cent.

16—A smaller number of dead canes was found in the stripped cane of the unfertilized plat than in the unstripped cane.

17—In each of the thirteen fertilized plats, there were more dead canes among the stripped than among the unstripped cane.

18—There were 2,539 more dead canes (on an average) to the acre among the stripped cane than among the unstripped cane.

A discussion of the relative degree in which the various plats responded to the methods of fertilization adopted in the plan of these experiments would be premature at this time. Safe conclusions cannot be drawn from the results yielded by an one-crop test and it will be necessary to continue this series through a number of cropping periods before proper comparisons can be made. The fallowing and green manuring of the field in which these experiments were conducted placed the land in excellent condition and the yield of cane and sugar on the unfertilized area approached the maximum limit of production. With succeeding crops the weight of cane harvested from the unfertilized plat will naturally diminish and the effects of fertilizers on the other plats will become more pronounced.

The results from stripping this first plant cane crop of the series are of particular moment, and while it is essential that further data be obtained in this connection from future tests with rattoons and plant cane, it is also very important that the results already gained be published at this time. The losses from stripping in these several instances appear almost incredible when we grasp their full significance. For instance, if we consider the case of Plat No. 4 which gave the *smallest* loss from stripping (for the fertilized plats) and compare the yields of sugar of the stripped and unstripped cane, the losses from stripping are found to be the following.

1—Cost of stripping.
2—Cost of fertilizer.
3—Value of 3.26 tons of sugar.

To this astonishing total must be added still another loss, which though not so immediate is very important and that is the resulting inferiority of stubble left over for the future ratoon cane.

Having noted the decreased yields of cane and sugar due to the removal of the dried leaves, it will now be of interest to consider the underlying causes in some detail.

In April, 1904, Mr. R. C. L. Perkins, writing of the injury done to cane by the Rind Disease, stated:

"This is a wound fungus, and unquestionabbly it starts in the "punctures made by the leaf-hopper in the cane-stem. * * * "Whole cane fields are simply saturated with the spores of the "fungus, and where a stem is punctured by leaf-hopper one can "only wonder that any escapes inflection. * * * It is clear

"that countless millions of spores are frequently produced on "one internode of a single stick of cane. What must be done "is clearly to protect the stem as far as possible from the leaf-"hopper for a stem once infected with the fungus is largely "or altogether ruined. On no account, therefore, *unless it is "absolutely necessary for reasons of cultivation,* should cane be "stripped so as to expose joints with the rind still soft, in fields "where leaf-hopper is abundant. If such stripping be made, "the young joints will be freely pierced by the ovipositors "of the female hoppers and give ready access to the parasitic "fungus. I believe, that until the leaf-hopper is subdued by "natural enemies, this is the only really effective manner in which "great loss from the fungus can be avoided. The injury done "to the leaves by the egg-laying of the leaf-hopper is as nothing "to that when the stem is pierced."

In the case of the field under consideration, the leaf-hopper and the rind disease have unquestionably been the most responsible agents in reducing the yields of the stripped cane. Through the rank, stimulated growth following the application of large quantities of fertilizing material the cane acquired a comparatively soft rind which on becoming exposed through the removal of the dried leaf sheaths offered an attractive field for the egg-laying of the hoppers. The hopper punctures gave ready access to the spores of the rind fungus and hundreds of dead canes bore evidence of the results. While the unstripped cane also suffered from these pests of the field, their injuries were comparatively small, and the number of dead canes left in the rows were considerably less. The great majority of dead cane stalks showed the presence of the rind fungus in the stripped and unstripped sections. The fact that the stripped unfertilized cane gave a slightly better yield than the unstripped unfertilized cane indicates that where the cane was permitted to make an unstimulated growth, with a resulting firmer rind, the conditions in general favored stripping, though hardly to a degree which would be compatible with economy.

In this series of tests all of the plats were laid out on the leeward side of an adjacent field. While the stripped and unstripped rows in each plat had practically the same exposure to the prevailing winds, the shelter afforded by the field to windward doubtless influenced the results to a very considerable extent and served to increase the losses from stripping for two reasons.

1—Leaf-hoppers are known to frequent the more sheltered parts of a field in preference to the exposed parts.

2—In this sheltered locality it is reasonable to suppose that the soft internodes of the cane stalk, exposed by the removal of the leaf sheaths, would harden more slowly than would be the case if they were subjected to the force of the prevailing winds.

They would therefore present a suitable surface for the leaf-hoppers in their egg-laying activities for a longer period.

The stripped rows of the unfertilized plat was slightly more exposed than the stripped rows of the other plats and a certain small allowance should be made for this fact.

In stripping, large numbers of leaves which are still performing their functions are often removed. The injuries from this too-high stripping are two-fold. The cane not only receives a certain check in growth as a consequence, but it has been pointed out by Dr. Cobb that the removal of the green leaves is usually effected at the expense of a portion of the rind, and an abrased area is left on the surface of the cane stalk to furnish ready access to the ever present spores of the Rind Disease. If plantation laborers were more moderate in their zeal and left a couple of the dried leaves on instead of taking one or two of the green ones off, this cause of loss would be eliminated.

The data yielded by the stripping tests described in this bulletin lead us to at least one very definite and important conclusion. It is strikingly evident that careful field experiments should be carried out on the plantations to determine the economy in removing the dried leaves from the cane. The universal and simultaneous presence of the leaf-hopper pest and the Rind Disease in Hawaiian cane fields has created conditions which warrant careful investigations with regard to stripping not only on different plantations, but on different parts of the same plantation. The fact that one-half of a plantation may be stripped with profit is not always a guarantee that the other half will not be stripped at a loss, especially where the lands are characterized by an uneven surface with its exposed hills and sheltered depressions and where the fields are liberally fertilized.

It is very unlikely that any plantation in the islands will ever suffer a general loss from stripping approaching that of the Experiment Station in the tests (with three strippings) we have described, but at the same time it is not too much to suppose that under some plantation conditions it will be found that stripping not only does not increase the sugar output but also that it minimizes the effects of fertilization. The fact that a large yield of cane and sugar is obtained on a given field following fertilization and stripping is in itself no justification for stripping; still larger results might be made from the same field from fertilization without stripping. A large number of plantations strip only once, either early or late, or at most twice and at such times as the least possible injury could result even under adverse conditions, and in these instances it is probable that any field tests which may be conducted will amply demonstrate the economy of their practice.

RAISING SEEDLING SUGAR-CANES IN CUBA.

Increased attention is now being paid throughout cane-growing countries towards the possibility of raising improved varieties of sugar-cane by hybridization. The area under seedling canes is gradually extending, and it is hoped that breeding continually for a cane of greater vigor and hardiness, giving a larger yield of sugar per acre, will be the means of improving the prospects of the cane sugar industry. The following extract is taken from a report from Mr. E. F. Atkins, Harvard Experiment Station, Cienfuegos, Cuba, and shows that, owing to a favorable season, excellent results have been obtained from the hybridization experiments carried on during the last season:

"Four years of careful hybridization resulted in but two seedlings, and it is gratifying to note that, owing to a favorable season, with intervals of warm weather of sufficient duration to permit fertilization of the flowers and ripening of the seeds, our efforts have proved successful. With the aid of the greenhouse to ward off severe cold spells during germination, we have this year raised over 600 seedlings, nearly all the result of hand fertilization.

"Hand fertilizing was carried on daily from the earliest flower opening in November until the middle of April, the close of the flowering period, often without success, as several sudden cold waves destroyed quantities of the seeds before the ripening period.

"Those which succeeded in escaping severe cold weather for thirty or thirty-five days were then collected and sown in the greenhouse, where they could be protected from the cold, and the pots and boxes were placed over pans of water further to protect them from being destroyed or carried off by ants and other insects.

"As a test to their germinating power in various soils, seeds were sown in red iron-clay soils; black humus mixed with fine clay; decayed leaf mould and sand; equal parts of garden soil and sand; pure sand; paper blotters, etc. The best results were obtained from the mixture of black humus soil and clay. The seeds germinated freely in it and continued to grow nicely without the necessity of transplanting until large enough to stand moving without injury, and the soil remained moist and friable for a long period.

"The leaf humus proved first rate, and the seeds germinated freely in it, but it dried out very quickly being too porous, and when kept wet, algae formed on the surface which proved destructive, and the plants had to be transferred to a more solid mixture when very tiny. Leaf soil when decomposing produced detrimental fungi. Clean sand proved satisfactory

as a germinating medium but slow, and the seedlings grew very weakly. Great care had to be taken in watering to keep the young plants from 'damping off' in dull weather. Results in red clay soil were poor, as the soil baked and became hard in drying off, and if kept wet the seeds decayed. The other soil experiments and blotters proved failures. In all cases the seeds were sown thickly and covered lightly, samples buried deep (less than ½ inch) died.

"I have found great care essential in watering, especially seeds of 'Crystillina' and 'Cinta,' which proved very delicate under all conditions. The best results were from soil kept continually moist.

"Quantities of seeds were sown in the open ground in prepared beds, but without success. I have searched over a great deal of territory in the fields in various soils and under all conditions but have failed to locate a single seedling of spontaneous origin."

Many interesting points are set forth in this report, especially those relating to the experiments in different kinds of soils, and they go to show how much care must be taken to obtain the successful germination of sugar-cane seeds.—Agricultural News.

JAVA.

The following extract from the Consular Report on the trade of Java for the year 1905 reviews the position of the sugar industry in that island:

"Notwithstanding the fact that the planted area was slightly larger, the 1905 sugar crop only yielded a production of 1,028,357 tons, or a decrease of 36,398 tons, as compared with that of the previous year. This must be attributed to the unfavorable weather experienced during the planting season; at the time when copious rains were most required there occurred periods of drought, which had an injurious effect on the canes and resulted in the juices being of inferior quality. The satisfactory prices obtained by planters, recorded in my last report, were not only well maintained but later in the season rose to a level which has not been approached for some years.

"With regard to cane diseases, Mr. Vice-Consul Rose reports as follows:

" 'Progress is noticeable in the endeavors made to eradicate the many diseases to which sugar-cane is liable, the success being due, in great measure, to the process of careful selection.

The best results were again obtained from the seedlings, the popularity of which increases annually. The foreign cane has fallen into disfavor and is likely soon to be entirely abandoned, while the indigenous cane, although yielding good results, proves expensive through having to be nurtured in gardens in the hills.'

"As foreshadowed in my last report, the profits made by mills on the 1904 working were in most cases expended on new machinery, and the majority of the mills in Java may now be said to be up to date as far as installation is concerned. Many are now capable of producing, in addition to the usual qualities, superior sugar, which in shade and grain most nearly approaches the refined article and finds a ready market in India.

"With the exception of the United Kingdom, which only took 9,230 tons, as against 55,511 tons in 1904, the exports to various countries have been much on the same scale as during the preceding year.

"The results obtained from the free use of sulphate of ammonia and ground-nut cake on sugar plantations continue to be most beneficial."—Agricultural News.

MORE USE FOR BEET MOLASSES IN EUROPE.

Consul General Hackara, reporting from Berlin on German scientific methods of securing the highest unit value of every part of the raw material, especially of the sugar beet, says that there are over a thousand chemists in Germany working in up-to-date laboratories in the interest of the sugar industry. One of the principal by-products of beet sugar is, of course, beet molasses and during the campaign of 1904-05 the output of molasses was 366,860 long tons. The present price of this molasses at the factory is 71.4 cents per kilo, or 14.30 cents per ton, the total value of the molasses being thus about 5¾ millions of dollars. The scarcity of animal foods in Germany leads to the considerable use of molasses as a component part of cattle feed. The food value of molasses is diminishing its use for distillation, as alcohol made from it cannot compete in price with potato alcohol. During the year 1903-04 2½ millions of gallons of alcohol were produced from molasses, whereas the annual product from potatoes was over 80 millions.

Molasses is now employed in the manufacture of brewers' yeast, dyes and dye wood extracts, shoe polish, chicories, table

syrups, ordinary candy, etc. The increasing use of analine colors for dyeing purposes has greatly reduced the consumption of molasses in the manufacture of vegetable dyes. Shoe dressing and creams have considerably lessened the amount of molasses consumed in the manufacture of blacking. It seems to be used as an adulterant in the manufacture of German chicory. This finished product is sold under the trade name of "caffee surrogat" at a price of about 4 cents per pound at the factory.

The exhausted beet pulp and beet cuttings constitute a valuable fodder and especially when molasses is added to them. The pulp and cuttings are called schnitzel, and about one-half of the wet schnitzel is returned gratis to the farmers who furnish the beets.

Referring to the American beet sugar industry, it is said that:

In the United States where the manufacture of sugar from beets may be said to be in its infancy, but which in the past few years has made gigantic strides—from six factories some eight years ago, which extracted only 30,000 tons of beet sugar, to fifty-four factories, which it is estimated produce 295,000 tons, valued at $15,000,000—the question arises whether or not our beet-sugar makers thoroughly appreciate the economic value of the by-products. Are the latter not considered a drawback, to be removed either at too low prices or to be given away gratis provided the receiver pays the cost of hauling? If American farmers and sugar makers desire to save the enormous sum, over $90,000,000, which we now have to pay to foreign nations for the sugar necessary to supply the wants of our own consumers, and at the same time to build up an industry which will not only benefit our farmers but also their land, they can not afford to ignore the scientific economies of sugar production.—Louisiana Planter.

PROGRESS IN SUGAR GROWING.

A prize of $20,000 is offered by the beet-sugar manufacturers of France to anyone who shall first discover and apply in France a new method of utilizing sugar in the arts. It is required that the method shall increase the consumption of French sugar 100,000 pounds per annum.

The effect of sunshine on sugar growing is said by the New Orleans Picayune to make the crop more productive. Thus

Spain has become equally as successful with beet-sugar growing as with her established cane-sugar industry, notwithstanding an arid climate. On the other hand, the storms and fogs that envelop the British islands are said to have prevented the development of the beet-sugar industry there. England's annual average hours of sunshine are but 1,400, while Spain has 3,000 hours.

J. M. Ceballos, of New York, after a seven-weeks' trip to Cuba, declares that the Government forecasts as to the sugar crop were entirely wrong. Special Agent Pepper's report, written some time ago, was based on estimates, he says, of conditions which have improved, and he believes that the crop will reach the high mark of last year, 1,165,258 tons. Mr. Ceballos adds that everyone is busy in Cuba now, and that if 10,000 workingmen were to go there today they could find almost immediate employment as bricklayers, mechanics, laborers, etc.

New Orleans firms are capturing many contracts for the equipment of foreign sugar plants, chiefly in Mexico, Porto Rico and Cuba. One New Orleans concern, the Eastwick Engineering Company, has undertaken to build a $3,000,000 refinery in the Cordoba region. The Whitney Iron Works, of New Orleans, and other large concerns are busy with sugar-machinery orders. J. B. Craven, of New Orleans, has secured the contract for a big sugar factory at Naguabo, P. R., for the Esperanza Central Sugar Company, a $750,000 concern. Andrew W. Preston, president of the United Fruit Company, is at the head of the Nipe Bay Company, a $7,000,000 concern, which will establish a sugar plant on the north coast of Cuba. They plan to handle no less than 5,000 tons of cane sugar daily.