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W. M. GIFFARD AND THE FORESTER AND AGRICULTURIST.

The production of sugar requires so much study and concentration of thought on the part of those directly engaged therein, that the wonder is, not that plantation men take so little interest in diversified industry, but that they find any time at all to devote thereto. In spite of this fact, however, a number of our most active and progressive sugar planters are prominent in their promotion of other agricultural enterprises. Notably among these are H. P. Baldwin, of Maui, who is actively promoting a sisal plantation at Haiku, and is financially backing the Pineapple Cannery at the same place. He is also, through the Haleakala Ranch Company, active in his support of the proposed homesteaders' sisal plantation in Kula, Maui. Another notable instance of disinterested devotion to the interests of the smaller agricultural industries, is that of Mr. Walter M. Giffard, Manager of the Plantation agency firm of W. G. Irwin and Company, one of the largest business concerns of the Territory. Mr. Giffard, at considerable sacrifice of time and effort, has accepted a position on the Board of Agriculture and Forestry, upon which Board he has been a most active member, as a member of the Forestry and Finance Committees, and as Chairman of the Entomological Committee. In addition thereto he voluntarily undertook the editorship of a magazine to be issued under the auspices of the Board, to be devoted to the interests of forestry and agriculture.

There is nothing more difficult in the line of editorship than the production of a bright, newsy and instructive magazine, with so restricted a field as that of the Forester and Agriculturist. It is easy to do so for two or three months, but the steady grind of month after month draws on a man's vital forces, and shows the stuff he is made of.

Mr. Giffard has stood this test well, and has created a valuable adjunct to the cause of diversified industry in Hawaii. He retired from the editorship of the Forester with the December number, but still retains his connection with the Board, and will continue to be a contributor to the magazine.

Mr. L. G. Blackman, a member of the staff of the Kamehameha Museum, assumed the duties of editing the Forester with the January number, and from the high character of his articles heretofore published in the Forester, we shall expect to see it conducted on the same high plane that has heretofore characterized it.

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Errata: In publishing the report of the Committee on Experiment Station in the November issue, there was omitted therefrom Appendix VII, "On Some Diseases of Cane Specially Considered in Relation to Leaf Hopper Pest and to the Stripping of Cane." We have, therefore, published the Appendix in this issue.

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ANNUAL MEETING OF HAWAIIAN SUGAR CHEMISTS' ASSOCIATION.

The annual meeting of the Hawaiian Sugar Chemists' Association was held in Honolulu, October 31.

There were present Messrs. Messchaert, Eckart, Hartmann, Crawley, Johnson, Greenfield, Nichlas, McQuaid, Peck, Jordan, Werthmueller, Batelle, Easton, Brodie, Toepelmann, Giacometti, Fujii and Shorey.

Election of officers for the year 1905 resulted as follows:

President—E. E. Hartmann.

Vice-President—Horace Johnson.

Secretary-Treasurer—Edmund C. Shorey.

Executive Committee—E. E. Hartmann, Horace Johnson, Edmund C. Shorey, Ph. Nicklas, F. E. Greenfield, C. C. Krumbhaar, Alex. Brodie, Jr.

Reports of the chairmen of the several committees were read as follows:

Extraction—E. E. Hartmann.

Polarization—W. McQuaid.

General Control—A. Fries.

Reports—H. Johnson.

After discussion of these reports the "Provisional Methods" in use during the past season were taken up and after a few unimportant changes were adopted.

The title will now read "Methods of Analysis Adopted," instead of "Provisional Methods."

Probably the most important point discussed was that brought up by Mr. Crawley, namely, the importance of members doing some other work than mere routine analyses. On motion of Mr. Crawley a committee of five was appointed to report on this matter. This committee reported to the general meeting at a session held Nov. 1, and as a result of this report the following lines of investigation were directed to be taken up, a committee of one being appointed in each case to have charge of the work:

1. The extraction of sugar from settlings and scums.—P. A. G. Messchaert.
2. Superheat clarification.—C. C. Krumbhaar.
3. Crystallization in motion vs. crystallization in coolers.—E. E. Hartmann.
4. The value of waste molasses and press cake.—Edmund C. Shorey.

The old committees were ordered continued and a special committee to report on the polarization of molasses.

A letter from Dr. Wiley, Chief of the Bureau of Chemistry, Washington, D. C., to the secretary, calling the attention of the Association to the effect of temperature on polariscope readings was read and discussed, and an additional paragraph added to the methods under polarization covering this point.

The meeting adjourned at 3 p. m., Nov. 1, closing the most successful meeting in the history of the Association.

In northern Queensland there has recently been a conference of prominent sugar growers, looking to the maintenance of the sugar industry in that section where the absence of a supply of labor threatens its existence. Since Queensland joined the Australian Federation she has been compelled to yield to the laws enacted for the exclusion of colored labor from the entire federation. A considerable amount of Chinese and native negro labor is available, but not very satisfactory, and the Queenslanders turn to their supply of Kanaka, or South Sea Islanders with whom they have brought their industry up to a production of 100,000 tons of cane sugar, or more. The general government has recently been offering a bonus on all sugars produced throughout with white labor and many of the leading men of Australia are determined, if possible, to have what they call a white Australia, with no intervention of colored people. The sugar districts, which are in Queensland chiefly, and towards the north, there corresponding with our south here, are persistent in their efforts to get some modification of the law, or some relief in some way that shall give them some satisfactory labor system, and no satisfactory solution of the problem seems yet to be in sight.

ORIGIN OF CANES GROWN IN HAWAII.

(Letter of C. F. Eckart, Director of Experiment Station.)

Honolulu, November 11th, 1904.

Hon. Wm. G. Irwin,

Honolulu.

Dear Sir:—

Following our conversation of last evening regarding the origin of various canes grown in the Hawaiian Islands, I have looked over a list of varieties grown at various times at the Sugar Experiment Station at Audobon Park, La.

In the volume entitled "Sugar Cane" published by Dr. Stubbs some years ago, considerable space is devoted to this subject and particular reference is made to the varieties shipped to Louisiana by your firm in 1887. Dr. Stubbs says:

> "In 1886, through the courtesy of Hon. Norman J. "Coleman, the Hon. Thos. Bayard, Secretary of "States, instructed the United States Consuls in "sugar countries to collect and send to the Sugar Ex-"periment Station samples of all varieties of sugar "cane obtainable. There were fifty-five samples in "all received. Some of them were in excellent order, "and were easily propagated; others in excrable con-"dition—in fact, every eye dead. These samples were "received with names frequently purely local or de-"scriptive of color only, giving no indication of origin. "A few were intelligently named. Those sent from "the experimental gardens of Dr. Alvarez Reynosa, "of Cuba, through Hon. R. O. Williams, from Mr. W. "G. Irwin, through Hon. J. H. Putnam, were intelli-"gently labeled and described. * * * The letter of "Mr. Irwin, also inserted, is a valuable description of "the varieties sent, particularly of those indigenous "to the Hawaiian Islands."

The letter referred to was as follows:

"Honolulu, H. I., Aug. 1, 1887.

"Sir:—

"In accordance with your request we have obtained "from one of our plantations thirteen varieties of "sugar cane. The canes are carefully packed and will "go forward per steamship Australia to-morrow.

"The package labeled No. 12 contains four varieties "of cane imported by us from Queensland, Australia, "viz.:

"Altamatie, red with faint dark stripes; Rose Bam-"boo, pinkish yellow; Yellow Caledonia, pale yellow; "Elephant, purple, with pale green stripes.

"These four canes do very well with us, more espe-"cially the first mentioned. The canes labeled Manu-"lete, Uwala, Ohia, Okilolo, Honuaula and Papaa, are "indigenous to these Islands. These canes on lands "situated at any altitude between 1,550 and 2,000 "feet, are, from the fact of their being exceedingly "hardy, the favorite varieties of our planters for such "lands. The two packages labeled respectively Kanio "and Ainakea, came originally from Mauritius, where "they are known as the light and dark Bourbon canes. "These two canes yield well on our highlands. La-"haina cane, No. 11, was brought here by Capt. "Pardon Edwards, from the Marquesas Islands, and "was first planted at Lahaina, whence its name. This "cane is preferable to all others on land near the sea "level to an altitude of 1,500 feet. Its introduction "into this kingdom has increased the yield of sugar "at least fifty per cent. In consequence of its heavy "stooling, this cane should be planted not less than "six feet between the hills. Kokea, No. 13, does fairly "well on side hills and dry lands, but is not a favorite.

"We are, sir,

"Yours truly,

"WM. G. IRWIN & CO."

The descriptions of the various canes contained in this letter show that what is now termed "Altamatti" is not the same cane as the variety known by that name in 1887. The "Altamatti" of the present day is a cane so furry that the rind is obscured and the cane has a greyish, velvety appearance. I am inclined to believe that what is ordinarily called "Bullock-heart" cane on the plantations to-day is the "Altamatie" of twenty years ago. This merely shows how readily names of varieties have been confused in the past and how necessary it is to keep varieties, which are introduced for experimental purposes, labeled. Another interesting fact brought out by this letter is that the "Ainakea" ordinarily classed among the indigenous varieties is an imported cane from Mauritius. It also shows that our Yellow Caledonia has been growing in the Kau district from a time previous to 1887, it having been distributed from that point all over the Islands. According to Stubbs, it came originally from New Caledonia, although it was introduced into Hawaii through Queensland by your firm.

Trusting that these matters may be of interest to you, I remain,

Yours very respectfully,
(Signed.) C. F. ECKART.

REPORT ON GENERAL CONTROL WORK. *

SAMPLING.

All analytical work done for the Control of a Sugar Factory from the raw material through the process of manufacture to the final products becomes immediately worthless so soon as one of the following three conditions is neglected, viz: the sampling, the preservation of the samples and the judicious carrying through of the analysis itself. Of what benefit is a carefully carried out analysis if the material at one's disposal does not give a correct average of the whole (material) which has to be examined? If for the determination of sucrose half a dozen samples of cane were taken from the carrier each day, those would not represent an exact average of all the cane which had gone through for that day. It is therefore unreliable in a roller mill to directly determine the sucrose in the cane by taking above average samples for the true results. The sucrose in the cane is therefore calculated from the analysis of the juice and a factor varying with the fibre content and the extraction of juice, or the total sugar in the extracted juice plus the sugar left in the bagasse gives the total sugar in the cane. In either case the sampling of the juice coming from the mill and its correct analysis is of great importance in general control work.

Each chemist has his own way for getting average samples and local conditions give preference to either the one or the other method.

There are several methods for getting a continuous sample from the first rollers and intermittent samples with the help of upward or downward motion of machinery, or weighing machines are often used for the mixed or clarified juice. Continuous sampling of juice through a small pipe and valve has the disadvantage that the fibre in the juice will choke up the

[*Report presented at annual meeting of Hawaiian Sugar Chemists' Association.]

small opening, besides that, the flow of juice is not always regular. With diffusion juice, containing very fine fibre, this method is impracticable. An arrangement which I have at Makaweli now works so well that I take the liberty of mentioning it here. A piece of $\frac{1}{4}$-inch pipe is connected with the main juice pipe close to the superheater receiving tank so that the juice when the $\frac{1}{4}$-inch valve is opened will run into this tank. Against the outflowing juice is put a broom-corn from an ordinary broom; as this is put at an incline the juice will run down that broom-corn and drop into a sample bottle containing some formalin. The fibre in this device makes absolutely no trouble and the dripping of the juice goes on as regularly as clock-work. It can also easily be regulated by closing or opening the valve; as a rule I have it arranged so that it will give from 60 to 75 drops a minute. Every two hours these samples are analyzed in the laboratory.

The task of a rational control is, however, not only to obtain and analyze accurate average samples of a longer or shorter period, but it is in some instances also necessary to take single samples of juices, syrups, molasses, etc., at any time from any tank or strike. As it is necessary to have each clarifier of the same alkalinity, or to boil each strike to the same required concentration, one clarifier may be sour, another overlimed, the average sample, however, will show the desired alkalinity; again, one mudpress cake may be nearly exhausted while another contains more than a profitable sucrose content and the average sample will not show that any irregularities have taken place. In regard to mudpress cake the method of sampling is of great importance in the value of general control work. When one considers that so much here depends on the good will of the labourer, whether he sweetens off according to instructions or not, furthermore that often the inadequate arrangements for sweetening off on some of the older types of presses, or technical difficulties or careless work in the clarification make a good exhaustion of the press cake difficult, it is clear that the chemical control at that station is very important. It is not only the duty of the chemist to put down the losses in the press cake—as he finds them—but also to remedy any irregularities in the work of same. As a rule the samples are taken during the discharge of the presses, but even after sweetening off the sugar content in one press or in one chamber is different in all parts of this chamber and as the getting of samples is left to the laborer occasional samples taken by the chemist himself are of considerable value. As the mud press cake preserves itself for a considerable time and even the water content does not readily decrease, it would be advisable to take the average sample from the mud wagon. In some mills the mud is mixed with water and runs into the field; this, of course, would give an excellent average sample and could be analyzed by determining sucrose by direct polarization and after finding the spec. gravity or brix by weighing a certain volume of the mixed (diluted) mud, the real amount of sucrose in the original cake could be calculated.

Massecuites should be sampled during the whole time the pan is discharging; these samples can be collected in well stoppered bottles and their analysis made once a week.

From each strike one sample of sugar is taken while the sugar drops into the bags; this sample is immediately polarized and kept in tightly closed bottles. On some places samples are taken from each bag as it is weighed—throughout the whole strike—and put into an open container. This method is not advisable because the sugar soon dries out and gives a higher polarization than it actually had at time of weighing.

I have no average samples of No. 1 molasses, but take samples and analyze them whenever the work in the mill requires it.

The same is done in regard to 2nd and 3rd molasses; samples are taken at any time that different boiling or a change in the cane make a change in the manufacture necessary. As often as possible I take sample of 3rd molasses. The 4th massecuite being stored in large cisterns, its molasses gives me a good average sample for the crop.

ENTRAINMENT.

The cause for mechanical losses in evaporators and vacuum pans are leakages of the tubes or coils; when working, there is no chance of juice being lost as the pressure in the heating steam is always greater than the pressure in the boiling or juice space. Steam and condensed water may enter the juice space, but juice will never escape into the steam space, until the evaporator is shut down, when losses of juice through these leaking tubes cannot be prevented, and if the condensed steam is used as boiler feed water, the sugar is soon discovered in the boilers.

There are other causes for loss in an evaporator. For example: The vapor may carry with it small particles of juice, and under unfavorable conditions this may lead to serious losses. In the first vessel of an evaporator this rarely occurs; in the syrup vessel, however, where the steam or vapor occupies a much larger space the thick juice is more or less atomized by the bursting of steam bubbles and these are then carried off to the condenser where they are lost in the condenser water. This water should therefore often be sampled and analyzed for sugar.

The Executive Committee of the H. S. C. A. last year recommended in regard to entrainment the following: "A continuous sample of the evaporated water should be taken and analyzed every 6 hours. Two litres are evaporated to 100 cc and the sucrose determined either by polarization or by inversion and the determination of invert sugar by Fehling's solution.''

I really do not see why this water should be examined every 6 hours or four times a day and also where the chemist is going to find the time to do all this. If, however, there is an evaporator which shows entrainment badly then the above method may be in place. Besides that I do not see why the reaction of naphtol is not mentioned; we surely want an evaporator in such a shape that only traces of sugar can be found in the condensed water. As a rule I use naphtol; if I find more than traces of sugar I evaporate the water to 1-10 its volume, invert and determine by Fehling's solution.

Only occasionally I take samples of the condensed vapor and the condenser water and test for sugar. Once during the crop I take a whole week in which I take continuous samples from the evaporators for entrainment, another week is used for testing entrainment in vacuum pans.

Some years ago we put a 2½-inch pipe through the whole height of the vapor outlet pipe to condenser on evaporator and vacuum pan. This internal pipe had an open slot cut on that part facing vapor outlet and so arranged that the juice—collected in it—could be trapped. The proportion of area of opening on this pipe to area of vapor pipe was 1:30.

I took the juice which collected in this internal pipe throughout the whole strike in 3 parts.

(1) From beginning of strike to graining point 900 cc of juice had collected of 5.6 pol.

Sucrose calculated for the whole area of vapor pipe=3.04 lbs

(2) From graining point to ¾ strike
950 cc of juice of 2.7 pol.
Sucrose= 1.55 lbs

(3) From ¾ to finish of strike
200 cc of juice of .57 pol.
Sucrose= .07 lbs

Total sucrose lost by entrainment= 4.66 lbs
or .006% per 100 sucrose in pan.

In the same way I found in the evaporators for the 24 hours a loss of between .002 and .008% on sucrose in the cane. This small amount of sugar mixed with the big volume of condenser water will hardly even throw traces of sugar by naphtol. The amount of condenser water can be calculated from the amount of the condensed vapor and its temperature and the temperature of the water entering and leaving the condenser, by the formula:

$$X = \frac{606.5 + .305\ (\text{temp. of vapor—tem. of condenser water})}{\text{temp. of condenser water—tem. of original water.}}$$

X=Water necessary for the condensation of 1 kg. vapor.

UNDETERMINED LOSS.

Every sugar factory that has chemical control, has undetermined losses. These losses are the difference between the total losses during the process of manufacture and the sum of all the losses determined in bagasse, press cake, entrainment, waste molasses, etc. This total loss is invariably higher than the sum of the determined losses and an unknown or undetermined loss has therefore to be recorded.

We distinguish amongst undetermined losses,

(1) Those losses which are known but cannot be determined during the course of manufacture, and

(2) Losses which are unknown and probably not real losses of sugar. Losses of the existence of which one is aware but which are not determined are especially losses which are caused by the destruction of sugar in heating the juices, in evaporators and vacuum pans, losses in filterpress cloth and mechanical losses caused by leakages or spilling of juice or syrup. The sum of these losses is generally small, provided that the juices have been kept alkaline and no appreciable leakages have taken place.

Losses which are unknown form the greater part of the undetermined losses, and it is assumed that these are not real losses of sugar. The correct determination of sucrose in the cane—no matter what method is used—depends firstly on the obtaining of correct average samples and secondly on the correct figures for the weight. There are, however, during a crop, many chances for errors in weighing cane, or in weighing or measuring juices. The weighing of the final product, the sugar, is much more reliable and accurate and the sampling much surer, its weight being only about 10-15% of the weight of the cane; errors are therefore lessened in the same degree.

During the last 12 years of the Makaweli mill the undetermined losses ranged between 2½% and 3½%. Other plantations had the same, but have in later years reduced this loss to less than half of one per cent., upon which I have looked with a great deal of suspicion.

Dr. H. Claassen, the German sugar expert, says:

"Great attention and care is necessary to correctly determine the traceable losses. If sampling and analysis be done carelessly one finds nearly always low losses; low total losses and low undetermined losses. A low loss calculated from the chemist's book is not always a proof of good work, on the contrary, such figures should be looked at with suspicion. According to reports of factories the technical management of which is known to be good, the total losses are between 7% and 10% on the sucrose in the beets; of these 4-6% are determined, so that nearly half the amount appears as undetermined losses. Even if it is not pleasant for a chemist to report such high losses, which would be ruinous, if they had to be calculated as real losses of sugar, there remains nothing else to do for the chemist who loves the truth. But it must be assumed that these losses are not real sugar losses but polarization losses for which a sufficient explanation has not been found."

These remarks, of course, apply to beet sugar factories, but I do not see why their undetermined losses should be so much higher than some which of late have been recorded here in cane sugar factories. It might be said that diffusion may be responsible for the high undetermined losses, but the sucrose under the conditions pertaining to diffusion could only be converted into invert sugar, and an increase in glucose is hardly noticeable if the cane is good and the process works rapidly.

While those mills especially which have crystallizers report a very low undetermined loss, mills which work the old cooler process, come as high as 3%. It is possible therefore that much of the undetermined loss occurs during the handling of molasses goods and is due to inversion. This belief is strengthened by a report of a Java factory which I received lately. In this factory the massecuite is separated in one day's time into marketable sugar and waste molasses, and the chemical control is most reliable, the figures therefore trustworthy.

This mill has a loss in waste molasses and undetermined of 4.74%, the lowest loss that has been recorded, as a lower quotient than 30 is not to be expected and now all loss by inversion or spilling is avoided.

I am sorry the report did not separate the losses in waste molasses and undetermined loss; however, we have the fact remaining that there is an undetermined loss, and so far I know of no factory on these Islands that does such excellent and rapid work in manufacturing sugar, consequently a greater undetermined loss should be expected.

WASTE MOLASSES.

For the determination of brix or dry substances we have a number of methods:

(1) Mr. Hartmann's method of direct water determination as described in the provisional methods of the H. S. C. A.

(2) The determination of special gravity by a piknometer.
(3) The direct water determination by drying with sand.
(4) Direct spindling.
(5) Determination of special gravity by Mohr's balance.
(6) Diluting the molasses, spindling and calculating the brix of the original molasses by the formula:

$$\text{Brix of original molasses} = \frac{100 \text{ x polarization of orig.}}{\text{purity of solution.}}$$

(7) Making a solution of 1 part molasses and 1 or 2 parts water, the brix of the solution is to be multiplied by 2 or 3 to get brix of original molasses.

The determination of the spec. gravity of a solution by piknometer is a simple matter; in order to calculate from it the dry substance one supposes that what is dissolved in water, consists only of sugar, or that the non-sugar bodies contained in the solution, all have the same spec. gravity as the sugar. Is the spec. gravity determined, one finds from Scheibler's tables the respective sugar content and takes that as the dry substance.

The supposition, however, that the spec gravity of non-sugar bodies is equal the spec. gravity of sugar solutions of the same percentage, is purely arbitrary, and in no way agrees with the facts. One finds also that the spec. gravity determined by dilution and spindling varies with the results obtained by direct determination of spec. gravity. The reason of this lies in the difference of contraction in the various proportions of water to non-sugar bodies of differently concentrated solutions. Mr .Hartmann proved this directly by taking a molasses of 90° brix and diluting it with 20, 30, 40 up to 80% water and determining the spec. gravity in all these solutions by piknometer, and calculating from it the spec. gravity of the original molasses. It was found for example, that by mixing 1 part of molasses with 3 parts of water the difference in brix was 2.7 degrees.

For pure sugar solutions therefore the dilution method gives absolutely correct figures; with the increase of non-sugars however and the increase in percentage of dilution the incorrectness of the method increases.

Mr. Hartmann says:

"The quotient of purity found by dividing single polarization by brix as found by dilution method is of value only for the comparison of work in the same sugar-house day by day," or in other words: the apparent purity and the apparent brix do not deserve the attention which is given them in the sugar houses. Its determination is easy and would be of value if we could find relations between the apparent and real purity or between apparent and true dry substance. Weissberg has tried this but without success. He intended to use the method of purity determination by specific gravity with massecuites by dissolving the massecuite in water to a certain dilution and determining factors with which the "found" apparent purity had to be multiplied to get the true purity. Weissberg calculates that the apparent purity reaches the true purity the closer, the purer the product is, because in such products the influence of the non-sugar bodies on spindling is the smallest. If he had chemically pure sugar the factor would be "one." It has, however, been found that such general factors are not possible. Even if we could always take the same dilution and thereby eliminate the error caused by different concentrations, the composition of the non-sugars would be a different one for various products and would therefore influence the brix reading irregularly. These factors could be used, however, if they were determined for each factory and for each of its products separately, and yearly a new table would have to be arranged, the cane being different each year.

The determination of the real or true substance by direct water determination is much more exact, although it is even here necessary to comply strictly to rules, or else one gets wrong results. The temperature should not be higher than 95 to 100° C. If after drying at a temperature of 95-100° Celsius constant weight is finally obtained, a decrease in weight, especially with waste molasses, will take place as soon as the drying is continued at 100-105° Celsius. The reason of this may be that different non-sugar bodies give up their water at different temperatures and cane juices and their products generally decompose easily. Where the limit is, is hard to say and I think Mr. Hartmann's method does not only give a good and easy way for the determination of the water in molasses or the true dry substance, but it also gives the time, in which the operation should be finished, and I therefore think its use should be generally adopted, while the dilution method would be of value for comparing work in the same sugar house; it would be well, however, to use the same % of dilution with each determination, as the error increases with the degree of dilution.

I have tried a method which determines the brix by piknometer in the diluted molasses and calculates by a certain formula the true dry substance from the apparent dry substance and apparent purity.

Molenda found by numerous experiments a factor of 1.10, which means, that 1 gramme of true non-sugar dissolved to 100 grammes increases the density of the solution to 1.10; from this the true purity is calculated by the formula:

$$\text{True purity} = \frac{100 \times \text{apparent purity}}{\text{Apparent purity} + \frac{100 - \text{apparent purity}}{1.10}}$$

$$\text{Or true purity} = \frac{1100 \times \text{apparent purity}}{1000 + \text{apparent purity}}$$

In a number of tests made here with waste molasses I find not 1.10 but 1.15 the correct factor for our molasses; if I substitute that factor into above formula a true dry substance is received which varies but little from the figures found by direct determination of the water content in the molasses. Although this determination has no strictly scientific foundation and its calculations are based on practical experiments, it gives useful results for general control work, if the factor be calculated for each mill.

This method is as follows:

200-400 grammes of molasses are weighed in a tin or vessel containing a spoon; the molasses is then diluted with either ¼ or ½ its weight in water. By careful stirring with the aid of the spoon the contents are thoroughly mixed and the foam removed. The polarization is done as usual, the brix is determined by piknometer or by Mohr's balance. If ¼ of the molasses weight has been used for dilution, brix and polarization are multiplied by 1.25; if ½ has been used, brix and polarization are multiplied by 1.5. Below is the average of a number of determinations by various methods:

DILUTION.

100 parts molasses + 100 parts water.

	piknometer	spindle
°brix	87.77	88.00
%sucr.	32.14	32.14
app. purity	36.62	36.52

100 parts molasses + 50 parts water

	piknometer	spindle	Calculated from above formula
°brix	87.22	87.40	80.08
%sucr.	32.14	32.14	32.14
app. purity	36.85	36.77	.....
true purity			40.13

DIRECT WATER DETERMINATION.

	Hartmann's method. % dry subst.	Drying with sand % dry subst.
°brix	79.62	79.53
%sucr.	32.14	32.14
true purity	40.36	40.41

GENERAL REMARKS.

As I said before, the correct determination of sucrose in the cane depends firstly on the correctness of the samples and secondly on the exact weights. I will not speak of measuring the juices which, to say the least, is impracticable and incorrect; but *so far* the weighing by the different automatic weighing machines in use on the Hawaiian Islands leaves much to be desired. One chemist will swear by a machine which another one will condemn, and as the foundation for general control work is the correct figures for the sugar entering the sugar house, only the best methods for weighing the juice should be used. The Executive Committee of the H. S. C. A. in 1902 recommended the following:

"With regard to weighing the juice the committee is of the opinion that weighing is the only method that will do away with doubts and differences about the amount of sucrose entering the boiling house, and that the juice should be weighed on ordinary scales, an equipment of two tanks and two scales being necessary. As few mills will be so equipped for the coming crop members are expected to apply this method, using the weight of juice as obtained by automatic weighers or measuring tanks as the case may be, *keeping in mind, however*, that the equipment of the mill with *proper apparatus is necessary for accurate work.*"

I do not think there is a single mill in these Islands that weighs the juice on ordinary scales, therefore the figures for the sucrose in the cane calculated from the sucrose in the juice plus the sucrose in bagasse are more or less depending on the accuracy of the weighing machines in use at present.

The weighing of cane is equally unsatisfactory. The position of cane-weighers is often trusted to people whose only qualification is that they are cheap; the weighing during the night is in many cases left to either Japs or Portuguese. Then we do not have clean cane to deal with and the amount of trash which is deducted on different plantations is ridiculously high at times. I was for instance told that on one plantation they deducted from 4% to 10% on weight of cane for field trash. In rainy weather nobody knows how much the scale weights are affected, and even if we deduct for the rain water, we are only guessing at it. With all these difficulties in a very essential part of the chemical control it is not surprising to find reports for losses in a sugar factory ranging between 11% and 20% and higher.

In conclusion I wish to say that whatever work is done in the laboratory, it should be done properly and most carefully, samples should be taken not only in day-time, but throughout the 24 hours; accurate results can only be obtained by so doing.

As it is the chemist's duty to watch the manufacture closely, his time should be as much in the factory as in the laboratory; he has to watch the process of manufacture from the juice to the waste molasses in all its stages, and to take care that by cleanliness in the whole factory every danger of fermentation and infection is avoided.

A. Fries, *Chairman.*

WHY LAHAINA CANE WILL NOT GROW IN HILO DISTRICT.

As I have been connected with the manufacture of sugar for a period of nearly 20 years, naturally I take a deep interest in any subject appertaining to its production, and there is one subject which has often set me thinking, that is, the degeneration or non-growth of Lahaina cane in the Hilo district.

Some few years ago, there was a general cry that Lahaina cane was played out and would not grow any more, and it's the same story today.

I have often asked the question from different parties: "Why will not Lahaina cane grow in Hilo district? and I must say, as yet, I have never received a satisfactory explanation.

One party will tell you that the continual in-breeding or rather using seed to plant the land that produced it, has done it; others say, that perhaps there has been an overdose of some particular acid or soda which has done the mischief; again, that the lands are run down and impoverished, from lack of good fertilizer; again, the germ theory.

To the first of these answers, so-called in-breeding, cuts but little figure, from the fact, that seed from other districts planted here, did not show any material improvement.

To the second, it's possible, but highly improbable, because some of the lands have received little or no fertilizers.

To the third, yes; there is no question as to the lands being impoverished, but heavy fertilizing (as you will see later on) will not improve matters.

As to the germ theory, I admit, I was a strong supporter, and it's only very recently I changed my mind.

Taking all the above into consideration, I was compelled to look for other causes.

I have come to the conclusion that the weed "hono hono" is the principal cause of the trouble, and will further on state my reasons.

A short time ago whilst driving into Hilo, I took particular notice of the cane growing at the road side, and it was field after field of yellow "Caledonia" and not a single stool of Lahaina cane visible, (ten years ago it was all Lahaina), and it was with considerable regret I noted the change.

On some of the fields I noticed patches, whereon, the cane was a great deal higher and more healthy looking than the balance of the field.

The reason of this was easily accounted for, that in cleaning off the fields after cutting, they had raked the "hono hono" and other weeds together, placed in a pile, which was after either burnt or allowed to rot, making a surface soil, rich in vegetable matter.

In conversation with Mr. Jamison (the head luna at Pepeekeo) on the subject, I asked him, Would Lahaina cane grow on these patches? He assured me that it would, saying, that wherever Lahaina seed was planted on these patches, it grew as well as in days gone by, mentioning, at the same time, that the cane directly outside of these patches would not grow.

If such be the case, then this would corroborate my theory; it wouldn't be so much a question of germs, but simply proving that you had put back in the soil, the food of the Lahaina cane, which the hono hono had taken from it. As you know, Lahaina cane is a comparatively delicate plant, and a surface or rather shallow feeder, so is "hono hono" a surface feeder. The Caledonia being a deep-rooted cane is not so much affected.

Now, then, is it not possible, nay, more than probable, that the "hono hono" in taking the food that is essential to its life, is also taking the food of the Lahaina cane?

Of course I may be wrong, yet, I think it would be a good policy to work along these lines; it certainly is open to a good discussion. Up to a few years ago "hono hono" was comparatively little known, or at least had not become a pest in the cane fields of Hilo. I personally don't remember having noticed much, if any, in the fields on my prior stay here about nine years ago, and it's since that time that the Lahaina cane commenced to degenerate. There is certainly a strange coincidence, that as the hono hono became a pest in the cane fields, it was quickly followed by the degeneration of the Lahaina cane.

In referring back to the question of fertilizing, I would state that in a conversation with Mr. J. Scott some three years ago, he stated that he had tried different fertilizers and used plenty of it, on different patches of Lahaina cane to see if it would be of benefit. He told me it apparently made no difference, it would come out of the ground all right, grow a while, and then stop.

It is my opinion that in growing "Caledonia," making it easy to keep down the weeds, naturally eradicating the hono hono from the fields, plowing deep, turning up new soil, and liberal fertilizing, we will yet see Lahaina cane growing as profitably in Hilo district as before.

THE LESSON OF SUGAR.

[From the Spectator.]

During the discussions which preceded the conclusion of the Sugar Convention we did our best to urge upon the Government and the House of Commons the folly of violating the principle of the free and open market. We met the argument that in fighting sugar bounties England would really be fighting the battle of Free-trade by pointing out that there is a principle wider even than the principle of Free-trade—the principle of the free and open market. Our duty, we contended, was not to go into the question of why this or that commodity was cheap, but, subject to revenue considerations only, to allow every man who had anything to sell to come into our markets and to sell it there at as low a price as he liked. It was not our business to stop him at the gate of the market to ask him why his commodity was so cheap, and to turn him back if we were not satisfied with the reasons he gave for its low price. Commerce, we declared, will only flourish when it is let alone, and when no external considerations are allowed to impede the free sale and exchange of commodities. We urged again and again that if this violation of the free and open market should be carried out, certain things were sure to happen. In the first place, the price of sugar would rise to the prejudice of the British consumer. Next, the confectionery and allied trades would suffer seriously from the enhancement in the price of their raw material. While we allowed any one to sell us sugar at any price he liked we possessed the means not only of feeding our own people cheaply, but of producing confectionery, biscuits, jam, and mineral waters at a cost which enabled us to export them throughout the world. Finally, we pointed out that if the open market were interfered with, the risk of "corners" and "combines" being formed to raise artificially the price of sugar would be greatly increased. You cannot "corner" a commodity of universal use while you have a free and open market. It is in a market which is not open, but artificially restricted, that "corners" and combinations to raise prices spring up like fungus growths.

All these injuries and inconveniences which we felt sure must result from the Sugar Convention and its interference with the free and open market in sugar have come to pass, only, unhappily, in a far worse degree than we thought possible. The evil has happened, but intensified ten times over. In our most pessimistic moments we never imagined that the country could lose as much as £8,000,000 sterling a year. Yet that is the figure at which an expert, Mr. Clarke Saunders, editor of the Confectioners' Union, writing in Wednesday's Daily Mail, places it. This means not only that every family in the country has to pay more for an essential article of food—the loss to a working-class family owing to the rise in the price of sugar is calculated to be already sixpence per week—but that a great industry is being crippled by the increase in the cost of raw material. Mr. Chamberlain has been up and down the country for a year and a half searching for a ruined industry. Mr. Clarke Saunders tells him that he will find one close to the place where he is to make his speech at an East End meeting in three weeks' time. He will find within a stone's throw of the hall in which he is to address his audience an unoccupied confectionery factory which at one time employed seven or eight hundred men, women, and girls. Here is a real ruined industry, and one ruined, if Mr. Clarke Saunders's facts are correct, which we do not doubt they are, not by Free-trade, but by the violation of the Free-trade principles. That, however, is only one example. Throughout the great confectionery industry depression prevails. Our exports are decreasing because we have voluntarily deprived ourselves of the benefit of a free and open market, and have insisted on excluding cheap sugar. On the other hand, our rivals in Switzerland, a country not a party to the Convention, are getting the advantage of the cheap sugar from Russia and other places which we have voluntarily and deliberately debarred ourselves from using.

What makes the rise in the price of sugar especially annoying is that it is largely due to a "corner" in sugar—a "corner" which has been made possible owing to the restrictions on the English markets imposed by the Convention. On this point Mr. Clarke Saunders is supported by Mr. George Mathieson, the managing director of Clarke, Nicholls and Coombs, and one of the clearest-sighted and best-informed men of business in the confectionery industry. He points out that the present rise in prices is due to the sudden increased consumption of sugar in foreign countries, and to the fact that the Convention shuts out from us 500,000 tons of Russian and other sugar which would otherwise be available. Great

Britain has now a restricted instead of a free market. "Speculators, therefore, are within the Convention-provided ring compelling us to pay the prices they choose to fix. While the Convention lasts this game can be repeated." "Corners in sugar," Mr. Mathieson goes on, "have been created before. But this one is different. Then they invariably collapsed within a few months and only the more wary of the speculators came out unscathed. Advantage was taken by sugar holders in all quarters of the world to hurry forward by first available transport their surplus stocks to the free British market, and thereby secure the fine prices the speculators had created. The corners thereby were broken. The Convention has changd all that. With the exception of Java, which finds its natural outlet in the East and in America, and is consequently available for us to only a small extent, most large supplies of sugar are now prohibited to us. The Convention practically confines us for sugar to Convention countries. These in turn find it more profitable to supply first their own people, owing to the working of the surtax, so all the cornerers have to do now is only to hold up the surpluses of France, Germany, Austria, Holland, and Belgium, and then they have Great Britain at their mercy." Mr. Mathieson ends his letter with the following observations: "I assert without the least fear of contradiction from any one cognizant with all the facts and willing to state them impartially—(1) that had there been no Convention there would have been no abnormal increase in Continental consumption; hence (2) that there would have been nearly 1,700,000 tons carry over instead of 1,100,000 tons at the end of last sugar year; (3) notwithstanding the somewhat deficient crop the supplies would have been most ample; (4) that in such circumstances no corner would have been possible; and (5) that sugar would have been 5s. per cwt. (½d. per lb.) cheaper to us than it is today. Of the 1d. per lb. which the British consumer is paying extra for his sugar today, half goes unnecessarily to foreigners through the operation of the Convention, and half (our own customs duty) into the British exchequer." In other words, the Sugar Convention has had the effect which all who had studied the subject were certain it must have. It has raised the price of sugar to the consumer, it has injured the confectionery trades, and it has exposed us to those evils of "corners" and combinations from which, as a rule, our industries are free, but to which the industries of Protectionist countries are always liable.

We trust that the lesson of sugar will not be lost upon those who are now clamouring for a policy of retaliation. The Sugar Convention is in fact, though not in name, an example of retaliation applied in a peculiarly favourable case—in a case where the conditions seemed specially like to produce success. Yet we see the result. If we are foolish enough to enter upon a policy of retaliation in the case of other commodities, we have little doubt that the interference with the free and open market which will be absolutely necessary to render that policy operative will produce similar evils. If, for example, we contrived to negotiate treaties with certain foreign countries to stop the so-called "dumping" of steel and iron, and were successful in the work of excluding "dumped" steel and iron, we have no hesitation in saying that the results would be the same as those which we are now witnessing, to our grievous loss, in the case of sugar. A certain number of countries might, no doubt, agree to treaties which would prevent what Mr. Balfour designated in his Edinburgh speech as "tariff-fed competition." But if this were accomplished, and our markets were consequently closed against the product of countries which did not agree to modify their fiscal systems in accordance with our threats of retaliation, and if we lost accordingly the benefits of the free and open markets, we should be sure to suffer an increase in the price of steel and iron, and a liability to "corners" of the kind that have taken place in the case of sugar. The object-lesson thus offered by sugar has been a terribly expensive one; but if it acts as a lesson in what happens when nations are foolish enough to let their Government interfere with the course of trade and commerce, and with a free market, it may not have been purchased too dear. No doubt the loss of £8,000,000 sterling a year—a loss which probably could not now be recovered even when we denounce the Convention, as we trust we shall—is a very serious one; but it is nothing compared with the loss that would be incurred if the Government were to engage in the policy of retaliation on a great scale, and were to interfere with the free and open market in a dozen or so of our great staple industries. We might then lose, not £8,000,000, but £80,000,000 a year. The principle which is essential, and on which we must insist, is that on no considerations other than those of revenue will we interfere with the free and open market, and prevent men selling here at their own price whatever they have to sell.—The Spectator.

During October, 1904, Hawaii received from the United States, 59,248 pounds of refined sugar valued at $3,449, against 188,244 pounds valued at $9,654 in 1903. The islands received a total of 1,435,525 pounds of refined sugar valued at $73,306 from the United States during the ten months ending October, 1904, against 1,527,182 valued at $74,507 in 1903. During the same ten months, Hawaii shipped to the United States 710,-036,785 pounds of raw sugar valued at $23,971,643, against 834,320,981 pounds valued at $27,746,041 in 1903.

A CRITICAL MOMENT.

There is no longer any doubt that the total supply of the world's sugar markets will not be able to equal the demand, if the present phenomenal increase in the home consumption of the European countries is maintained. While as yet all estimates of the various beet and cane crops are mere guesses, and it will be some time before the actual outcome can be accurately known, it is certain that the European beet crop is considerably short, that the world's cane crop, in spite of its increased percentage, will not fill the deficit, that the so-called invisible supplies will be wiped out, and that the visible supplies will be tested to their utmost capacity no matter how much they may be increased out of the invisible stock.

The question is merely, will the increase in prices, which has already resulted from these conditions, be sufficient to condition of the market, work toward a still higher rise of check the further increase in the sugar consumption; or will the speculation, which is always on the lookout for such a sugar prices, until the limit of a reasonable balance between supply and demand is exceeded and the basis laid for such a disastrous slump in sugar as occurred in Europe in 1889?

Every sugar producer welcomed the sanitation of the world market which came as a result of the Brussels sugar convention. And the further improvement of the chances of the producer by a shortage of the European beet crop was likewise a natural and welcome development. But there is an element of danger in the practices of the great speculators, which must be reckoned with.

Already the news is heard that the Federal Sugar Refining Company has outbid the American Sugar Refining Company in the raw sugar market and has wiped out the long maintained level of prices for the producers of raw cane sugar. The Federal is now holding back vast quantities of sugar in the expectation of throwing them on the market after the bull movement will have reached the desired climax. If this speculation succeeds, and the consumption does not disappoint the sellers, the domestic sugar producers will benefit by the tactical move of the Federal. But if it fails, and the small producers have held back their sugar until that time, they will lose.

This is the most critical moment in the present sugar situation, and it will be a wise and far-seeing man who can time the right moment for the disposal of his product.—Am. Sugar Industry.

SUGAR MANUFACTURE IN JAVA.

BY E. V. JELTES, SUGAR CHEMIST, CHICAGO.

The cane sugar industry on the island of Java, the most cultivated and populous island of the Dutch East Indies, has certainly to thank the strong will and energy of the factory managers for its importance in the present world's sugar market. While ten years ago the price of one picul (136 pounds) of muscovado, the raw sugar generally made there, was at least 16 guilders ($6.40), it was sold during recent years for 4.5 to 5 guilders ($1.80 to $2). Nevertheless, every campaign finds almost all the factories on the island running at full speed, in spite of the enormous falling off in prices. It was in that critical period that the sugar manufacturers of the island awoke and began the struggle for life in the competition with the rapidly growing beet sugar industry, in consequence of which they became ingenious and hard working men.

Formerly they had an easy time, for it was not hard to make sugar, and if there was some waste, little attention was paid to it, as plenty of profit was made in any case. One did not need a long experience or hard study in order to become an employe or even a superintendent. But at present one may be sure that not one grain of sugar is lost without the knowledge of the superintendent, and only young men with a good education and graduates of colleges of mechanical and chemical engineering have a chance of finding employment with a prospect of promotion in Java sugar factories. Special technical schools and colleges for sugar industry have been established in Holland, where young men are trained for the purpose of qualifying themselves for the control of sugar manufacture in its technical and chemical details. This and the installation of better machinery brought about a better economy. A better quality of cane was obtained after long selection and careful experiments.

The progress in cane cultivation is shown by a news item just received from one of the leading Java sugar factories named Tjomal, near Pekalongan. The item states that Tjomal finished its six months' campaign with an output of 185 piculs per bouw (7,096.5 square meters). When one considers that not so very long ago the amount of sugar in cane was about 60 piculs per bouw, or less than one-third of the above amount, one realizes what has been accomplished by selection, experiment, and good field work. Another fact which proves what can be accomplished by good technical control, is that this same factory thought three or four years ago that it had reached its limit of milling capacity, when it turned out from 11,000 to 12,000 piculs per day, while last year it turned out 14,000 to 15,000 piculs and had less loss of sugar in bagasse.

The superintendent is the responsible man. He is the chief of the whole plant, of the technical part as well as of the agricultural. In most cases the superintendent also sells the sugar to large commercial houses which bring it on the market. The land being generally owned by the natives, he has to make contracts with them for rent of land, and he is assisted in this by employes of the plantation and district commissioners of the government. The laborers in the fields and in the factories are natives. Only the sugar boiler station is taken by Chinamen. The natives, though generally very smart and skilful, are by nature too lazy and too unreliable, and a white man could not stand that kind of work on account of the suffocating heat. Chinamen have proven themselves best fit for this station.

Many of the natives make good mechanics and blacksmiths. These and some other well-trained men are employed all the year round to repair machinery and apparatus. If the laborers are treated well, they almost always come back for the next campaign to be engaged for the same stations which they had charge of before. In this way one obtains well-trained employes, and a very small staff of white people is often sufficient to control a large factory in a first-class way. If a factory changes its native employes every year, the white employes will have to work twice as hard. An ideal composition of a staff for a Java sugar factory would be: One chief engineer and chemist who generally works only by day; under him four chemist-engineers, two for each shift, one acting as engineer and the other as chemist. When I say that he acts as chemist, I mean that he is the responsible man for everything which has to do with the process of sugar making and that he has to superintend the whole factory. He is also responsible for the analyses made in the laboratory and makes the important ones himself. The ordinary spindle and common analyses are made by well-trained and educated native boys. The engineer of the same shift is in charge of the control of steam boilers, machinery and apparatus.

One generally finds some more white men around in the factory as assistants here and there, or as apprentices who make themselves useful. The weighing station, bookkeeping and storeroom are in the hands of reliable white men, while the office help is composed of well-educated native boys who generally write a beautiful hand and are good figurers.

The climate in those parts of the island where sugar factories are situated is so hot that a white man cannot be expected to work and stay wide awake for twelve hours. Therefore white employes work in shifts of eight hours, while native employes relieve one another in shifts of twelve hours.

The *methods of control are uniform in almost all the factories*, and this is very important, as it is now possible to mutually compare data. This is done by a committee formed in the critical time and called "Algemeen Syndicaat van Java Suikerfabrikanten," which established experiment stations in Java and introduced among its members one uniform way of control and analysis of factory products, materials, fertilizers, soil and water. This uniformity makes accurate comparisons possible and by the help of these one can generally locate the cause of unsatisfactory results.

The general control enables the manufacturer to learn daily the exact quantity of cane milled, the quantity of sugar introduced and the amount of sugar lost in the milling operations. It shows him how much of the introduced sugar passed the different stations of the factory and how much of it was lost there. It gives him an idea of the quality of all the different products and by this he knows the conditions of the apparatus. The basis for the whole control is the mixed juice, that is, the juice coming from all the mills (generaly three) together. This juice flows into the measuring tank where the lime milk, after having been measured, is added. Analyses during the whole day give the average amount of sugar in this juice. Thus the total amount of sugar introduced that day can be figured. When this amount is known, losses in the next station can be detected. It also serves as a basis for figuring the weight of cane passed through the mill that day. The composition of the mixed juice and the losses of sugar in the bagasse are stated about every two hours by analyzing carefully taken samples. Dry matter in the bagasse is analyzed for a control of the mill. A good mill does not leave more than 45 per cent. of the water in the bagasse.

Even with the best mills, one has never yet pressed more than 90 to 94 per cent. of the total amount of sugar out of the cane. Thus from 6 to 10 per cent. go into the boiler furnaces. The high pressure in the mills introduces many impurities into the juice which cause many difficulties in the process of manufacture. In former years, a loss of sugar in bagasse of 12 per cent. in 100 saccharose in cane was not rare, and now we find that it is as low as 1 per cent.

For the amount of cane introduced into the factory, the bascules on which it is weighed give a satisfactory answer. These bascules have to be verified in certain intervals by the chemist on watch and great care is taken in keeping them clean. A very good factor for judging the effect of the mills is the quotient of the introduced sugar and the sugar in the cane. Soaking with hot water and sometimes also with juice from the bagasse mill is done right after the first mill, when the pressed cane comes out of the cylinders. Thanks to its elasticity, this cane opens easily and its opened cells quickly absorb the hot water. A dilution of more than 15 per cent. of the first mill's juice has never given any better result. The less water is needed in getting the sugar in the bagasse down to the lowest figure, the better it is, for it means less steam for the evaporation.

Until the juice has become thin juice, it does not require much control, especially when the men are all well trained. The alkalinity of the thin juice is a very important thing. The purity and glucose quotient have any value only when ripe and healthy cane is milled, which may be considered as free from levulose, and when the alkalinity is so low that no decomposition of the glucose is possible. Total analyses of the thin juice are not made, only regular brix weighings and polarization several times per day. Apparatus for noting alkalinity are standing in the factory to test by the clear juice, whether the addition of lime is right, in case the composition of the mill juice is changed. The alkalinity is kept as low as possible and one does not add more lime or soda in the filters than is needed to prevent the juice from becoming acid, in which case the impurities would dissolve again. If carbonation is used to purify the juice, the same control is applied as that used in beet sugar factories.

As for the control of the filtration, regular weighings and tests on sugar in the precipitates which are wasted will suffice. In the evaporation thick juice is regularly tested for brix; the purity and the glucose quotients serve to show whether any desirable chemical processes are taking place. With the brixes of thin and thick juice, one figures the quantity of evaporated water. The condense water from the evaporators is tested for sugar by the help of the alpha-napthol method.

At the masse-cuite station, where the total sugar loss has to be stated in comparison to the quantity introduced according to the control of the juice-making process, extreme care must be taken in weighing and taking samples. With present methods, however, a perfet control is almost impossible. Where the new methods of getting masse-cuite have been introduced during the last years, the control of that station is now directed especially at the quantities of sugar obtained in the centrifugals and in the syrups. Tests of the masse-cuite for acidity are also important, as it is a recognized fact that the crystallization will be less perfect if the acidity is too high. The syrup coming from the centrifugals is tested for polarization. This and the quality of the sugar control the sugar boilers.

Every day sheets, showing the results of the day's work, are filled out in duplicate by the chemists. In the same way monthly sheets are filled out and handed to the heads of the company or owners of the factory.—[American Sugar Industry.]

RELATION OF FOREST TO IRRIGATION.

By Gifford Pinchot.

Forester, U. S. Department of Agriculture.

The National Reclamation Act, whose passage was directly due to the personal interest and effort of the President, is of a broader national character than many people in the East realized at the time. It will give to those portions of the country which it does not directly touch far more than the effect of that general reflex action which the prosperity of any part of the United States must have upon every other. In this case there are specific reasons, and of these the greatest is this: That the development of the arid West through irrigation will be of unmeasured importance to the East by the creation of more and greater home markets, for it is by home markets first of all that our people prosper. The Reclamation Act is a national benefaction whose blessing falls first and most plentifully upon the West, but which does not fail to bless any portion of the Union.

One of the fundamental facts which nearly every man here knows to his own cost is that there is more irrigable land in that prosperous country we used to know as the great American Desert than there is water to irrigate it. Water is the measure of the value of land, and it is water that the West needs. Every addition to the water supply will extend the irrigated area. When all the water now available has been put to use (and in many regions that time has either already arrived, or will not be long delayed), every deduction from the water supply will reduce the possible irrigable area. It is of the highest importance, therefore, not only to have a water supply but to keep it.

No argument is needed before this Congress to prove that forests conserve the water supply and vastly increase its usefulness for the purposes of irrigation. They do so by reducing evaporation, by regulating and sustaining the flow of streams, and by helping the snow water to get into the ground by seepage instead of into the air by evaporation. The forest is the first and most important factor in the water supply of the West, except the water itself.

In the West the forest does not now occupy nearly all the area suited for its growth. Doubtless every man here is familiar with denuded slopes dotted with the charred remnants of forests which have been destroyed, and with great stretches of open land, as to which there is no apparent reason why they should not be covered with trees. The fact is fire has driven the forest from vast areas upon which it should naturally flourish, and to which it may be restored by natural seeding or by extensive plantations. But it is not only the area of the forests which is reduced by fire. Very many forests are traversed by fire year after year and yet not destroyed. But no forest can be burned without suffering in what is to you its most important function—its capacity to store fallen rain.

The protection of the forest protects the present supply of water. In many places continued and effective protection will largely increase the steady flow of water in the streams, because many forests are now in poor condition. But this is only half the story. If the forests now standing are valuable for water supply then new forests created on water sheds now denuded will also be valuable. Here lies the possibility of increasing the irrigable area by increasing the water supply.

We know already that forest plantations on the open plains of the central West are taking on the character of natural forests, are reproducing themselves from seed, and are even extending their own boundaries. Forest planting in the irrigable mountain States is still too young to afford such examples, but the efforts of nature to cover again the denuded slopes furnish ample proof of what can be done.

The importance of all this lies in the fact that the extension of the forest on denuded water sheds will unquestionably be accompanied by an increase in the available water supply: I might cite case after case from older countries to sustain this contention, cases of springs restored and streams sustained by the renewal of the forest. We have begun planting too recently to prove it here, but unquestionably man after man in this audience could furnish proof of the converse proposition, that the destruction of the forest reduces the water supply. It stands to reason that if we restore the one we restore the other. Forest fires then not only restrict the forest area, but they restrict the irrigable area as well.

What is the remedy for this age-long attack on the irrigable West by forest fires? It is a triple one. First, extension of forest reserves over all mountain water sheds of streams used for irrigation; second, a national forest service to control the forest fires and destructive lumbering, which is often their cause and nearly always their confederate, and thirdly, tree planting on denuded areas in the forest reserves.

I hold with emphasis not only that it is the duty of the national government to extend the irrigable area by increasing the low water flow of streams through planting on denuded water sheds in the forest reserves, but I also believe firmly that we are about to undertake as a nation more extensive forest plantations than have ever been made elsewhere. There is a definite need which can be met only with the protection of existing forests and the planting of new ones, and it is not to be doubted that we shall meet it.—Forestry and Irrigation.

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*ON SOME DISEASES OF CANE SPECIALLY CONSIDERED IN RELATION TO THE LEAF-HOPPER PEST AND TO THE STRIPPING OF CANE.**

BY R. C. L. PERKINS.

The marked increase in the spread of certain diseases of cane and in severity of these attacks that has followed the increase of leaf-hopper, has become so serious that the following notes, partly compiled and partly the result of my own observations, have been put together as supplementary to the Bulletin on the leaf-hopper.

Nearly a year ago, almost coincident with the first bad attack of leaf-hopper on Hawaii, as indicated in that Bulletin (p. 44 of reprint), an unusual outbreak of some parasitic leaf-fungus was noticed, and this was shortly followed by a similar spread of fungus diseases affecting other parts of the cane. It must not be supposed that these fungi are new to this country; they have been known to us for at least some years sporadically, but are now epidemic. The present epidemic is clearly due to the abundance of leaf-hopper.

At present by far the most widespread and injurious of these diseases is the so-called Rind disease. Like other fungi, this appears under several very distinct forms, and the so-called "Root disease" is by some authorities considered as one of these forms.

The most important of these forms, and by far the most common in the islands at the present time, is that which was called the "Cane Spume" by Dr. Cobb, the Australian plant pathologist, who well describes the general appearance of the disease as follows:

"It occurs in the stalk and leaf after they are dead, or nearly so, in the form of conspicuous black eruptions, which in damp weather, especially if it succeeds a period of dryness, exude a black, kinky thread. When the eruptions are numerous these threads give the cane the appearance of having made a growth of kinky, coarse, jet-black hair." The earlier stage of the disease is as follows: "As soon as one of the spume spores alights on an injury it sprouts and enters the tissues of the cane, and by its growth inside the cane causes the adjacent rind to lose its natural color, become brown and shriveled. At last the diseased area becomes very light brown, or even almost white, and there appear over its surface numerous pimples, which, when they break, emit the kinky, black threads already described." He further remarks that half an inch of this thread contains one and one-half million spores.

This is a wound fungus, and unquestionably it starts in the punctures made by leaf-hopper in the cane-stem.

DAMAGE DONE BY THE FUNGUS.

This is very great on some plantations, and I have seen cane which had very largely recovered from bad leaf-hopper attack still worse damaged or entirly destroyed by the subsequent attack of this fungus. There is diverisity of opinion as to the effect of grinding the fungus-attacked cane. It is said by some that the quantity of juice alone is affected, but others declare that the use of the diseased cane leads to a marked deterioration of the juice and of the sugar manufactured therefrom.

DIRECT REMEDIES RECOMMENDED IN OTHER COUNTRIES.

All the authorities seem to agree on one point, viz.: the great advantage of burning all trash after the crop is harvested. In addition, others advise the cutting out and burning of all diseased canes. In some countries it is certain that improvement has followed such action. So far as can be done, such procedure should be followed in these islands.

WEAK POINT IN REMEDIES SUGGESTED.

Although some help might be afforded by adopting the above remedies, yet one cannot but be skeptical as to their real

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effectiveness in these islands. On examining the stripped stem of young cane, I find that the fungus has already attacked this severely, while the present year's crop is still in process of harvesting. 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 infection. From what has been said above, 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 be 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 egg-chambers of the female hoppers and give ready access to the parasitc fungus. I believe that until the leaf-hopper be 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.

I have previously advocated a suspension of stripping in fields where "leaf-hopper" is very numerous, because a vastly larger proportion of the insects that prey or are parasitic on the hoppers are destroyed by stripping than of the hoppers themselves.

Examination of the relationship of stripping to fungus attack in very widely separated and even climatically different localities has shown me a further cause to give this up, while the leaf-hopper pest is predominant. I find one reference to the value of the leaf as a protection against this fungus disease in a report from the West Indies, which says: "The stems of the canes have been in a great measure protected by the leaf-sheaths up to a later period than is usually the case, consequently so many of the canes have not been killed by the rind fungus, but now it is on the increase."

At the beginning of these notes I have referred to the fact that this fungus appears under several totally distinct forms. Another of these is known as the "pineapple disease," because the affected cane has a pineapple-like odor. This form is also present on the islands, but appears to be much less dangerous than the first described, more easily controlled by burning the trash, and less liable to be widely and quickly spread. It is probable that the spores are freed and scattered only on the entire rotting of the cane. I have seen cane that had been used for seed very badly affected with the "pineapple disease," so that very few eyes sprouted.

Still another form is easily distinguished by the fact that the spore-producing bodies are set with dark hairs. It has further been stated that the "root disease" of cane is also another form of the "rind" and "pineapple" disease. This root disease likewise reproduces itself in two manners, the spores in the once case being formed in external reproductive bodies, while in the other case they formed internally in the cells of the cane. I have not found the form of the fungus in cane examined by myself microscopically thus far, but it is probably present. I may say that on one occasion cane affected with rind disease and planted by me died with all the external signs of root-disease.

It is quite clear that, above all things, great care should be taken in the selection of seed cane during the present abundance of leaf-hopper. This cane should always be selected from fields where the stems show little or no sign of perforation by the hopper for its egg-chambers. Cane badly perforated can hardly fail to be infected with the rind fungus, at least in most localities. Cane which has not been stripped will probably afford the soundest stems. As the perforations by leaf-hopper, and likewise the external evidence of the rind disease, are both conspicuous enough, any one who has eyes to see can select the cleanest cane available for planting. At the present time, it is advisable that all seed cane should be soaked in a bath of one pint of carbolic acid to 100 gallons of water shortly before planting.

For those who wish to confirm the presence of the disease by microscopic examination the following brief technical descriptions are added:

Trichosphaeria sacchari Massee (all forms).

=Thielaviopsis ethacetius Went. (The so-called pineapple disease.)

=Colletotrichum falcatum Went. (The so-called root disease.)

=Strumella Sacchhari (the "cane spume" of Cobb).

(1) Form bearing asci.

The perithecia are ovate, black, obtuse, clothed with sharp, slender septate bristles of a brown color, paler above. Asci cylindrical, rounded at apex, stipitate, 8-spored, spores 8—9x4 micromill.

(2) Stylospore form.

Forming collections of small black raised bodies, surrounded with epidermis, the conidia cylindrical, brown, obtuse at both ends, 14—15x3.5 micromill, extended in black, curly threads of various shape and of gelatinous consistency. (=Strumela sacchari form).

(3) Macronidial form.

Forming irregular velvety black spots, the conidia formed in the inside of the hyphae in chain-like order, and freed as brown ellipsoid bodies trunate at each end. 18—20x12 micromill.

(4) Microconidial form.

Like the macroconidial, the conidia 10—11x6 micromill. (3 and 4 are the Thielaviopsis ethaceticus of Went).

(5) The conidia are borne on a stroma from which spring dark hairs 100—200x4 micromill the whole forming a black velvety patch on the external surface of the cane. The conidia are falcate or sickle-shaped 25x5 micromill.

(*Colletotrichum falcatum*—the so-called root disease of the cane.)

PRELIMINARY NOTICE OF ANOTHER CANE DISEASE.

I may also call attention here to another disease of cane, which formerly noticed in isolated cases, in certain parts is now inclined to become epidemic. This disease in many respects resembles that called "Top-rot" by Wakker and Went in their work on cane-diseases.

The leaves of the crown in bad cases are all killed; the youngest ones become a putrid mass with an intolerable stench; the stems contain little juice, and are extremely brittle. As the top dies the lower eyes grow out in the young cane. Old cane does not seem to be affected by this disease. One or more of the so-called "rust" diseases are often present on the diseased cane. At present I have no full knowledge of the distribution of this disease in various districts, and I should be glad of such information. In the affected canes examined by me, the abundant bacteria seemed to be the cause of the disease, and not fungi. I cannot trace any connection between the disease and leaf-hopper attack. Its extent seems to me to be probably due to the unusually wet season we have just passed through.

Honolulu, April 7, 1904.

Mr. John Anderson, lately engineer with the Makee Sugar Co., Kealia, Kauai, has patented a device for burning molasses. This molasses burner is said to be effective, based upon the fact that it atomizes the molasses better than any other method of treating it and thus rendering it readily combustible and less slag and dirt are produced and the fire is more easily controlled and the amount of heat generated greater. Considerable experimentation has been had in the burning of molasses in Hawaii, but in Louisiana the demand for molasses for stock feed has now become so great, both for home consumption and for export to Europe, that there is no longer any discussion of molasses burning. The fact that molasses is such an excellent food article for man and beast would seem to remove it entirely from the fuel list,-unless the cost of transportation from remote localities makes it practically prohibitive. The name given to the final molasses in the Hawaiian Islands is rather suggestive of the fact that they have scarcely any other use of it than to burn it, that is "waste" molasses.—Louisiana Planter.