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The latest quotation of sugar in New York was 3 7-16 cts. for Cuban centrifugals. The European beet crop is being harvested, and as before stated, will be very large, probably five millions of tons, which, added to the one million tons of old stock carried over from 1896, cannot fail to have a depressing influence on the price during 1897, and prevent any advance over current quotations.

Eastern American markets appear to be heavily stocked with fruits. The apple crop in particular has been very large, and the wholesale price for best apples, one dollar per barrel. A cash sale of 10,000 barrels of the choicest apples was made at 90 cents per barrel. Oranges in New York, \$5 per barrel; Florida pineapples \$9 to \$17 per barrel, best bananas, 90 cents to one dollar per bunch, wholesale, lemons \$2.50 to \$4.50 per barrel.

The average wheat crop in Russia is 301,000,000 bushels, in India, 225,000,000, in Argentina, 62,000,000, in Canada, 52,000,000, in the United States, 490,000,000. The severe drought in India, Russia and Argentina, have reduced the sup-

plies to nearly one-half the average of former years. In consequence the price has risen to more than double what it was a year ago. The exports from the United States have, in consequence, been large, and still continue, at very high quotations.

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HAWAIIAN SUGAR CROP FOR 1896.

As stated in our last issue, the sugar crop of the Hawaiian Islands for the past year (October 1, 1895, to September 30, 1896) was the largest ever produced here, owing to exceptionally fine weather throughout the entire year, and to very greatly improved field and mill work. The following statement has, since our November issue went to press, been issued by Dr. Maxwell, Director of the Hawaiian Experiment Station:

Year.	No. of Acres of Cane Manufactured.	No. of Tons (1200 lbs) Sugar Made.	Yield of Sugar per Acre.
1895-6	55,729	227,093	8,148 lbs.
1894-5	47,399½	153,419½	6,472 lbs.
Increase	8,329½	73,673½	1,676 lbs.

The Hawaiian crop is, on an average, eighteen months in growth, and is thus biennial when compared with the annual crops of Louisiana and beet-sugar countries, which occupy the ground only nine months.

WALTER MAXWELL,

Director Bureau and Experiment Station, Hawaiian Sugar Planters' Association.

The production of sugar on each of the islands has been as follows:

	1895-6.	1896-7.
Hawaii	61,643	109,299
Kauai	42,816	51,650
Maui	27,735	39,097
Oahu	17,433	25,782

The above is reckoned in short tons of 2000 pounds. In long tons the total is 202¾ tons. Five plantations only have exceeded ten thousand tons each. These are Ewa, 12,124; Hawaiian Commercial, 11,933; Makaweli (Kauai), 11,407; Paauhau, 10,957, and Onomea, 10,013. The average yield per acre throughout the group has been 8,148 pounds, which includes plant and ratoon canes.

IMPROVED CANE CARRIER.

A very ingenious car for carrying sugar cane from the field to the mill has recently been invented by Mr. J. A. Hughes, a car builder in the employ of the Oahu Railway Company of this city. Four cars of the new pattern have been completed—one of which is in use on the Ewa Plantation, and is giving great satisfaction on account of the ease and economy with which it is operated. The remaining three cars have been purchased by the Hakalau Plantation on Hawaii, and are now on the way thither. The chief improvement consists in the way in which the car is tilted and discharged, requiring only one or two persons. From a description in the Gazette, we copy the following:

“The first feature noticed in the construction is the movable floor, which can be tilted to either side by a power hoist when the load is ready to dump into the flume. The ends are stationary. Another improvement is the stakes and stake pockets which are so fixed that any Jap who is half sry can throw the three side stakes out of the pockets in less than a jiffy. Then the floor is tipped to the proper angle, and five tons of cane fall into the flume or by the cane carrier. The labor of at least seven men is dispensed with by this method of discharging. Cheapness is another thing that has not been forgotten in the production of this car. It is composed of Nor’west lumber, except the buffer blocks, and most of the iron parts are malleable. The makers claim this car can be put up for a figure that will never stand in the way of a large order when a manager sees the operation. Ewa Plantation has already placed an order for 10 of Hughes’ cars, which will be built as soon as possible.”

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HAWAII VERSUS TAHITI.

The San Francisco News Letter of Nov. 7 contains a very unfair and misleading article based on a rumor that “negotiations are said to be on foot between the Oceanic Steamship Company and the French Government, by which it is contemplated to change the route from San Francisco to New Zealand and Australia by way of Tahiti, instead of Honolulu.”

Had the News Letter taken the trouble to inquire at the office of the O. S. S. Co. in San Francisco regarding the truth of the rumor, in all probability it would have learned that the only grounds for the report were substantially these: the French government has been for years endeavoring to secure steam service between San Francisco and Tahiti, and is ready to pay a moderate subsidy for it. This offer has probably again been renewed, but unless largely increased, neither the Oceanic Co. nor any other party will be likely to undertake the service to Tahiti, much less to New Zealand.

Tahiti is now connected with New Zealand by regular subsidized steamers, semi-monthly, and these steamers, it is said, barely pay expenses, although they touch at several island groups on each round trip, picking up a little trade and travel, here and there.

Tahiti is a small island about the size and shape of Maui, with an area of say 600 square miles, and only one good harbor for large vessels. It is very mountainous, and cut up into valleys, the steep ridges running down to the sea, rendering them in some cases accessible only by canoes. Formerly each valley had its own chief and people, and those living in one valley could not enter another valley without permission of the chief. This rule has been annulled since the French took possession of the island. Still there are no large areas of arable land as in our group, and almost the only products are oranges, bananas, cocoanuts and such like. The annual exports and the foreign travel to and from the island, are very small. The exports and imports are hardly worth quoting.

Some twenty years or more ago, the French Government offered inducements to establish a steam line between Honolulu and Tahiti, carrying cattle thither and wood back. One or two sailing vessels made trips thither, but there was nothing in it, and the venture was abandoned. At one time Mr. S. G. Wilder thought of engaging in the service, but the plan was abandoned as unwise.

The group of eight or ten islands lying near Tahiti have no foreign trade or population to speak of, and can never offer inducements for steam lines, even when the Panama and Nicaragua canals are completed.

The enterprising firm of Spreckels Bros. of San Francisco, who are the ruling spirits in the Oceanic S. S. Co., will never abandon ports or group, or a trade which sustains two packet lines of twelve or fourteen sailing vessels, and four monthly steamships of three thousand tons each, carrying full cargoes and passenger lists, and doing a business of millions annually, between Honolulu and San Francisco, for a new route and port, which can furnish no passengers, no sugar, and only a picayune traffic in oranges and cocoanuts, amounting to a few thousand dollars annually.

Bro. Dan. O'Connell delights in drawing his long bow now and then, aimed at Hawaii, but his arrows fall mid-channel into the deep blue ocean, as harmless as snow flakes fall on the peaks of the Sierras.

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AN INTERESTING AND VALUABLE REPORT.

In this issue we conclude the very interesting report of Dr. J. Hastings Reid, who visited these islands a year ago, as an expert to examine the methods of sugar cane cultivation and manufacture, and report the same to the Colonial Sugar Refining Co. of New South Wales. Commenting on it, the Queensland Sugar Journal, from which the report is copied, remarks:

“We feel sure our readers will appreciate the lucid and exhaustive way in which a most interesting subject has been dealt with, so much has been said by persons more or less competent to express an opinion as to the splendid work which is being done in the Sandwich Islands, and as to the marvelous returns, which are being obtained by the system of cultivation in those islands. Both sides of the shield are now exhibited to the critical eye of the Queensland farmer, and he has an opportunity, made quite easy by the facts laid before him, of considering exactly how suitable to Queensland would be the adoption of the Hawaiian practice. We are also let in considerably behind the scenes as to the value of the individual returns which find their way into print as setting forth the technical value of the work done in the Hawaiian sugar factories. The rival merits of diffusion and crushing and the general cost of mill work have considerable light thrown upon them in

the report. * * * 'Diffusion has been steadily losing ground,' so we are told, and this in the face of the wonderfully low figure of cost shown as the result of the milling factories, seems hardly a matter of surprise. But probably no fact will strike the average Queensland mill-owner more strongly than the statement that one mill, with rather a poor crushing plant, has succeeded in making its sugar for £5 11s per ton. The mere suggestion that such a thing is possible would, from a less reliable source, be received with derision. Yet the secret of this phenomenal success is out when we read that the mill was worked all the year round. * * * It is probable that the low cost of sugar, shown in Hawaii, is only attained in the Colonial Sugar Refining Company's mills in Queensland, and that none of the central mills or privately-owned factories have as yet reduced the cost of sugar here below £7 10s. We have been so prone to pride ourselves upon the work our central mills can do, that it is just as well that an expert has given us the opportunity of comparing our cost with that of another country, in our immediate neighborhood. We do not propose now to dissect the figures Professor Reid has supplied, but we direct particular attention to the report, and feel sure that a study of it from the first page to the last will not only amply repay the investigator, but will result in the adoption in Queensland of such improvements as may be suggested by the experience of our friends in the Hawaiian Islands."

In a private letter to the editor, Dr. Reid says: "When writing the report, I did not expect that any portion of it would be published, and much, of course, could not be reproduced. * * * I retain very agreeable impressions of my visit to Hawaii, and of the pleasant and hospitable characteristics of the many acquaintances I made during my stay there."

The doctor's report is probably the fullest statement of the working and results of Hawaiian sugar plantations, that has ever been published, and the fact that many of the details given have never before been in print, render the report more interesting and valuable. When we add that the methods of cultivation, fertilizing and mill-work are every year undergoing steady and rapid improvement, it will readily be seen that Hawaii will soon if she does not now, stand in the front rank of cane sugar-producing countries, as regards quantity per acre and quality of the sugar produced.

NOTES ON SUGAR IN HAWAII, 1896.

BY DR. J. HASTINGS REED, PH. D.

[Concluded from Page 460.]

CULTIVATION — (Continued). Agricultural implements do not need special mention. Steam plows and cultivators are employed whenever practicable, the engines and implements being usually of specially strong design, as stoney land is common. The horse-plow in general use for breaking up in deep soils is the Hendry Breaker, or others of similar design, and for furrowing, double mould board plows of large pattern are in favor. Shallow plowing is usually done by the walking sulky plow, which is similar to the Gilpin sulkies used in Fiji, but without pole or seat. For 6-in. to 7-in. plowing these walking sulkies do good work; they are considered superior to the Gilpin, and are 20 to 30 per cent. cheaper.

The stock used in the plantations are principally California mules, which cost, landed on plantations, \$150 to \$175 each. They are strong, heavy animals, of good constitution. I was informed that they had a working life of about 10 years. Horses are of Hawaiian breed and are useful and cheap. Bullocks find considerable use in some districts, but mainly for heavy team work, though occasionally for plowing and furrowing. Where deep plowing is practiced the teams are from six to eight mules or horses, or twenty bullocks, and one or two teamsters accompany the plowman. Where the plowing is shallow, as with walking sulkies, three strong animals is the usual team, and these are managed by the plowman. Small Hawaiian mules, about the size of those shipped to the Company's Fiji plantation, are required for packing or for light cultivation work. Considerable quantities of feed are imported from California, such as mixed wheat and barley hay, barley and bran, and these are fed with chopped cane-tops and molasses.

The transport of cane is effected in different ways, according to local conditions. Fluming is adopted wherever practicable. Locomotives drawing heavy cars (three to eight tons load) running on substantially laid tracks are also used. In some instances on level lands and by the use of light locomotives and semi-portable track, cane is drawn direct to the mill from where it

is loaded in the field. Gravity roads, mules and bullock carts are also requisitioned.

My general impression of cane cultivation on the Hawaiian Islands was very favorable. All sorts of conditions exist, and the various methods of procedure employed are those which local experiences have shown to be most convenient and profitable. I liked the care taken in thoroughly working the soil to the greatest possible depth, making it loose, open and in the best condition for cane root development, besides also enabling artificial manures being applied to the best advantage. Though no doubt, it is always well to choose the best plants, yet it would seem that this is almost of lesser importance than the mechanical condition of the soil. The best seed on cold, sour or sticky soils cannot be specially productive. With shallow surface soils shallow planting is necessary, and high hilling appears the best practice. On low-lying lands wide permanent ridging, as recently adopted by us, seems most advisable. Where soils are deep and open, then the deepest cultivation is to be recommended, and perhaps the — method might be followed with advantageous results. Heavy applications of lime or coral sand will always do good on stiff soils, which are also mellowed or improved by green manuring. The careful preservation of stable manure under cover, as is done at —, is well worthy of imitation, and the — treatment of filter-press cake appears a good one.

MANUFACTURE.—Marked progress has, I understand, been made of late years in the introduction of more powerful mills than formerly existed, and Krajewski crushers, National shredders, and particularly cane levelling knives for preparatory work have been freely adopted. Hydraulic pressure regulators and toggle gears are also much favored. Diffusion has been steadily losing ground, more so during the last two years, since the introduction of the "Cora" nine-roller mill at Ewa plantation, which has been doing very satisfactory work. It is freely rumored that the — diffusion plant will shortly be thrown out and milling substituted. — and — are two large plantations, both started about five years ago with diffusion as the mill process. — diffusion experience proved most unsatisfactory, and the change to milling, two years ago, has been

accompanied by economy of work and great reduction in the difficulties previously experienced in the boiling house. Both are irrigation plantations, growing heavy crops of Lahaina cane of high sucrose content, but comparatively low purity. (about 84 quot).

Two-roller mills have been quite a fashion in Hawaii for some years, but at the present time a change of feeling has set in. Though several new two-roller mills have been erected, even as late as last year, I found more than one manager who regretted that a three-roller mill had not been chosen. Being practically without chemical control in Hawaii, there has been no means of comparing the relative nature of the crushing done by the two classes of mills.

The most common type of crushing plant is a three-roller mill followed by a two-roller, or perhaps two two-roller mills. In a few instances the mills are driven by separate engines, but more generally two mills are driven by one engine. Triple crushing with three three-roller mills is becoming popular, and two three-roller mills preceded by a Krajewski crusher is also going to have many adherents. Cane levelling knives, which have just been introduced, have been fully adopted and are giving general satisfaction. I visited three mills where triple crushing in three two-roller mills is the practice, viz., No. 1 has rollers 78x36, No. 2 rollers 60x30, and No. 3 rollers 72x32. No 2 mill is preceded by cane knives and works on irrigated cane—which is stated to be more easily crushed than that grown under ordinary conditions—and the crushing there, though by no means good looking, was the best of the three. No. 3 mill has shredded cane to deal with, but there the crushing was very inferior, while at No. 1, without any preparatory treatment, the work at the mills was wretchedly poor.

An impression exists, even among Hawaiian engineers, that the advantage of the two-roller mill lies in the fact that the whole strain upon the top roller (say 200 tons) is exerted in crushing the cane passing between the two rollers, while the same pressure on the top roller of a three-roller mill is divided, in some proportions, over front and back roller and trash bar, and that the individual pressure only sums up to the original 200 tons; so they argue that, for a given strain, a more severe

crushing can be done with a two-roller mill. The latter assumption is a mistake, for we know that, assuming the directions of the lines of pressure on front and back roller to be at right angles to each other, which is about correct for most three-roller mills, and neglecting the friction on the trash bar, which does not appear to be excessive under favorable conditions in regard to setting, the square of the top roller pressure is equal to the addition of the squares of the back and front roller pressures. With good setting the front roller pressure need only be moderate, so that practically the whole of the pressure on the top roller will be exerted on the cane between top and back roller. Really, a three-roller mill might be looked on as a two-roller mill (top and back rollers) with a positive feeder (top and front roller and trash bar). The ordinary two-roller mill is at a disadvantage without a positive feed, as the limit of pressure which the "grip" of the rollers on the cane passing through can overcome is not so great, when heavy pressure is put on the top roller, the mill will not take any feed at all if the setting is too close. Mr. —, formerly a great advocate and believer in two-roller mills, is now inclining to the view that superior work can be done by three-roller mills, though he is not prepared to condemn the former on account of the want of reliable information as to the class of crushing done by both. Mr. —, of —, in reconstructing his mill last year, has put in two new three-roller mills, 60x30, with hydraulic gear on back rollers, and driven by one — engine capable of developing 220 h. p. These mills are preceded by a National shredder and followed by a two-roller mill. At the time of my visit the last two-roller mill was not extracting a drop of juice. This mill seems to have been put up, as it formed a portion of the old plant, and being seemingly too good to sell at a sacrifice or otherwise dispose of, was thought to be possibly of some service. Maceration water was not being applied at this period on account of being run rather close with fuel, though this is not usual.

The "Cora" nine-roller mill (three three-roller mills) at Ewa plantation is a very fine piece of machinery and has given great satisfaction to the company. Working on irrigated Lahaina cane and with very slight maceration (under 10 per cent. dilution), an extract of 93 per cent. of sucrose is obtained, and megass furnishes all the fuel required under normal conditions.

This nine-roller mill is driven by one powerful engine, cylinder 24x48 in., capable of developing 500 h. p., but ordinarily working at about 300 h. p. with 70 to 75 lbs. of steam. The rollers are 78x34-in., of hard cast iron, with 16-in. iron shafts—steel shafts in Hawaii and Louisiana have proven very unsatisfactory—and pinioned at both ends. This, it is claimed, much reduces torsional strain and minimizes chances of breakage. The setting of the trash bar can be regulated from outside the housings, and each mill is fitted with Fisher's hydraulic gear on the top roller; the ordinary working pressure being, first mill, 355 tons; second mill, 365 tons; third mill, 400 tons. The setting of the rollers was given as below: First mill, front, 5-8 in. back, 1-16 in. Second mill, front, 3-16 in; back, close. Third mill, front, 1-16 in; back, close. Surface speed of rollers in feet per minute is: First mill, 20; second mill, 22; third mill, 24. Cane knives have recently been fitted in front of first mill, and the regulation of feed has been followed by better work all through the train. During a full day's work (23 hours) the mill deals with 800 short tons of cane; that is to say, 31 long tons per hour. About 5 per cent. maceration water is applied behind both first and second mills (10 per cent. in all), and the megass analysis figures this year average about C. S. 5 per cent. (water 39 per cent., with first crushing juice perhaps 18 per cent. C. S. The surface speed of rollers at this mill is much higher than is customary elsewhere in Hawaii. Careful tests have been repeatedly made, I was told, which proves that the extraction at Ewa with a given thickness of feed is not one whit better when crushing at a surface speed of 14 ft. to 15 ft. per minute than when crushing at the higher rate above mentioned, and the aim there is to have a fairly thin even feed and fast roller speed in preference to thicker feed and slow speed. This practice confirms also Louisiana experience, and is worthy of careful consideration. The working of the engine and mills is very smooth and easy, and the regularity of the feed from mill to mill left nothing to be desired. The quality of the iron of the rollers seemed to be specially good, for, after nearly two years' work and crushing over 100,000 short tons of cane, they scarcely showed a sign of wear. The grooving is sharp and shallow—about five or six to

the inch—and there are no longitudinal grooves. Mechanical pushers are not used, nor are they needed.

At — mill triple crushing is also practiced, and there, too, good work was being done. The first mill is an old one, driven by an independent engine, while the two following mills are of the same make as the — mill, but with 60x32 rollers and one engine developing nearly 200 h. p. The cane at —, a dry district, is much harder than that of—, and is more broken up in the triple crushing than at the latter mill; there is also slightly heavier maceration under general conditions. The megass analysis about C. S. 4 per cent., water 44 per cent., with perhaps 17 per cent. C. S. in first crushing juice. It is perhaps possible that at — the moisture in the megass is not quite so low as represented by the figures given, on account of unavoidable delay in preparing samples for analysis, but the difference will not probably be great as the appearance, and also the behavior on entering the furnaces indicated dryness.

Of the adjuncts to the mills, for preparatory treatment of the cane, the shredder and knives need only passing reference, but the Krajewski crusher deserves special mention, as it possesses some advantages over the shredder. The general appearance of the crusher is doubtless familiar. It is either placed above the mill in a position similar to that usually occupied by the shredder, but also may be placed on the ground floor, which necessitates the use of a light carrier between crusher and first mill. The crusher consists of two steel rollers (54x20 in. or other size), fluted longitudinally in a zig-zag, and in such a position that the so-called teeth of one roller fit between the teeth of the other. The pitch of the teeth is about 5 in., so that the cane stalks in passing through are severed or partly severed every $2\frac{1}{2}$ in. The bearings are supported on powerful springs as a safeguard against breakage should any foreign obstacle be thrown on to the carrier. The surface speed is about the same as that of the mill roller. Unlike the shredder, the roughest and most uneven feed in the carrier is not prejudicial to the work of the crusher.

In passing through the crusher most of the cane is broken into $2\frac{1}{2}$ in. or 5 in. lengths, and about 50 per cent. of the juice is extracted. The broken cane slides down the mill apron with great evenness and smoothness, presenting a good feed to the

first mill, and in this form is, I believe, in a favorable condition for good extraction. It is driven by an independent engine of slow speed, and the extra consumption of steam in those mills where the crusher has been introduced is stated not to be noticed. The cost of this apparatus is, however, considerable, on account of the patentee's high royalty on the fluted rolls. The favorite style of boiler is still the tubular and Galloway set tandem. The firing takes place at the end of the tubular boiler, and the flame passes along under both tubular and Galloway, returning through the flue and tubes, and finally passes back to the chimney along the sides of both boilers. They are generally of fair size and are well bricked in. The furnaces are also usually of large capacity, and plain step-ladder grates of ample area are favored. Particular care is taken to keep the grate area carefully covered with an even layer of burning megass, and at — this is much facilitated by placing an obstruction in the shape of a piece of angle iron a few inches below the delivery of the automatic feeder.

Superheaters are frequently used and doubtless effect some economy, but it seems preferable to utilize at the boiler itself all possible of the heat generated, than to be wasteful of the heat at the boilers and endeavor to economize afterwards by the use of superheaters.

Coal is not used at the Hawaiian mills unless where diffusion is practiced. As the fibre in the cane in Hawaii does not apparently differ much from that of Australia and Fiji, and, perhaps excepting irrigated cane, the cane does not seem to be more easily crushed. It appears that in comparing the work of our mills with those of Hawaii (the better ones) we are in one of two positions. We either do not generate steam with the same economy as they do, or else we make demands on steam out of proportion to the value of the increased extraction obtained. The most common type of clarifier is the oblong cast-iron tank (500 gallons) with steam girds. Cleaning tanks, where clarified juice is boiled and skimmed are occasionally used.

Presses are principally of the Honolulu Iron Works pattern, and are very similar to the Kroog. Foul juice montejus are usually preferred to pumps.

There are still a few double effects, but triples are in general use. Scrupulous cleanliness of the effects is a strong point in

Hawaii, and the cleaning is not considered at all troublesome. When working single shifts it is customary to scrape the last vessel every night; this is not very laborious for one man, as the vessels are small. At the end of each week, water, acidulated with hydrochloric acid, is left in the pots for about 12 hours, after which the scale is said to be thoroughly softened and easily removed by hand scrapers. In other cases sour water (fermented molasses) serves for softening the scale; this is stored in tanks or vats and re-used many times. The construction of the pans does not call for extended remarks; they are, as a general thing, small and old fashioned. The newer pans of larger capacity are furnished with a large number of coils—the top coil being often within one or two feet of the dome—and I frequently saw the level of *masse cuite* within a few inches of the neck of the pan. The coils are of small diameter and there is considerable vertical and horizontal space between them.

At —, on Kauai, a Croiner pan has recently been erected, and its work is giving satisfaction; it boils *masse cuite* to about 6 per cent. of water. There are no coils, but the heating surface consists of a series of rows of perpendicular tubes. Six tubes are arranged in a nest around one central tube, and the steam, entering the central tube at the base of the pan, travels upwards and is distributed at the top into the six branches; it is then delivered, or rather the condensed water is delivered, into a channel common to a series of nests, whence it is conveyed by a pipe to a central steam trap which serves for the whole pan.

Fugals are principally Weston and Boston-Weston type, but several mills are equipped with Hepworth machines. The usual size is 30 in. diameter. Mills in Hawaii turning out 40 to 50 short tons sugar per day probably do not exceed four men at the fugals and fugal engine per shift. I noted the fugging at —, and found the time occupied per charge No. 1 was usually under three minutes. The sugar was about 98.5 per cent. polarization, so that the moisture would not probably be much more than $\frac{1}{2}$ per cent. The fugals are generally situated on the ground floor, and the discharged sugar is carried by archimedian screw, grasshopper conveyor or chain scraper to the bagging room. In other cases where the fugals are on the first floor, the sugar falls into bin shoots, which in turn discharge direct into the bags.

With very few exceptions the greatest cleanliness is observed in Hawaiian mills, and proper provision is nearly always made for keeping every station sweet and clean, a condition which encourages cleanliness in the workers. Cleanliness is an old cry, and its necessity has been recognized in most food stuff factories. The condition of butter and cheese factories, meat and canning works and others often calls forth favorable comment, but the small mill, where the complicity of deteriorating fermentations, though perhaps not so observable to the senses, is none the less harmful, has not yet received the attention it deserves. In Hawaii, neat and careful lagging of steam pipes is almost everywhere the rule, and though most of the mills have been patched and added to again and again, they gave me the impression that every piece of work taken in hand has been done thoroughly, and the necessary finish which facilitates uninterrupted work has not been neglected. Negligence engenders waste, discomfort and decay, and as a general thing may be said "never to pay."

The liberal use of incandescent electric lights is everywhere in vogue, much to the comfort of the night workers. The production of this light appears to be, and is stated to be, the very acme of simplicity. A small engine and dynamo once started needs no further attention until the light is no longer required.

The mill juices are, in many cases, carefully weighed by a Baldwin weigher, or measured by a Cowan automatic measurer, both of which work satisfactorily. Mr. —, of —, has one of each, but he is not yet decided as to which he will give preference. I think the introduction of these machines desirable, not only as a more accurate determination of the juice actually delivered from the mills, but also as a check on cane weights. An accurate knowledge of the amount of juice entered for manufacture will probably do away with the variations in "undetermined loss," which so frequently confront chemists, or will at least aid in discerning the location of the losses if they really exist. At — there are two Cowan's measures, one for juice and the other for liquor. Last year the check by means of the measured juice as a basis agreed within $\frac{1}{2}$ per cent. with that kept on the basis of caneship analysis and cane weights. The weigher appears the more satisfactory instrument, but the measurer is cheaper and more readily cleaned. The temperature

of the juice passing through the measurer is easily averaged, and a continuous sample may be taken without difficulty.

Juice generally passes through a heater before reaching the clarifiers, but the temperature is not raised above, say, 120 deg. F., and liming is done in the clarifiers at the discretion of the sugar boiler. Skimming is not often practiced, and decidedly the best clarification is obtained when the juice is withdrawn from the clarifier below the blanket. Skinmed juice, even after long standing in the subsiders, does not equal that clarified in the other way.

Boiling low in the effets is the rule in Hawaii; this, I am told, has been found the most efficient custom; the liquor is concentrated to about 27 deg. B. The limited head room and absence of save-alls probably results in some loss by entrainment.

Vacuum pan boiling is accomplished with great rapidity, by aid of high pressure steam, at most mills, and at a rather high temperature.

As regards decomposition of sugar in boiling, perhaps this is no greater with high temperature boiling and short operation than with low temperature and longer time of boiling, and the former has the advantage of making harder and cleaner grain, which will enable a stronger sugar being turned out of the mills. At six Hawaiian factories where only one brand of sugar is made the average polarization was a little over 97 per cent. (and this in every case without washing), while the average of straight first sugars at other mills will probably be 98 per cent. polarization. The proportion of the various grades of sugar made varies much, this, of course, depending entirely on the character of the work done at the boiling station. At —, where about one-third of the first molasses is returned to the mixed juice and "straight" sugars are made, the proportion was, in 1895: First sugar, 78 per cent.; second sugar, 18 per cent.; third sugar, 3 per cent.; fourth sugar, 1 per cent.; and the average polarization of all grades at San Francisco was 97.93 per cent., equal to, perhaps, 96 n. t. At —, where third and fourth sugars are re-melted, the proportion for 1895 was: First sugar, $86\frac{1}{2}$ per cent.; second sugar, $13\frac{1}{2}$ per cent.; and average polarization 98.03 per cent. at San Francisco, equal, say, 96 n. t.

As before remarked, fugalting at the Hawaiian mills proceeds with great rapidity. At —, for instance, with four 30-in. fugals driven by a light engine and three men per shift, 40 to 50 short tons of sugar could be turned out daily, and yet not be particularly pressed.

From the figures given me, representing total cost of manufacture per ton of sugar at the mills (say 96 to 97 pol.) I find this varies from \$25 to \$35. Cost per ton is reckoned from the total expenses for 12 months divided by tons of marketable sugar produced during that season.

Mr. —, of —, supplied me with figures, showing cost of manufacture and maintenance for crushing season only, and these are given below. "Labor" includes engineer and sugar boilers' wages, also proportion of staff salaries. "All stores" covers line, filter-press cloth, oils and engineers' stores.

<i>Cents per ton.</i>	
Labor wages	\$1.65
All stores and maintenance.17
Bags and twine.	1.40
<hr style="width: 10%; margin-left: auto; margin-right: 0;"/>	
Total	\$3.22

This is \$3.22 per short ton of 96 to 97 pol. (assumed). Now, one short ton 96 to 97 pol = 0.933 long tons 88 n. t. One long ton of 88 n. t. s. on the above figure would have cost \$3.45 or 14s 4d for all manufacturing charges.

Cane is flumed at —, but it is estimated that somewhere about 8 tons of cane are required for a ton of sugar. If we take 8 to 1 for 88 n. t. s., then the cost of manufacture per long ton of cane, including all charges, amounts to 1s 9½d for the season, or for labor alone (including proportions of staff salaries) 11d per long ton of cane—which is quite a good figure under that head. Of the total cost of sugar at the mill floor I was furnished with figures at several places.

Cost per long ton 88 N. T. S.	Remarks.
1. £7 2s	Irrigated plantation, diffusion plant.
2. £6 1s	" " fair crushing plant.
3. £6 5s	" " poor " "
4. £6 18s	" " fair " "
5. £5 11s	Rainfall plantation, poor " " (works 12 months.)
6. £6 14s	Irrigated " rather poor " "
7. £7 16s	Rainfall " good " "
8. £6 1s	" " " "

Most mills have to bear marketing charges of about £2 per ton; a few, favorably situated, may place their sugars at the refineries for 28s to 30s per ton. The details of cost of production (cane and manufacture) for these different mills will be found on the following pages:

1. An irrigated plantation, not favorably situated as regards climate, yields about four tons sugar per acre for plants and long ratoons, and two to three tons per acre for short ratoons. Cane to sugar, about eight to one.

Crushing plant, five-roller mill; old plant; crushing rather poor; maceration about 4 per cent. dilution. Mill grinds 15 hours per day.

Cost of manufacture, 1895, per short ton of sugar—

Cane at mill.....	\$24.84
Manufacture	4.10
Bags	1.46
Cartage to wharf.....	.29
<hr/>	
Total	\$30.69
To Honolulu	2.02
Cartage42
To San Francisco.....	4.99
Insurance46
Commission72
<hr/>	
	\$39.30

<i>Year.</i>	<i>Cost per ton.</i>	<i>Year.</i>	<i>Cost per ton.</i>
1895.....	\$39.30	1892.....	\$57.85
1894.....	45.92	1891.....	74.92
1893.....	47.00		

2. Favorably situated rainfall plantation. Crops about five tons per acre for plants and long ratoons. Cane to sugar estimated at nine to one.

Crushing plant, shredder and three two-roller mills; maceration very high and intermittent. Has large excess of megass, which is thrown into sea.

Cost on 840 acres plant cane at 5½ tons sugar per acre—

	<i>Per Acre.</i>	<i>Per Short Ton Sugar.</i>
Clearing	\$ 14.92	\$ 2.62
Plowing	13.90	2.44
Planting	13.90	2.34
Manuring	2.90	.51
Hoeing	7.21	1.27
Stripping	9.38	1.65
Cutting	10.09	1.77
Transport	34.18	6.00
Manufacture	25.70	4.50
Rent and Taxes	3.81	.67
Maintenance	7.26	1.27
Marketing	56.80	9.97
	\$199.51	\$35.01

3. Rainfall plantation, subject to long spells of dry weather. Average yield plant, long and short ratoons, 2½ tons per acre (evidence of great improvement in yield since manures have been used). Crushing plant, five-roller mill (since changed to nine-rollers). Cane to sugar, 8.7 to .1 (with five-roller mill); maceration about 5 per cent. dilution.

	<i>Per Ton Sugar on Mill Floor.</i>
Preparing and planting	\$ 5.02
Cultivating and growing	11.25
Cutting and delivering cane	5.79
Manufacturing and maintenance	6.07
All other expenses at mill	7.36
	\$35.49

“All other expenses” includes repairs to buildings, roads, fences, implements, and wages, rent, taxes, insurance, etc.

[Concluded.]

REPORT ON INSECT PESTS.

Honolulu, Oct. 6th, 1896.

J. MARSDEN, Esq., Chairman of the Committee on Diseases and Insect Pests of Sugar Cane:

Sir:—I herewith submit a few notes on insects affecting the sugar cane as found on my recent trip through the islands, with a few suggestions of the remedies thereof.

The work done since my appointment will be treated more fully in a general report to the Government.

Compared with the cane fields visited in the Figi Islands and Australia, I am glad to say that these islands are most fortunate in the few plant diseases and insect pests affecting the sugar cane. The effective and rigorous modes of extermination against them leave hardly anything to be desired.

THE CANE BORER—*Sphenophorus Obscurus*.

This may be classed as the most injurious enemy of the sugar cane present on these islands. Its ravages will exceed those of all other insects combined. Its attacks on the sugar cane, however, seems confined to the more damp localities, whilst in drier places such as Lahaina the borer is hardly noticed. I have been informed that the Lihue Plantation has recently suffered severely from the attacks of the borer. Not only sugar cane is damaged by this insect, but many other plants are damaged by it, chiefly the bananas and cocoanuts. A grove of the latter was shown me in Hilo, in 1894, that was badly infested by the beetles. Setting fire to the dry leaves was recommended; this was done and the plants have since entirely recovered. Dying cocoanut palms were examined and in the tender heart of the palm was found great numbers of the insects, in all stages.

To my knowledge this beetle is not present in the cane fields of Australia; there the larva of a *Nonagria* moth is very destructive to the cane. It is only a question of time when the borer will be present there also, as it is very numerous on Fiji Islands. During my visit there in 1892 Governor Thurston informed me that soon after the cultivation of cane was commenced and coolie labor from India was introduced, a disease

appeared upon the banana plants that eventually spread over all the islands, destroying both the cultivated and wild varieties of the plant. I attributed this destruction entirely to the attacks of the sphenophorus beetle, as this could be found in large quantities, breeding both in the tops of the bananas and in the tubers below ground, causing the same effect upon them as upon cane plants in these islands. The latter when planted from seed injured by the borer, producing only dwarfed bushy plants; the same effect was noticed in the banana plants. During my stay at the Nausory Mills in Fiji, various methods were tried to mitigate the ravages of the borer, which at that time was so numerous that fully 50 per cent. of the cane coming to the mill was affected, in addition to this, large quantities of cane were utterly destroyed, and left in the field. Nothing more effective was found than the simple plan of catching the mature beetles by placing pieces of split cane, one foot in length, flat side downward, about 10 feet apart in places most affected by the beetle; during the night the beetles congregate under the pieces of cane to feed upon the juice, and are collected in the morning by children, who are paid a small sum per pint of the beetles. Enormous quantities were caught in this manner, and the result in two years was most gratifying, the borers were nearly got rid of at a very reasonable cost, less than two per cent. of the canes showing any sign of the borer.

The effective remedy in use here, burning off the trash as soon as possible after the cane is cut, is not resorted to in Australia, hence the enormous increase of fungi and insect pests.

Mr. Geo. H. Fairchild, manager of the Makee Plantation on Kauai, informed me that on his arrival at that place, the fields were swarming with the borer, yet by burning the trash twice, in the field and collecting what remained and burning the same under the boilers, an almost entire exemption from the attacks of the borer was obtained. Such results are gratifying and the plan should be followed wherever it is practicable.

It appears that the beetle, as a rule starts its work in young cane fields, first along stone fences where such exist; here they find protection from the sun and from fire during the time of burning the trash. Collecting the beetles by children, as is done in Fiji, would doubtless be of great benefit and comparatively inexpensive.

The two fungoid diseases so successfully introduced upon the Japanese beetle did not work so well upon the cane borer, owing no doubt to their harder covering. 30 borer beetles inoculated with the fungus on May 25th, began to die and show traces of the fungus growth a week later, yet some of the beetles lived and filled the pieces of cane that was placed with the beetles for food, full of eggs, eventually all succumbed to the virulence of the disease, as did others in subsequent experiments. The larva of the borer dusted with the fungus spores was more readily affected, in five days the fungus growth could be observed on the outside of the larva. Messrs. T. H. Davies & Co. were furnished with a lot of infected beetles for trial in the open field. Up to this time no report of the result has reached me.

The numerous species of toads introduced here from California and Japan appear to increase and good results from them may be expected in the future, not only to devour the cane borers but also the various cutworms and caterpillars, etc., injurious to the cane and other plants.

AEGOSOMA REFLEXUM, Karsch.

On two certain slopes at Spreckelsville, Maui, and ever since sugar cane has been planted there, a large bone colored grub, with yellowish brown head and darker mandibles, thickest in front and tapering posteriorly, with three pairs of small legs on segments one to three, has done considerable damage to the growing cane by eating off below ground, destroying whole patches here and there. Specimens of the larva were shown to Mr. Perkins, who is probably better acquainted with the indigenous insects of these islands than any other living person. He identified the insect as belonging to the above species; he also informed me that the mature beetle had been repeatedly bred by him from dead as well as living wood on all the islands. The insect belongs to the Longicorn beetles and was described by Dr. Karsch some eighteen years since from specimens collected at or near Spreckelsville by Dr. Finch.

At the Kona Coffee Company's Plantation at Olaa the larva of the same beetle was shown me by Mr. Mason the manager, five coffee trees ranging from one to two inches in diameter, had

been cut off by them, just below the surface of the soil. On examination it was found that all the old and rotten logs lying in the coffee fields were swarming with the larva. In the case of the larva attacking the growing coffee trees, it will be found that this is not the habit of the larva to attack growing wood; these simply wandered away from the old decayed wood and becoming hungry attacked whatever came in their way. It is very singular that the beetles should remain in the same spots in the same fields at Spreckelsville for so long a time with what we may consider a scarcity of food. The male beetle was collected at Olaa in the evening, by their coming to a light placed on the ground, but if the sluggish heavy female will ever come to a light in sufficient numbers to warrant the use of this method for their destruction, is in my mind, questionable. As a remedy, a prolonged irrigation, wherever practicable, say from six to eight hours, would have a marked effect in destroying the larva as they cannot live under water for any length of time, the irrigation should be done once a week until all the larva are killed. Since the eggs of the beetles are undoubtedly deposited in old and dead pieces of cane in the fields, the removal and burning of the same should also help.

THE COCOANUT PYRALID, BOTYS, SP.

There are no means at hand at present to enable us to exactly identify this moth.

In former times everyone must have been well acquainted with the ragged appearance of the leaves of the cocoanut palms, this was caused by a rather large greenish larva that spun the fibrous parts of the leaf (within which it lived) together, coming out at night to feed. The same larva is also met with on sugar cane, banana and other plants. As the greatly improved condition of the cocoanut palms will show we have found for this insect a most effectual enemy in *Chalcis Obscurata*, Walk. Large numbers of this valuable insect were sent here during last year from China and Japan. At the present time the small active wasp can be found anywhere on this island, from the seashore to the highest mountain peaks, flying around plants and trees in search of their prey, which consists of the various

Pyralid and Tortricid larva as well as some of the larger Tineid and likely those of the Borabycids.

A second introduced parasite, a *Proctotrubid*, the larva of which also preys on that of the cocoanut moth, was found in large numbers and sent to Kauai together with the first named species.

LAPHYGMA FRUGIPERDA, HUB.

The *Pelua* of the natives, a dark colored larva with lighter longitudinal stripes, at certain seasons covering whole districts, destroying the grass during migration, defoliating the cane fields and every green thing that comes in their way. The moth generally deposits its eggs on the under side of the leaves of trees and shrubs as well as on grass and weeds, the eggs are deposited in groups of several hundreds, they are of a grayish color and partly covered with hair from the mother moth. The young larva after issuing from the egg, drops to the ground and commences its destructive work; in about three weeks they become full grown and enter the ground to pupate, the mature moth issuing some ten days later. On my walk from the Volcano to Pahala, recently, the caterpillars were so numerous that it was impossible to step on the ground without crushing numbers of them. The only Dipterous fly on these islands, a species of *Tachina*, was here observed only occasionally; this as well as the numerous Hymenopterous parasites (*Ophion*) are found preying on the larva of the native moths on elevations of 2000 feet and upwards. The most effective enemies of the *Pelua* at present are no doubt the birds, principally the plover and quail, the first it seems to me feeds chiefly on these larva and should be protected in consequence.

The moth is an American and was met by myself anywhere in the United States as well as in Brazil where it is quite numerous, but never was the larva found in such abundance or even in destructive numbers, showing that in its original home it has sufficient parasites to keep it in check and every effort will be made to introduce the same here.

GRYLLOTALPA, SP.

A species of mole cricket has appeared in very large numbers in some of the moist valleys on Oahu, it is likely another Asiatic

introduction, as a rule these crickets are found around the muddy borders of shallow ponds and watercourses where they live in burrows resembling those of moles, and like that animal their food consists chiefly of earth worms and the larva of various insects. The opinions as to its habits are as yet divided; whilst some authorities claim that it is beneficial, others place it amongst the injurious insects.

Specimens kept in confinement here with pieces of sugar cane would hardly touch them, yet they readily devoured a large number of the larva of the Adoretus or Japanese beetle, as well as those aphodius and a number of earth worms, all within 24 hours.

The ground infested by these crickets was examined and found to be very wet and completely riddled with the burrows down to a depth of three and even four feet, as many as three and four specimens were brought to light in a single shovel full of the soil. In such localities there is no question as to the injurious effects of the crickets on young cane plants, wherever they were numerous almost all of the seed cane was destroyed; they would burrow into the seed from all sides, destroying all the eyes, where the plants had made a growth of a couple of feet the cricket would burrow in below the ground and eat to the center, killing the plant. This is the only instance so far observed of the depredations of these crickets here. In rice and taro fields no damage has been observed as yet, and the only damage that is likely to occur to cane is when it is planted in wet swampy land, as the cricket can only live and thrive in such places, and is not found in ordinary arable land; even in the swamp where the cricket was very numerous, it did not attack the old cane but paid its attention solely to the newly planted seed and very young plants.

This cricket, although living in marshy land, cannot live under water, yet it is a good swimmer; the only remedy that can be recommended at present is to flood the land with water and collect the crickets as they come to the surface, and destroying them by placing them in a vessel containing kerosene and water.

The fungoid so contagious to many insects and larva here, does not seem to have any effect on this lively cricket, nor will he have anything to do with poison given in the style of bran,

sugar and arsenic. As yet, the time that this insect has been under observation, is too short to arrive at any other conclusion as to a remedy for this insect. American authorities, to whom an account of this cricket has been reported, may have better suggestions to offer.

DACTYLOPIUS CALCEOLARIA, Mask.

Living behind the leaves and feeding on the sugar cane, is what is generally known as the white louse. It had done considerable damage to the cane by sucking the sap and making the stripping a hard task, owing to the copious dust, produced by the powdery exudation of the insect. To all appearance, during the present season, the scale has practically disappeared from the plantations visited, this is owing to the work of an introduced ladybird, *Cryptolaemus Montrouzieri*, which feeds chiefly on the mealy bugs. The beetle has been observed in large numbers everywhere, particularly in the cane fields, soon after it had been distributed over the islands.

A second species of these useful insects found feeding on a similar coccid in California and known under the name of *Scymnus debilis*, Lec. was also introduced here and is now found in large numbers. Other enemies of these scales, of which many species are present on these islands, have been introduced, and with their help, the formerly so destructive mealy bugs will soon be a thing of the past, and an improvement in the cane noticed in consequence.

Mr. Maskell reported a mealy bug under the above name, from the Fiji Islands and there is little doubt but that it is identical with the species here. The insect was reported as being extremely abundant, whilst in the cane fields visited in Australia, it was but rarely found. This is no doubt owing to its natural enemy, the *Cryptolaemus*, being present.

APHIS, SP.

During July of the present year the Minister of the Interior called my attention to a new blight that had appeared on the cane at the Kilauea Plantation on Kauai. I visited Kauai and Manager Ewart kindly accompanied me to the infested fields. On examination a small greenish louse was found in great abundance, feeding on the lower leaves and causing them to dry up

and become covered with a black smut, caused by the honeylike exudation of the Aphis. The field first visited was still badly infested with the lice, but there was also present in countless numbers the introduced lady bird, *Coccinella repanta*, Thumb. This was feeding on the lice, and everywhere the groups of their yellowish eggs could be seen on the under side of the cane leaves, and the active yellow and black larvae were swarming. A few Syrphid flies could also be noticed here and there, and the larvae of a small gray fly, *Oscinid*, was also present.

It could be seen that with the natural enemies present, the attacks of this Aphis (the most prolific creature in nature) would soon be mitigated; in fact it would be but a matter of a few days until their entire destruction was effected in any particular field. This was shown on the field that was first attacked by the Aphis. Here not a trace of the plant louse or the lady birds could be seen, except the numerous cast-off skins and empty pupa cases of the latter.

Here and running parallel to the attacked Lahaina cane, and only separated by a ten-foot road, was a field of Rose Bamboo cane which was and had been entirely exempt from the Aphis.

Previous to this the same Aphis had appeared on the Makaweli Plantation, and it was the same lady bird that cleaned it out. It was also met with at Heeia and at Lahaina. In both cases the lady bird came and mastered it. Dr. Maxwell has handed me a letter from Mr. H. P. Faye, at Mana, Kauai with a parcel of cane leaves that were infested with the Aphis. Among the leaves was also found large numbers of the larvae of the lady bird, as well as the larvae of the Oscined fly. This fly greatly helps to reduce the numbers of the various Aphids on these Islands. The same fly was observed everywhere in Australia, Ceylon, China and Japan, feeding on various plant lice. It is also common in California. In a recent letter, Mr. Ewart writes:

“We have that horrible blight again. This time it has attacked the young plant cane, and quite away from any of the cane that was infested before. The lady bird is there in full force, and the rain of the last few days seems to have done quite a lot of good, washing the leaves clean.”

Probably ever since the Gray American Lady bird, *Coccinella*

abdominalis, was introduced to these Islands, a small Hymenopterous parasite has been preying on the mature. This parasite is the *Centistes Americana*, which is found all over the world. It attacks the more recently introduced lady bird, the *Coccinella repanta*, as well, and the time may come when the parasite may become so numerous as to considerably reduce the numbers of this particular and very valuable lady bird.

Another Aphid-feeding species, *Platymus Lividigaster*, has been introduced and has increased to a remarkable extent, chiefly upon Orange-feeding Aphis. It is hoped that this will also feed upon the cane Aphis. As yet the parasite has not attacked this lady bird, and it is not likely that it will.

This important matter will be kept constantly in view and many other enemies of the plant lice will be introduced.

Respectfully submitted,

A. KOEBELE.

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REPORTS ON SHARE PLANTING.

Office Onomea Sugar Company.
Papaikou, Hawaii, Nov. 14th, 1896.

Mr. Sanford B. Dole, President Republic of Hawaii, Honolulu, Oahu:

Dear Sir—Your letter of Nov. 7th received and contents noted. It is true that for several years I have been trying experiments in the raising of cane that would give others than the Plantation Co. a chance of making more than mere days' wages.

Some of the following statistics I gave to the Labor Commission, but they may be of use to you or to some one else, so give them to you to use as you see fit.

There have been several plans adopted with varying success.

First—Cultivation of fields by contract at a stated price per acre. This has been tried several times and has always proved disastrous.

Second—Cultivation by contract at a stated price per acre, but the contractor to have a bonus on a specified sum for each ton of sugar produced over and above a certain yield for the entire field, and to pay a forfeit for each ton less than the stated yield. This contract proved successful to both parties and was

carried out to the end without friction and with mutual satisfaction. The contractor was paid a bonus.

Third—Cultivation of fields by contract. The contractor to be paid a specified sum per ton of cane produced. As it is expensive in this district to weigh the cane, settlements of these contracts have been made when the cane was ripe on a mutual agreement as to probable weight of cane, and these contracts have proven satisfactory to both parties.

These contracts have been in all cases with Japanese, and the work performed by companies of their own people, who shared the profits.

Fourth—Grinding of cane grown by outside parties on their own land. The net proceeds of the sugar produced being shared as follows: To the planter, two-thirds; to the mill company, one-third. Planters are Hawaiians, Portuguese and Chinese. They have all made money.

Fifth—Purchase of cane grown by our own laborers on land belonging to the Plantation Company, in the ravines and on otherwise waste land that from its situation cannot be profitably cultivated by the company. Seed is furnished free of charge, and the cane when ripe is cut and transported to the mill free of charge to the planter, and a specified price per ton is paid for the cane. (Weighing is also at the expense of the mill.) During the past year I have paid out to our men who have grown the cane under this system the following sums: To Japanese, \$13,255.32; to Portuguese, \$2,233.49; to Chinese, \$614.73; to Hawaiians, \$245.70; to others, \$163.15. Total, \$16,512.39.

This system has been profitable to all parties, and to show that it is popular with the men I give you the figures showing the growth of the industry: Bought cane of laborers, 1891, \$825.00; 1892, \$1,618.00; 1893, \$1,721.57; 1894, \$2,372.50; 1895, \$6,210.20; 1896, \$16,512.39. And there is a large area of cane growing for the years 1897 and 1898.

All these plans except No. 1 have much in their favor according to circumstances or local conditions, and probably many of the plantations have tried the same or other systems with success.

A few years ago a paper was read before the Social Science Club by Mr. Olesen, in which he advocated the subject of co-

operative work, and the paper was widely circulated through the newspapers.

He seemed to think that we were all plodding along in the old ruts, and even if we did occasionally take a fresh start we would still be like the street car horse in Oakland, who, seeing a chance to escape from the stable, ran off at full gallop, but kept between the rails of the track; and Mr. Olesen evidently felt the need of enlightening us. His figures were incorrect from his ignorance of the sugar plantation work, but although his arguments were based on false premises, and his summing up faulty, his cause was a good one.

Hoping that you may find this of interest, I remain,

Yours very truly,

WM. W. GOODALE.

Manager's Office, Ewa Plantation Co.,
Honolulu, Oahu, H. I., Nov. 14th, 1896.

To the President and Members of the Hawaiian Planters' Association, Honolulu, H. I.:

Gentlemen—I have been requested by a gentleman standing high in the esteem of you all to write a few facts concerning profit sharing as practiced on Ewa plantation, and its results, and herewith beg to hand you a copy of our agreement with the laborer, and also a statement showing actual results of their work during last season, which I trust you will find of interest.

We have in operation at this date fifteen companies, with a total of 215 men, cultivating about 1,400 acres of cane. This is evidence of the satisfactory working of this system.

We feel certain that the influence of these companies over the other laborers almost (if not quite) insures us against any serious strikes or other labor troubles, and also against fires in the fields.

We could let out the whole planting in this way, but I feel that until there is enough free labor in the country to tide over the planting and grinding seasons that it would not be safe to let it all out, as we must have extra labor at these seasons, and consequently must keep something for them to do during the months when work is slack.

In Louisiana I noticed that when the grinding season begins the planters send to New Orleans and engage large numbers of men, who work until harvest is finished, when they return to the city.

The writer believes that some such system as ours should be adopted by every plantation in this country, and as soon as possible, as it improves the condition of the laborer in many ways, and creates a feeling of confidence between the plantation and the laborer, and would be the means of encouraging and bringing free laborers into the country and placing us in a similar position to our friends in Louisiana. Also it would gradually and surely bring a better class of laboring people, which in a few years would probably give us a white population who would to a large extent take the place of the present class, and the country would be settled with people of our own race, which would be very beneficial to the sugar industry, as well as to the country at large.

Some of my friends tell me they cannot adopt this system, as their water supply cannot be relied upon, and in reply to this excuse I would say that we have really been short of water during the past four months on account of having 400 acres more large cane growing under the three pumps on the west side of Honouliuli than last year, and consequently had to deprive all these fields of water to some extent in order to go ahead with our planting; and during the whole of these months there has not been a single instance of dissatisfaction among the companies. They knew they were getting their full share of water and were perfectly satisfied. It seems to me that this experience should encourage others to try the system, and I trust these few remarks may be the means of setting some of our plantation owners and managers to thinking on this all-important subject.

Respectfully yours,

W. J. LOWRIE.

This agreement, made this day of 189. . . , by and between the Ewa Plantation Company, a corporation, of the first part, hereinafter called the Employer, and of the second part, hereinafter called the Planter, Witnesseth:

ducted from the sound cane and all expenses connected with separating and weighing such unsound cane, shall be charged to and deducted from the Planter's share. All of the cane to be stripped at least *twice*, and in heavy places *three times*, whenever so directed by the Employer, and all roads and ditches running through said fields to be kept clean and free from weeds.

IV. It is likewise hereby agreed that all work, labor and service to be performed by the Planter under this agreement shall be subject to the supervision and shall be done to the satisfaction of the Employer in all cases; and if it shall seem necessary to employ extra labor to do the work satisfactorily, the Employer shall so employ extra labor and all costs of same shall be charged to and deducted from Planter's share with interest at the rate of nine per cent. per annum and the Planter shall always be subject to the supervision or order of the Employer.

V. For all labor performed under the terms of this agreement in cultivating and harvesting cane upon the land set off to said Planter, he shall be paid at the rate of per ton of two thousand (2000) pounds of cane on all of the cane, subject to conditions of Article III, produced upon the land cultivated by himself in common with others as aforesaid, such proportionate part as his labor bears to the entire amount of labor expended upon such premises by the Planters, averaging the same between the total number of such Planters.

VI. From the proceeds of his labor, as set forth in the last Article, he shall return to the Employer the advances set forth in Article I, aforesaid, as therein set forth.

VII. This agreement may be terminated at any time by the Employer, and upon two months' notice by the Planter, the Planter being entitled upon such settlement, to wages at the rate of dollars per month for the term of his service rendered, deducting therefrom the advances as aforesaid under Article I.

VIII. In case of the death of the Planter during the term of this agreement, the estate shall be entitled to an immediate settlement at the rate of dollars per month, deducting advances as aforesaid; or settlement may be deferred until the crop is harvested and then it shall be made upon the terms

hereof for the proportionate time given by said Planter hereunder. In case of accident or sickness of said Planter whereby he is prevented from performing the labor under this agreement, if he shall not supply labor in place of his own, the Employer shall do so and a proportionate amount of said Planter's share under this agreement shall be deducted for the time lost.

IX. The Planter, together with his co-workers, shall have the right to inspect the weighing of their cane at any time.

X. The Planter shall not have the right to transfer or assign his share to another without the written consent of the Employer, and in case of any such transfer it shall not be recognized, and all settlements shall be made with the original Planter or his heirs or legal representatives in case of death.

XI. The Employer shall in no way be held liable for damages to said crop or any portion thereof by fire, storms or for unavoidable delays in the Mill.

XII. This agreement shall terminate and be at an end when the last cane upon the fields to be cultivated hereunder shall have been placed upon the cars and weighed, and settlement shall be made in full, not later than three months thereafter.

In Witness Whereof, the said Employer has caused the execution of these presents by the attachment of its corporate seal together with the names and seals of its President and Treasurer and the said Planter has hereunto set his hand and seal the day and year first aforesaid.

Signature of Planter

.....

EWA PLANTATION CO.,

EWA PLANTATION CO.,

By its President,

By its Treasurer,

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REPORTS ON FORESTRY.

To the President and Members of The Hawaiian Sugar Planters' Association:

Gentlemen:—Owing to an extended absence from the islands and an unusual press of business since my return, I have been unable to write anything in the shape of a report on the subject of Forestry for presentation at this annual meeting of the Asso-

ciation. I have, however, had the pleasure of examining the very interesting reports submitted herewith by Messrs. Baldwin and Forbes, two other members of the Forestry Committee, and they have both treated this all-important question so thoroughly, that I do not see that I can add anything at present to their remarks. The ground has also been gone over by other committees, year after year, and I am sorry to say that but very little has been done in the way of systematic preservation and planting of forests, as a result of their recommendations. This fact is to be deplored, as success can only be insured by a systematic course being adopted and by the assistance of the government in providing us with "professional foresters," and also with a "Forest Police" to protect the forests from encroachment of cattle, &c., after planting has taken place.

Hoping that this very important matter will soon receive all the attention it deserves, I am

Your obedient servant,

W. M. GIFFARD,
Chairman Committee on Forestry.

W. M. GIFFARD, Esq.,

Chairman Committee on Forestry:

Dear Sir:—Valuable and interesting reports on forestry have, during the last few years, been presented to the Hawaiian Sugar Planters' Association—reports that have gone thoroughly into the subject and quoting at length from scientific authorities, have shown clearly the influence of forests on the flow of springs and streams, and also on the climate and rainfall of a country.

The influence of forests upon climate, and the value and necessity of preserving our forests must be so patent to all, that I will not go into an argument on this subject; but confine myself to a few practical thoughts drawn from my own observation and experience.

We do not need to argue the question, or present the views of scientists on the subject; for we have on the islands enough of proof, that where forests have been cut down or destroyed by cattle, the rainfall has diminished; and, on the other hand, where pains have been taken to preserve and increase the forests

and growth of vegetation in the district, the rainfall has increased. I am told that the district of Hamakua, Hawaii, where the forests above the plantations have been devastated and destroyed by the axe and by cattle, the rainfall has diminished in the last few years, in fact, that the climate there seems to have changed. It is said, that formerly they had more local showers than they now have, that the clouds would gather over the land and towards night the showers would drop; but this has changed, and most of the rain of the district is now, what is called "trade wind rain."

In the district of Makawao, Maui, during the past thirty years or more, the mountain forests have been gradually encroached upon by the axe and by live stock, and unquestionably the rainfall has been diminished. It is difficult to get at the exact diminution of the rainfall, as rain gauges were not generally in use thirty or forty years ago; but the testimony of the old residents goes to show that there must be less rain now than at that time. On the other hand, in Honolulu and vicinity, which is now a forest of trees and vegetation, where fifty years ago, there were but few trees and very little verdure, the evidence is that the local showers have very much increased.

In adopting plans and methods of forest culture, we should adopt such plans as can be carried out easily and with as little expense as possible. In my view, if this idea is not carried out, but little advance in forest culture will be made. Men do not like to put their money into investments that do not bring an immediate and sure return. Many cannot afford to do so, and if forests are to be produced by the planting and careful culture of each and every tree, but few forests will be planted. This I fear will be the practical result, no matter how much we may theorize on the subject.

In introducing trees from other countries for forest purposes, the value of the wood, and the general usefulness of the tree should not alone be considered; but pains should be taken to introduce such species, as readily spread themselves, and trees that bear seeds that can and will be spread and carried by the animals and birds.

The same rule should apply to the selection of trees for forest purposes now growing on the islands; and we have a number

of varieties of useful trees, introduced from other countries, that are easily propagated and are growing wild.

I consider the algeroba the most valuable and useful tree, ever introduced into this country, not only because it furnishes excellent fire-wood, and pods that are good feed for stock, but because it is so easily spread by animals, and grows so readily in dry and barren wastes, where scarcely anything else will grow.

The guava makes a good forest tree, where it is somewhat protected from the wind. It spreads readily, furnishes a fair quality of fire-wood, and is an excellent fertilizer of the soil. The species of guava, commonly known as strawberry guava, which was introduced here much later than the ordinary guava, and makes a finer and larger tree than the latter variety, I find is spreading in the forests at elevations below 2000 feet. This tree will make a good forest tree.

I have also found the mango growing wild, and spreading in a forest near the sea, in the Hana district on Maui.

If we would devote more of our efforts in forest culture to assist the propagation and spreading of trees throughout the country, that we now have, like the varieties mentioned above—trees that we know will propagate and spread themselves—the dry and waste regions will soon be covered with forests.

The Haiku and Paia Plantations lately purchased a large tract of forest land, on the slope of Haleakala above Makawao, and have fenced it up so as to shut out live stock. The lower part of this forest, consists principally of koa trees, that have during the past thirty years or more been cut off for fire-wood and lumber; but we have found that by running furrows here and there through the Hilo grass that covers the land, and by clearing off the grass around the old koa stumps with hoes, the koa seeds that have been in the ground under the grass, for twenty or thirty years, come up in the furrows we have made, and are doing well; and we expect to renew the forests again in this way.

Regions, where koa forests have been destroyed in other parts of the islands, can undoubtedly be renewed and restored in the same way, and quite possibly other forest trees as well. This is a very inexpensive, simple and easy method of renewing an old forest that has been devastated and destroyed, and I earnest-

ly recommend its adoption throughout the islands, where it is feasible to do so, by the Government and planters.

In connection with the forestry question, I cannot refrain from alluding to some of the shrubs and weeds that have been introduced and have been regarded as unqualified evils, but which have in my opinion rendered the country great service, by fertilizing the sterile and barren wastes on our low-lands, and by aiding the process of disintegration and decomposition in our rocky regions. Nearly all these pests such as indigo, lantana, kikania and oi, introduced during the last sixty years, grow and flourish on the low lands that are lacking in organic nitrogen, according to Dr. Maxwell and other chemists.

The indigo plant was introduced into this country in 1836, and at first it is said that a good quality of indigo was manufactured from it. It soon began to spread and grow in thick masses in the dry and barren regions on the islands. The rich lands of Waihee, Wailuku, Waikapu, the upper lands of Spreckelsville, and the Haiku Plantation and Paia Plantation lands were for thirty or forty years almost impenetrable, dense growths of indigo, often ten feet high, with a tap root longer than the stalk above ground. The indigo has pretty well run itself out—its day is past—but it has left rich land for the above named plantations from which six or seven tons of sugar per acre are obtained. At one time people felt disposed to execrate the name of the one who introduced the pest.

The kikania, a burr plant, was introduced in the early years, and spread rapidly and had full sway in dry regions. This has been one of our worst pests, but is nevertheless an excellent fertilizer of the soil. This plant has also run its day, except in certain localities.

The lantana, introduced as a garden flower in 1858, soon began to spread and grow everywhere, and take possession of even more dry and rocky regions than the indigo grew in. Whether the lantana will after a while run out, remains to be seen. I believe that following the history of other pests we have had that grew in thick luxuriance, it will in time run its course, and after rendering some of our aa flows, our barren flats, and such rocky barren hills as "Punchbowl" and "Diamond Head," somewhat fertile, will give way to more useful and ornamental vegetation.

Unquestionably the lantana and other pests, that have flourished here, have their place in the workings of nature, and they are important factors in aiding the decomposition and fertilizing of our soils. It is the ranchman of the country, who suffers most in consequence of these pests. They sorely vex and disturb his mind and temper, and diminish his gains. I am in the ranch business myself, and fully understand and appreciate their feelings relative to plant pests. But the ranchman must console himself with the thought that what is his loss may prove the farmer's gain.

H. P. BALDWIN.

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REPORT ON FORESTRY.

Hamakua, November 2d, 1896.

C. BOLTE, Esq., Secy H. S. P. A., Honolulu:

Dear Sir:—In submitting to you the following report on Forestry my remarks will be confined chiefly to the state of forest and means of improving, and that belt of country with which I am most intimately acquainted, viz: the northern coast of Hawaii from Hilo to Kohala. From time to time much has been debated and written on the dismantling of forest through the ravages of cattle along this belt, while it is much to be deplored that no active steps have been taken to finally arrest this wholesale devastation. The same state of affairs is equally applicable to other islands of the group, although to none more serious than the rich fertile districts of Hamakua and Kohala. Within the past few years these districts have suffered from a severe drought extending through a period of three years and although the rainfall of 1895-96 has been normal, it is noticed with regret, that the numerous mountain streams from Okala to Waipio show but the empty channels where water used to flow.

Does forest increase the rainfall is asked by some? To such my reply is, I believe its destruction will certainly lessen our rainfall, and refer them to French Journal of Forestry, 1885, where the experience of Rhanate, District of Bacharia, Central Asia, is graphically described. Thirty-five years ago this was

one of the most fertile districts in Asia. It was well wooded and splendidly watered. A mania seized the people for clearing forest, followed by civil war when the remaining forests were ravaged by fire. The consequences were not long in following, the country has been converted into an arid desert, all the water courses and irrigating channels having dried up.

It is proven beyond doubt, that forest trees exercise an influence in condensing the moisture of the atmosphere and in rendering a dry climate damp; as also the shading effect of trees in covering and conserving the water springs in forest lands. Another important benefit derived from trees which have been judiciously disposed, is the shelter afforded to lands suitable for improved agriculture and in amelioration of climate surrounding the same. Why delay and let the staple industry suffer when means of preservation are practicable. The ranchman as well as the planter wants to live; save both should be the policy of all, which can be done, only by preserving part of the forest becoming so quickly denuded.

In this belt of forest referred to, are large areas of land under Government control, some of which are leased for grazing purposes, others being broken up as homesteads for the cultivation of coffee, etc., while parts could yet be made available for preservation of forest, on the former two, the forest will soon be a thing of the past and we have left but the latter available for reservation. Planters in the districts mentioned, are in most cases alive to the damage which is sure to follow and willing to assist in prevention. Let the Government render its aid in setting apart these lands and willing hands will be near to build and maintain the protecting fences, which in a few years will amply repay the Government as well as the planter and ranchman.

A good example of what reservation will do, may be seen in a tract of several thousand acres, which is protected against cattle ravages by Pacific Sugar Mill, Kukuihaele. Twelve years ago the forest of this enclosure was but a collection of dead or dying trees, today it is a mass of coppice and seedlings growing up in a robust and healthy condition, wherever a vine or fern afford them shelter.

To gain a renewal of the forest it is thus seen, the first step

necessary is absolute protection from animals, so long as cattle roam at large it is impossible for vine or fern to survive. It will readily be seen by the close observer that those very ferns and vines are the first agents in natural reproduction setting in. So soon as a fern gets established the rough "Hilo grass" must succumb. Next we notice in a "sheltered nook" under the fern, or as the case often is on the stem of a "Ditoma or tree-fern," a young seedling of nature's sowing springs up, the origin of which has been carried by a bird, or wafted by the wind from a mature parent in the neighborhood and there deposited in the rich humus of decayed fern growth, where neither cattle or grass can disturb or retard its growth. In such a way is the work of natural regeneration carried on under the most favored circumstances: Under this process of natural regeneration, however, there are objections to offer, which the writer believes are worthy of notice. It is evident by the appearance of forests in this locality, even where no cattle disturb their growth, that the stunted indigenous stock has degenerated and required to be replaced by exotics of more robust growth, yielding a greater amount of more useful timber than does the present stock of established forests. The most useful timbers of indigenous trees are now rare. Hawaii, once famous for its export of wood, and rightly named the "sandal-wood islands" has no more claim on the title. The beautiful acacia roa is now quickly being exterminated and from appearances of the candle-nut tree and the limited altitude of its growth I fear it may soon be numbered amongst the natural beauties of the past.

To reforest these lands it is therefore necessary not to leave the work entirely to nature, but adopt the system of artificial reproduction and more particularly on these lands which have become entirely denuded. Before, however, such work is attempted the most important question of what to plant should be carefully studied or all attempts may end in bitter disappointment to the forester. Should the main object only be to increase the forest area, there will be little difficulty in selecting trees to accomplish this end, other features, however, should guide the planter; trees that will prove useful as a source of revenue when matured should be selected. Those which would supply the lumber now imported from abroad, trees valuable

for their acids, resin, gums, fibers, dye-wood, barks or edible fruits, etc. which are numerous in their nature and varieties. With a variety of climate like ours at the various altitudes, there is every opportunity offered to have a valuable class of timber grown to replace the now degenerating stock.

On altitudes ranging from 400 to 2000 feet, I will enumerate a few of the exotic varieties successfully grown here. The Australian casaurinia of course gives better satisfaction than any other as a wind-break and where planted singly, or in narrow belts, has from the construction of its long thin, wiry foliage, a power of resisting strong winds, which is possessed by few trees outside of the pine family. The casaurinia is also valuable when matured, as a timber suited for any purpose where a strong enduring wood is desired. I feel confident that for general use during its growth, etc. at maturity no better tree can be secured for planting on lower elevations. Borrowed, also from Australia, the *Grevillea Robusta*, eucalypti of sorts, and acacia of sorts do well at altitudes ranging from 400 to 2000 feet. *Grevillea R.* as a quick grower and producer of valuable timber is especially worthy of notice. The "camphor" tree of commerce grows luxuriantly on the lower altitudes and may in the future, where planted extensively, be looked to as a source of considerable revenue. Other varieties which grow well on lower altitudes here I find are the "Iak," sapan-wood, hog-wood, and *Ficus* so valuable for their gums, in variety. On the high altitudes there are a few varieties which I have seen grow well and doubt not where planted extensively will give entire satisfaction. Amongst those are the *cryptomeria* and cypress. The *cryptomeria Japonica* for rapidity of perpendicular growth and value of timber for general use, is in Japan excelled by none, such a valuable addition to our forests would certainly be worth having. Several of the cypress and *thuja* varieties, at 2000 feet elevation do exceedingly well and I doubt not that a few other of the conifer family if grown closely to suppress lateral growth would prove valuable additions to the existing forest.

The various methods of tree planting now in practice is unnecessary for me to outline, although I may remark that following the steps of a famous British tree planter and sow our trees from a cannon's mouth by explosives would not be applicable

to Hawaii. On the contrary at times, even with care, the planter is put to use all sorts of strategy to meet and overcome the swarms of insects that eat up seeds and dry weather to burn those plants just sent from the nursery. The forester who goes to work recklessly and is careless in exposing tender rootlets to a parching sun, or insufficient treading around newly planted trees need only wait for disappointment in store. A very common practice in tree planting on the islands I notice is deep planting, if from the belief that a small tree planted in a deep hole is better low down so as to be sheltered from the winds or otherwise I am uncertain, but it is a grave error to plant any tree deeper than it has originally been in the seed bed, and also to set the roots down in the poor and inferior soil as is often done.

It is encouraging to notice that within the past few years the Government have taken a more active interest in Forestry affairs than hitherto was done. While there has been considerable done towards creating an interest in forestry on the homesteads, etc., there yet remains much to complete, before the country's forests will be in an improving state. Through the energetic conservator of forests much has been learned as to what our climate and soils are possible of and it will be but a few years when his valuable introduction will have a telling effect. In concluding my brief report I can think of no better words than those of a classic writer in his humorous description of the "Auld Lairds" advice to his son: "Be ye aye sticking in a tree Jack, it will be growing when ye are sleeping."

Yours truly,

D. FORBES.

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THE COFFEE SITUATION.

The crop of 1896-97 is a demonstration of the extent to which a period of high prices has stimulated production. The area devoted to coffee has been rapidly extended in Brazil, in Central America, United States of Columbia, Venezuela and Mexico. Coffee-growing is a profitable industry when coffee sells in New York at prices considerably below a basis of 10 $\frac{3}{4}$ cents for No. 7 Rio. At the prices of the past five years planters have been receiving enormous profits.

It is apparent that we have entered a period of low cost. A decline has taken place of over 5 cents per pound in the cost

of Brazil sorts, and the question is whether this fall in the price has fully discounted a supply largely in excess of the world's requirements. The answer will be found in the estimated outturn of the 1897-98 crop. If that is up to or above the average supply, then there is a chance for lower prices. If the next crop is to be light in Brazil, it would seem as if the present basis was near bottom.

Messrs. W. H. Crossman & Brother are very close students of the coffee markets of the world, and show their faith by their works, and generally take the public into their confidence by issuing a circular giving their views. This they have again done under date of October 23, estimating an enormous crop in Brazil for 1896-97, viz., a total export of not less than 8,000,000 bags. This is a total far beyond the yearly average for seven years, ending June 30, 1896, of 5,657,286 bags (332,781 tons). In 1891-92 Brazil exported 7,267,000 bags, and it is certainly not unreasonable to estimate that the exports from the largest yield on record should exceed the shipments of 1891-92 to the extent of 733,000 bags. Brazil has furnished 54 per cent. of the world's supply. On that basis the crops of 1896-97 will aggregate 14,814,800 bags, based on a minimum Brazil yield of 8,000,000 and 6,000,000 for other countries, or about 500,000 bags above the average crops of the past three years.

The total deliveries in Europe and the United States for five crop years ending June 30, 1896, were 54,677,976 bags, or a yearly average of 10,935,595 bags.

Hard times curtail the use of coffee, especially if prices rule high. There has been no increase in the deliveries of coffee worthy of note since the advent of high prices, as the following table of deliveries in Europe and the United States shows:

Year.	Bags.
1895-96	11,142,813
1894-95	11,212,851
1893-94	10,571,533
1892-93	10,946,228
1891-92	10,804,551
Total five years	54,677,976
Yearly average (643,270 tons)	10,935,595

The above shows the steady nature of the world's requirements, which is subject to other than crop influences. Hard times and high cost cut down the demand. With a return to prosperity, the United States should increase its consumption of coffee at least 400,000 bags. Last year the deliveries fell below 1894-95 here and in Europe, but to slight extent. This shows

the fairness of Crossman & Co's estimate of requirements, viz., 11,500,000 bags, to meet which there is an estimated supply of 14,000,000 bags. Has a 5-cent drop discounted this big yield? Crossman & Co. claim not, and evidently look forward to coffee on a basis of 7 cents for No. 7 Rio in New York, based on former experience with a visible supply of 5,000,000 bags. The outlook for the 1897-98 crop is favorable for a full average yield. If it should duplicate the supply of 1896-97, we cannot see how it can fail to foster and maintain an era of cheap coffee. There is certainly no basis in sight upon which to carry forward a bull campaign. We have arrived at a time when it is fairly safe to carry liberal stocks, and the lower prices go the safer the operation of buying freely. Based on the actual movement of coffee, the Crossman & Co. circular is a conservative presentation of the situation.—American Grocer, Nov. 1.

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SUCROSE YIELDS PER TON OF CANE.

Each year when the campaign begins and progresses, there are ever varying, and often on the same estate marked discrepancies in the amounts of available sugar per ton of cane, and in consequence, even with the most efficient plants in charge of experts, aided by competent employees, to constantly reduce losses to a minimum in the processes of manufacture is extremely difficult, and requires constant, vigilant surveillance from the cane carrier to and beyond the centrifugals. In conjunction with the potent and complex meteorological influences, agricultural, chemical and mechanical factors each play an important part in the ultimate output of sugar per ton of cane. The chemical control may be all that could be desired with the present knowledge of the subject, and the machinery of the best; yet large yields can only be had by a combination of favorable influences in the fields, some beyond the ken and control of man, and others where he can display both judgment and intelligence.

The marked discrepancies in yields, due to causes other than purely climatic are such as to demand careful investigation, as the future prosperity of localities may largely depend on the possibilities of increasing the annual output per ton of cane from less than . . per cent. to at least 9 per cent. of commercial sugar.

Where the output per ton of cane from year to year varies from twenty to thirty pounds in different sections not far removed, and where the manufacturing plants are similar in crushing power, etc., the cause is agricultural, and in consequence in some measure chemical. Virgin soils, and those formed by crevasses of somewhat recent date, are proverbial for producing

excess of nitrogenous compounds, and a porosity such that prolonged growth will retard the ripening influences which would mature canes were the physical and chemical conditions of the soil different. Two properties may be located on the same stream at some little distance the one from the other (each under the general management of the same proprietor), the one which has been long under cultivation having the major portion of the soil of a very tenacious character; the other a sandy deposit, the result of a crevasse within a quarter of a century. From year to year the yield of sugar per ton of cane is always larger on the former estate than the latter, and there is a smaller average tonnage per acre, although at times the discrepancy is not very marked, notably when the season is favorable for the cultivation of the black soils.

What are the possible causes of the annual low sucrose content of the canes grown on the estate where the sandy soil preponderates, and what may at least partially remedy the defects? To some it may be deemed rank heresy to entertain the idea, yet, may not too deep ploughing, if persisted in at all times, be one of the causes of the want of maturity in the canes grown on porous, sandy soils? Shallower cultivation is certainly worthy of more than a casual trial, as careful tests alone can establish facts in agriculture.

Canes on new lands are laid by early to allow the earth to become compacted to obviate an excessive root development and ramification, and shallower ploughing will have the same tendency on older but very friable soils. In well drained, porous soils canes can be planted lower and given less hill than where the lands are tenacious and liable to become surcharged with moisture during the rainy season. Where the conditions are very favorable the action of the soil ferments may be too prolonged, and the canes kept green in consequence; therefore a shallower tillage and earlier laying by, although resulting in a slightly decreased tonnage, will enhance the chances of a larger sucrose yield per ton of cane.

As excessive leaf development tends to retard maturity, through the instrumentality of the dense shade, planting three rows of cane and three rows of corn on a given area of property will permit of the ripening influences of sunlight, and a free circulation of air, such that a portion of the ratoon and plant cane acreage will mature earlier and more effectively than if all the plantations are solid.

Where there is an annual tendency to unripeness in the canes the composition of the manures applied to the fields may prove of much greater moment than is generally conceded. All spring applications should be in a fine state of division, regardless of the

constituents; for plant canes they may be applied in the drills and the ratoons fertilized as early as circumstances will permit, to give as long a time as possible for the necessary decomposition of the elements for plant food, if in the form of cotton seed meal or tankage. Where the pea vines are removed for provender, tankage can be distributed and ploughed under in the fall, giving ample time for the transformation of the ingredients, such that they will materially hasten germination, promote early and rapid growth of roots and consequent development of stalk, each so essential to early laying by of the crop. Possibly to secure the best results but a limited amount of fertilizer should be applied where slow chemical action must take place before the elements become available to promote plant growth. Better far apply the same money value of nitrate of soda as would be expended for nitrogenous manures, either animal or vegetable, in conjunction with soluble phosphoric acid, to be more than compensated for in the increased maturity of the canes and the decrease in the length of the unripe tops. Canes thus treated will make more rapid development in June, July and August under average conditions, and if not applied in too large quantities the nitrates will become exhausted by the first or middle of September, thereby forcing the canes to a maturity not to be attained where nitrogen in a potential form has been used as a soil renovator. Numerous tests have proved that soluble phosphates tend to hasten maturity in plants when there is not an undue proportion of nitrogen in the soil, and it has been found by actual experiments that canes adequately fertilized with chemicals yield nearly two-fold tonnage over and above those grown on unmanured fields during prolonged dry summers with little or no increase in the sucrose content.

The chemical transformations which are at all times more or less active in the soil, whether fertilized or not (except during periods of low temperature), notably affect the sucrose content of the canes, and the results are witnessed in the factories during the process of manufacture, particularly when boiling second and third sugars. If the nitrogen in its various forms largely preponderates over the available mineral constituents of the soil, the ratio of sucrose to total solids will be disastrously low, and the proportion of molasses to sugar will be in excess, materially adding to the cost of manufacture. The chemist, by careful clarification, may free the juice of certain impurities; yet the amides, etc., will remain in such quantity as to render impossible the crystallization of a noted percentage of sugar in the complex solution. Until the chemistry of cane juice is better understood, and its clarification brought to greater perfection, the only known, at least partial, remedy is to cut the canes lower and leave more of the immature top joints in the field. Regardless

of the prejudices of the past, the chemist, as his knowledge of its requirements becomes more comprehensive, will find his presence in the factory will be better appreciated and his services recognized as all the more indispensable.

Contrary to the expectations of many who viewed the subject from a somewhat theoretic rather than purely economic standpoint, the general trend of opinion is in favor of compound crushing rather than diffusion plants to extract the juice from tropical canes. It is a delusion to imagine that the possession of even a powerful, well constructed compound milling plant will insure a high juice extraction. Very careful adjustments are as essential as strength and capacity; without them pounds of sugar per ton of cane will be consumed in the furnaces instead of reaching the centrifugals, their proper destination. If the machinery is not in line and the mill rolls carefully adjusted for the quantity of cane to be crushed per hour, and the feed is irregular from whatever cause, there will be a noted loss of sucrose per ton where the output per day is large, which may aggregate perhaps hundreds of thousands of pounds during the entire campaign. Many devices are being experimented with to lessen the cost of feeding the canes on to the carrier; but appliances to insure the utmost regularity (so important to secure superior results) are generally ignored—due, perhaps, in a measure to the false impressions that shredders and crushers correct the evil, although they counteract it to some extent.

In India, where the motive power is oxen, 70 per cent. extraction and over is had with the small outfits, and yet even with compound steam crushing plants but little more is had in some instances, because they are fed beyond their capacity, and loss of juice results or there are serious breakages. That small mills with the necessary strength for a limited feed can do excellent work can not be gainsaid—in fact rollers $2\frac{1}{2}$ feet long and 2 feet in diameter can probably do better work than 34-inch rolls 6 feet long, if each is fed in proportion to capacity. The problem of high sucrose yields per ton of cane is first agricultural, then mechanical and technical, and where the plants are accurately proportioned for the necessary daily output, with relatively small plants results equal to those to be had from massive outfits can be assured.

The volume of output per ton of cane will in the future become more intimately connected with the quality of work performed in field and factory in its production than in the past, as excellence in all that pertains to the cane sugar industry becomes more widely appreciated, as an essential to success financially.—Louisiana Planter.

THOS. MANN CAGE.