THE

PLANTERS' MONTHLY,

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Sugar has again dropped in price, and was quoted in New York, January 14th, at $5.56 for Cuban centrifugals of 96 deg. test.

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Bound copies of Volume VIII., of the PLANTERS' MONTHLY for 1889, and also for 1887 and 88, can be obtained by application to the editor. Price $3.50 each bound volume.

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We have received a set of the printed blanks used in the Calumet sugar mill and plantation work. These forms appear to be an improvement on those in use here, and those requiring new forms will do well to examine these before having the old styles re-printed.

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The new diffusion works of Haiku mill started up on the 8th inst., and were working satisfactorily until an accident occurred by the breaking of the cast iron band which surrounds the base of one of the diffusers. This has caused a temporary delay, which will be repaired, and the works will be in operation again early next month.

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As was anticipated, the grinding season at these islands did not fairly commence till about the first of January; and even now, owing to the stormy weather prevailing throughout the group, comparatively little sugar has been shipped. The crops are good, and if nothing untoward happens, the yield for 1890 will amount to about the same as for the previous year. During the few months past nearly every mill has had im-

provements made, and new machinery erected, which will add greatly to the efficiency of the work to be done. Probably more sugar per ton of cane will be extracted this year, and at less cost, than has been done in any previous season.

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During the idle months of mill work, Mr. J. S. O'Dowda, sugar boiler of the Waiakea mill, visited Louisiana, to examine into the methods practiced in the best mills there, and also to perfect himself as a chemist. Fortunately he obtained access to the laboratory of Prof. Stubbs, of the U. S. Government service, who permitted him to study and take part in all the experiments made there, and in this way to gather recent practical chemical information, obtainable in no other way so accurately, and which every sugar boiler should possess. The knowledge gathered during his absence ought to be valuable to the establishment in which he is employed, and which already stands at the head of our more successful sugar estates.

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Congress has taken no action as yet on the sugar duty. It is, however, quite probable that some reduction will be recommended, as has been proposed at the last two sessions of Congress. There are many difficulties in the way, the chief of which is the growing beet sugar industry, which needs Government aid in some form. Without such aid, it would never have prospered in Europe, and without aid in the shape of duty or bounty, it will never prosper in America. To begin now and pay a bounty in lieu of duty will create much opposition and jealousy from other industries, which need bounties as much as beets do. For this reason, the probabilities are that the final verdict of Congress will be, that it is better to retain the duty than to attempt to introduce a new policy into the Government, which will only create a bad precedent. The abolition of the tax on tobacco will be vastly more popular with all classes than any change would be in that on sugar.

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CANE CUTTING. HOW SHOULD CANE BE TOPPED?

The *Louisiana Planter* publishes the following, which deserves the attention of cane cultivators:

"On page twenty-two of Mr. Spencer's Magnolia report for 1885 (Bulletin II., United States Department of Agriculture), there occurs a calculation which possesses peculiar value at this time. He there shows how an average possible loss per acre of between $8.50 and $9.00 may be incurred by improperly topping, so as to leave one pink joint from each cane in the field. Correct cutting divides the cane through the node which separates the last pink from the first white joint. When the color

is in doubt the joint is to be considered white. Dr. Stubbs, in his Bulletin ten, page six, very strongly condemns, however, the practice which permits any portion of the upper white part of the cane to reach the sugar-house. Mr. Wibray Thompson, who examined carefully into this subject, at Calumet, last grinding, stated in the *Item* of January 21st, 1889, that the available sugar in juice from these white joints is a negative quantity, calculated to restrain from crystallizing an equivalent of sugar in the juice derived from other portions of the plant with which it becomes mixed. He actually found the percentage of available sugar contained in the fluid expressed from their adhering leaf-sheaths equal to that in the juice of these joints themselves. He carried his investigations also to the bottom joints. Basing calculation upon the Calumet tonnage, and butt analyses of that season, and the eighty per cent extraction its mill was at the time yielding, he established the average gross money loss per acre due to the loss of two and a-half inches from the lower end of each cane, at $16.90. Show this to your overseer and watch your knives personally!"

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WITH OUR READERS.

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With this issue a new volume of the MONTHLY commences, and we again urge every person connected with the sugar industry as well as with other branches of agriculture, to subscribe for it. It supplies its readers during each year with 576 pages of the most valuable and recent information that is published relative to cane, sugar and agricultural matters generally. We possess rare opportunities for gleaning from the best sources, information of practical value to our planters and farmers, which can be found nowhere else, and those who read the MONTHLY may rely on getting the latest and the best.

The full report of experiments at Calumet Sugar Plantation, Louisiana, commencing on page 9, is taken from the U. S. Government Bulletin No. 23. It forms one of the most valuable publications relative to the details of manufacturing cane sugar that have been given to the public. The Calumet factory is the property of Mr. D. Thompson, and is considered the most complete establishment of the kind in America. On account of this perfection, the details given will interest every sugar boiler and planter, and serve as a comparison with similar work on these islands. Mr. Wibray J. Thompson, son of the proprietor, enjoys the enviable reputation of being the most accomplished and successful sugar-house manager in the United States, and is probably doing more to advance and perfect the manufacture of cane sugar in Louisiana than any other man, and we trust he will make it convenient, in the near future, to visit our islands and examine Hawaiian mills

and plantations, among which he could surely gather some new ideas to add to his present large stock of valuable experience.

We have been obliged to omit some of the tables accompanying this report, but any one desirous of studying the subject more fully, will be furnished with the original pamphlet.

The article following the above, on page 27, on "Methods of Sugar Analysis, and Instructions for the Guidance of Sugar Chemists," will be useful to all who are making a study of the chemical analysis of sugar. In Louisiana every central factory and large mill has a chemist, whose duty it is to superintend and watch the various processes in the manufacture of sugar and molasses. Too little attention is paid to this branch of the business here, but the experience of other countries shows that the extra cost of a chemist is more than covered by the gain derived from the knowledge of a competent chemist.

From the Government Bulletin, published in Jamaica, we copy a letter, page 38, showing what is being done towards improving the sugarcane by cultivating seedlings, obtained mostly from the Barbados Botanical Gardens.

A new diffusion plant has been erected in New South Wales, which has been successfully operated. An account of its working, with some details not always given in such work, will be found on page 44.

A proclamation issued by the Governor of Jamaica against the importation of sugarcanes from Java and other infected countries, will be found on page 48.

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RAINFALL 1889.

Months.	Honolulu, Oahu.	Hamakuapoko, Maui.	Reciprocity, Maui.
January	1.40	1.85	
February	.54	2.50	
March	.60	.75	1.50
April	2.62	2.90	3.81
May	1.89	1.55	3.78
June	1.71	.50	3.
July	1.72	1.90	5.26
August	1.81	1.20	5.24
September	1.91	.70	4.12
October	1.32	.82	3.72
November	1.73	1.50	3.52
December	7.58	5.70	4.08
	24.83	21.87	38.03*

* For ten months.

The above data have been supplied by Mr. W. W. Hall, for this city, by Mr. W. Goodale, for Hamakuapoko, and by Mr. P. N. Rooney, for Reciprocity. We shall be glad to receive any rain records for other districts in the group, for the year 1889, and also previous years, if obtainable.

LETTER OF INQUIRY FROM FRANCE.

(TRANSLATION.)

PARIS, October 26th, 1889.

EDITOR PLANTERS' MONTHLY:

Dear Sir :—I beg to thank you for the very interesting numbers of the PLANTERS' MONTHLY forwarded by you. I have read with pleasure the two last numbers, particularly relating the account furnished by Mr. Williams of the "diffusion process" at Kealia, which I shall shortly have translated and inserted in the *Journal des Fabricants de Sucre.* If I am not mistaken the returns of saleable sugar obtained at Kealea exceed fourteen per cent of the weight of the cane. This is an enormous return, and one which it will not be easy to obtain from beet-root.

From this point of view allow me to ask one question:

In Europe, beet-root is purchased at twenty, twenty-five or thirty-five francs the ton, according to the country producing it, Germany being the country where the price is lowest, and France that in which it is highest. To obtain from ten to twelve and one-half per cent of raw sugar from beet-root, it is necessary to make a further expenditure of from fifteen to eighteen francs a ton, total expenditure being—in Germany, for example, twenty francs and fifteen francs equal thirty-five francs.

The question I wish to ask is the following: How much do you pay, in your country, for a ton of cane, and what further expenditure must be made to obtain from this cane 140 kilogrammes of sugar (fourteen per cent) using the diffusion process.

This question is interesting in comparing the relative prices of cane sugar and beet sugar, and if not asking too much, I shall be much obliged if you will answer it. On my side, I shall be pleased to furnish you with any information in my power that you may wish to receive.

I remain, my dear Sir, yours, etc.

GEORGE DUREAU.

REMARKS:—The above letter is from one of the editors of the *Journal des Fabricants de Sucre*, of Paris, who asks questions which it is difficult to answer, as the sale of cane by the ton to the mill before it is ground is rarely if ever done here. Still, some of our planters may be able to give him some information that he seeks, by furnishing statistics of the cost of cane, But the cost varies so largely on different estates and with different surroundings that, unless an average is struck, any estimates of cost that may be given will be misleading.—ED. PLANTER.

A VISIT TO LOUISIANA AND TEXAS.

A description of the Louisiana and Texas sugar districts during the grinding season of 1889, by one acquainted with the *modus operandi* in the Hawaiian Islands, will undoubtedly be of interest to the readers of the PLANTERS' MONTHLY.

Louisiana produces about one-tenth of the total sugar consumed in the United States, averaging 140,000 tons per year. This is done comparatively under the most trying circumstances, crops are planted and taken off in most cases between the months of March and middle of December, to escape the severe frost, the cane having only about nine months' growth. Juice will stand from seven to nine degrees Beaume, and the maximum yield in a favorable year will not exceed 5,000 pounds per acre, and the average from 2,000 to 3,000 pounds. Under such conditions, it is evident that the most careful management, both in the field and sugar-house is absolutely necessary. The first thing that strikes the visitor's eye in Louisiana is the great number of sugar-houses or mills to be seen, these are relics of the *ante-bellum* times, and upon investigation will usually consist of a three-roll mill, clarifiers and evaporators, for making syrup. Of late years central refineries have been erected, and the small plants within a radius of two to four miles, will be found connected with the same by means of pipe lines, the juice being first reduced to syrup and then pumped to the refinery, where it is made into the different grades of sugar for the market. However, with the advent of more powerful mills and diffusion, the small planter finds it more profitable to sell his cane to the sugar-houses fitted with the more modern apparatus, and the casual observer passing through the sugar districts, and observing the forlorn appearance of the sugar-houses on many plantations, is inclined to the opinion that the sugar industry of Louisiana is not in the most prosperous condition. On closer investigation, however, it is found that these old mills have simply outlived their usefulness, and have fallen into the category of "the survival of the fittest."

The roller system of juice extraction can be seen here of the most powerful description, rolls of all diameters up to forty inches, and in lengths up to seven feet, the shafts having journals sixteen and one-half inches diameter by twenty inches long, with engines and gearing in proportion. In one case, two two-roll mills are used with rolls forty-eight inches diameter by seventy-eight inches long. At Calumet plantation two three-roll and one two-roll mills are seen. At Evan Hall the double effect has 5,000 feet of surface with nine feet six-inch pans, the vacuum pan being eleven feet diameter and will make a strike of nineteen tons of sugar in six hours with

steam of ten pounds pressure. The shredder is also used here very extensively, with good effect. Many of the sugar-houses are fitted up in the most elaborate manner, and the work carefully systematized. They run continuously, night and day, until the crop is off. All cane is weighed and juice measured, in some cases actually weighed. The chemist controls all the work in the house, and the losses in manufacture do not exceed five and one-half to six per cent of the sugar expressed from the cane. The extraction, in the best mills, will average for the whole crop, without saturation, eighty-two per cent of the total juice, and with saturation between the mills equal to a dilution of fifteen per cent, the extraction is raised to eighty-eight per cent. This brings us to

DIFFUSION.

Diffusion was first introduced in Louisiana in 1873–74, the plant was built in Austria, by Julius Robert, the inventor, and was practically a failure, as it took four to six men half an hour to empty a cell. New batteries and cutters were built by Leeds & Co., of New Orleans, with a decided improvement, as a cell could be filled in thirteen minutes and discharged in from four to six minutes. This apparatus also proved a failure, and diffusion was not proclaimed a success until Dr. Wiley erected the Government apparatus at Magnolia. The plant was built by the Colwell Iron Works of New York, and consists of fourteen cells arranged in a circle. The cane slicers were supplied by the Sangerhausen Co., and consisted of horizontal discs six feet in diameter, each having twelve knives. These, however, have been discarded, on account of the amount of labor required for feeding, and the knives choking with fibre and cane leaves, as the cane is not stripped until it is cut, and a considerable amount of leaves get to the slicing machines on the cane. The batteries and slicing machinery recently erected possess many improvements over the original Magnolia plant, the bottom doors of the cells are opened and closed by hydraulic cylinders, and the doors are latched from the upper platform, this does away with the disagreable work below. In some cases the cells are fitted with a steam jacket, in conjunction with the heater, for getting a quick heat, when clarifying in the cells.

The cane slicing machinery is what is known as the Hughes system, and consists of a Ross cutter, which slices the cane into pieces one-half inch in length, it then passes into the comminutor, which consists of a small cylinder, from nine to twelve inches diameter and three to four feet in length with knives around the circumference, which prepares the cane for the battery. The Ross cutter is constructed on the same principle as the ordinary feed cutter, and requires comparatively

no attention, as it is self-feeding and one man at each machine is all that is required.

The discharged chips from the cells contain from .2 to .5 of one per cent sugar, and after passing through the mills are burned very satisfactorily by means of some additional wood and forced draught. In regard to their value as fuel Governor Warmouth states he had sold his mills at the first opportunity as the chips were not worth the trouble and expense of grinding, when coal could be had at $4.50 per ton, and the chips easily disposed of, as at Magnolia, by dumping into the Mississippi river.

At the Des Lignes sugar-house, with a battery of 400 tons capacity per twenty-four hours, they were about to make some experiments in regard to the evaporative efficiency of the chips, as they are burned under independent boilers. Whether or not the chips are of any economic value as fuel is of no special concern to the Louisiana planter at present, and it is only a question of the most feasible way to dispose of them.

DIFFUSION WORK.

In regard to the work done with diffusion in Louisiana, the average of last season's run at Magnolia showed an extraction of ninety-five per cent of the total sucrose, with a dilution of twenty-eight per cent on the normal or original juice in the cane, which was equal to an additional evaporation over double crushing without saturation of fifty-six per cent. While diffusion in turn gives us fifteen per cent additional sugar, or double that gained by saturation between the mills, which amounts to seven and one-half per cent.

The coal consumption with diffusion under the above conditions was 1.8 pounds per pound of sugar. This season it is expected not to exceed 1.2 pounds. The chips, as mentioned before, are not used as fuel and the average density of the cane juice nine degrees Beaume.

There is still room for a vast improvement in the evaporating apparatus, both in Louisiana and the Hawaiian Islands. At the Watsonville beet sugar factory with a daily output of forty to forty-five tons of sugar, the coal consumption ranges from one-half pound at the commencement of the season, to three-fourths pound of coal per pound of sugar at the end. The juice is of about the same composition as the cane juices in these islands.

All vacuum pans, clarifiers and evaporating apparatus and all heaters in diffusion batteries should be arranged to work with steam of about ten pounds pressure, this steam to be taken from a single effect and to operate directly from the main boiler. This system has effected a great saving of fuel in the modern beet sugar factory.

JOHN DYER.

REPORT OF CALUMET SUGAR FACTORY, LOUISIANA. CAMPAIGN 1888–89.

(From U. S. Bulletin, No. 23.)

This factory is located on the immediate bank of the Bayou Teche, four and one-fourth miles above the post-office town of Patterson, parish St. Mary, La., and has therefore an unlimited supply of water, well adapted to every sugar factory purpose. It is the result of additions and extensions made to an establishment began before but left in ruins by the war.

THE PLANT.

Its plant consists of: (1) Five-roller mill; (2) bagasse burner of the so-called Taylor type, the boiler setting being the invention of Mr. Lewis S. Clark, proprietor of the neghboring Lagonda factory; (3) eight copper clarifiers, with a capacity of 1,306.3 gallons each; (4) five Kroog filter-presses, manufactured by the Sangerhausen Machine Company, Germany, of 220 square feet filtering area each; (5) vertical double effect of 2,000 square feet heating surface per pan; (6) eight-foot vaccum pan, affording 337 square feet heating surface, operated at fifteen pounds, average steam pressure; (7) seven Weston centrifugals, divided into one battery of four for first sugars and one of three for wagon sugars; together with appropriate pumps, sugar-packers, electric lighting apparatus, machine shop, and their appurtenances.

THE BOILERS.

In addition to the three boilers fired exclusively by bagasse are two batteries, both arranged for coal, nominally of about equivalent horse power with one another and with the bagasse battery: (1) Four double flue boilers, twenty-six feet long forty-two inches diameter; flues fifteen and three-fourths inches diameter; (2) two seventeen-flue boilers, twenty-two feet long, fifty-four inches diameter; flues six inches diameter. Of these one battery only is operated at one time, alternation every second week permitting their maintenance in superior condition. Average coal consumed per ton of cane and per 1,000 pounds of commercial sugar during each of the last three campaigns has been as follows:

	1886–87.	1887–88.	1888–89.
Average coal per ton of cane, pounds	105.4	117.8	130.41
Average coal per thousand pounds of sugar, pounds	653.0	665.5	630.48

The three years' average per 1,000 pounds of sugar is believed to be the most satisfactory ever recorded for Louisiana. Steam is maintained for the wagon-room until the drying of any thirds is completed which may have been boiled, this in 1887–88 being only on May 17. No thirds were made in 1886–87. The coal, as stated, is for all purposes, including washing of

house, preliminary trials of machinery, warming of sleeping and other apartments, electric lighting, etc., and is all actually weighed. No hot water being allowed to escape from the establishment, the boilers are supplied almost entirely with hot distilled water. The small quantity required aside from this return is first filtered by a Hyatt apparatus.

THE MILLS.

The mills are operated by a single, adjustable cut-off engine, cylinder twenty-four inches diameter by forty-eight inches stroke. This is provided with Corliss valves and the Joy expansion gear. The cut-off being ordinarily accomplished only at forty-two inches, the engine is practically controlled by the wire-drawing of its governor, a practice rendered permissible by the use of its exhaust, under about four pounds average pressure, in juice concentration by double effect. An average of forty-three revolutions of the engine is maintained, under ninety-five pounds initial steam pressure. For every 100 revolutions of the engine the first or three-roller mill accomplishes 5.142 and the back or two-roller mill 4.210 revolutions. The principal dimensions of the two mills are given below:

	Length of rolls between collars.	Diameter of rolls.	Diameter of shalves.	Length of journals.	Diameter of journals.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Three-roller mill	59.50	29.50	12	12	11
Two-roller mill	66.00	40.00	18	20	16½

Both mills are heavily double geared with steel pinions and crown wheels throughout, neither being provided with hydraulic or other safety or pressure regulating attachments. The back mill is driven by its lower roll shaft, and is provided with a roughening device believed to possess much merit. The mills are separated fifteen feet between centers. Saturation between them was first introduced this season, beginning about the middle of its third run. This will find full discussion later.

This apparatus is operated upon a plan quite unlike that customary in the milling of cane in Louisiana in that the feed upon the carriers is maintained as uniform at all times as possible, variations in the amount of cane consumed being regulated to that received from the fields as nearly as practicable by altering the speed of the engine, the governer to which is provided with a speeding device. The speed of the centrifugals is likewise regulated to the necessaries of the sugar being dried. The otherwise constant necessity for a change of the mill's "set" is thus obviated, insuring a uniformity of expression and a reduction of time lost to be better secured only, it is believed, by the hydraulic pressure regulator. The average

juice extraction of this mill for a series of years, expressed in per cents of the canes' weight, has been :

	1885-86.	1886-87.	1887-88.	1888-89.
Extraction of 5-roll mill juice (per cent of cane)...	76.30	73.90	74.60	72.45

That of the three-roll mill prior to the erection of the supplemental rolls, the same engineer remaining in charge throughout, was :

	1881-82.	1882-83.	1883-84.	1884-85.
Extraction of 3-roll mill juice (per cent of cane)...	64.70	(*)	69.84	65.03

* Inundated ; no crop.

This indicates an average advantage, by campaigns of 7.58 per cent juice on the canes' weight to the credit of the supplemental mill, in which no account is taken of the variations in the character of the canes or the quantity of these treated per hour, which remain much more constant in Louisiana than upon more tropical estates.

MINOR CONVENIENCES.

The minor conveniences of the establishment are as perfect as they are unusual, and are mentioned as contributing largely to the excellence of results attained by it, and as worthy of imitation. Twenty-four syrup and molasses tanks and blow-ups, uniformly of 3,500 gallons capacity each, and 300 sugar-wagons, together with the entire plan and plant of the house, offer exceptionally favorable opportunities both to excellence of industrial work and of mechanical and chemical control. Strict uniformity of dimensions and patterns is adhered to wherever practicable in all duplications of tanks, wagons, pumps, centrifugals, or other parts. Two hot rooms permit string sugars to be treated at discretion by such temperatures as are thought best adapted to their various needs. Gas and water, with appropriate drains, are everywhere conveniently located. The circulating pumps and oilers operate automatically. No washouts exist for the loss of juices, scums or syrups. The sugar elevators, storage bins and packing arrangements are particularly well designed and executed. All but minor steam pipes, live and exhaust, are felted, and all steam outlets are trapped. The pumping plant is so reliable as to have caused no loss of time to the establishment since 1883. Speaking-tubes connect various parts of the building, which last is well illuminated by day and night. Utility, convenience in arrangement, permanence and consideration for the possible demands of the future, are evident throughout the factory.

ORGANIZATION AND ADMINISTRATION.

The organization of the establishment is probably the most complete in Louisiana, and its administration probably the most efficient, though possibly the most expensive. Besides an engineering department, with its chief, there are recognized

the following distinct branches, each with its appropriate foreman or chief, viz: defecating and filter-press, boiling, centrifugal, packing-floor, clerical and chemical. The foremen are chosen with reference to their especial skill in the various operations which they are to supervise, having been in the employ of the house ranging from four to eight years, are paid exceptional salaries, are expected to perform no part of the ordinary manual labor of their divisions, have no authority outside their own well defined precincts, live in the buildings subject to call at all hours, and are under the sole direction of the factory superintendent, who, in turn, is alone responsible to the proprietor. All other operatives are subject to the orders of the various foremen in whose departments they work, the latter having the power to discharge. The foremen report regularly the number of men employed, the amount and character of work performed, and such other matters as are desirable, either upon printed forms or blackboards, or otherwise, at the factory office daily.

Temporary instructions are generally posted upon bulletin boards in the various departments, instead of being orally given, to avoid misunderstanding. The work is for the most part done by six and twelve hour watches or shifts, instead of by the eighteen hour Louisiana system.

The fields manager and factory superintendent meet daily to co-ordinate and arrange the work of their respective branches, as far as possible, each to the best advantage of the other. To this system, worthy a larger institution, and to cleanliness, another considerable part of the establishment's past industrial success is no doubt due, the introduction of which elsewhere is the more to be recommended that it involves no additional outlay of capital.

PROCESSES PURSUED.

The raw juices from the two mills, passing through paraffined wooden gutters, where they mix at once, enter a sulphur saturation machine placed as close to the crushers as convenient. This machine, of the paddle-wheel type, is described in Bulletin No. 3, page 99, of this Department, and, except for the excessive amount of power required to actuate it, seems highly satisfactory. The sulphurous gas is produced by the burning of sulphur in a small iron furnace kept surrounded and cool by running water. The fumes first pass through lead pipes, also submerged in constantly changing water which effects their thorough cooling, then over a considerable surface of running water intended to wash them free of H_2SO_4. They enter the juice cool and practically free of the latter. A considerable quantity of this probably formed between the water bath and the saturation box, is trapped off at the entrance to the last.

The draught necessary to a combustion of the sulphur is fur-

nished by the movement of the paddle-wheel, and the furnace on which the combustion takes place is so constructed as to prevent, so far as practicable, the passage of any uncombined oxygen through the apparatus. Care is exercised to prevent the admission of air at any other point than through the furnace, as a safeguard against the subsequent production of sulphuric acid. A device to free the juice of its contained air also, before sulphurization, is proposed for next season, but seems little necessary.

The juice, entirely altered in appearance by this treatment, is then pumped at once into the defecators, upon the third floor. Bronze pump barrels and copper conduits are alone used for juice, skimmings and syrups.

The coils of a defecator being covered, steam is immediately admitted to these, and the addition of lime begun at once. By the time the defecator is filled, the liming is complete, the juice heated, and skimming begun. No boiling in the defecator is permitted. The skimming having been completed, subsidence goes on for from one-half to one hour before the decantation of the clear, defecated juice. About two inches of juice are removed from the surface of each defecator by the skimming and brushing, and about eight inches of settlings are left behind in the bottom of each thirty-five inches, approximately, being, therefore, decanted. The decanted juice goes immediately to the double-effect, no further settling being permitted. Skimmings and settlings are run to an appropriate receiver on the floor below, are limed and re-heated whenever this is thought necessary, and are pumped immediately through the filter-presses. The defecators are thoroughly washed with a water-hose and broom, the wash-water also going to the presses in the absence of washouts and a scum ditch. The filtered liquors join the juice from which derived in the double-effect's receiver, and are concentrated to syrup without delay. The rapidity and cleanliness with which these operations are performed probably account for the almost total absence of inversion, attributable to a use of sulphur, between raw juice and syrup, and for the absence of fermentation in the juice department. The work of the filter-presses received no attention from the laboratory this season.

Transparent liquors and a hard cake were the invariable rule. About eight hours and sixty pounds pressure were necessary to insure the last. Two hours were generally allowed for a cold water lixiviation of the cake, a pressure of some ten pounds less than that employed for the juice being used and the sweet water being run to two and one-half or three degrees Baume. This supplementary process, it is said, is nowhere else followed in Louisiana. Basing calculations upon last year's chemical data, the net savings from it, after deductions for extra evaporation, interest on extra plant, etc., to be about

$12 per day when the factory is working at its normal capacity —say, 300 tons cane per twenty-four hours. An extra large battery of presses was provided especially to meet the requirements of this lixiviating process. The filter-press cloths are customarily washed bi-weekly. On one occasion they were operated one week without cleansing. This introduced fermentation, and is not to be repeated. Six sets of filter-cloths answer for five presses. The wear and tear of these are nominal. After two years' service already, very few will need replacement before the close of another campaign. The syrup-tank bottoms and other sweet waters of the establishment are also brought back to the presses. The last operate entirely without expert attendance, except oiling of the juice-pump by the engineers. The lixiviation pump is allowed to run dry. The presses are worked on strict rotation and the times and other data of each pressing systematically recorded. Over twenty-two per cent of the entire volume of juice passes through the presses.

The treatment of syrups is similar to that of other Louisiana establishments. It is not thought necessary to settle these, and they are not re-heated and skimmed after leaving the double effect. The first product is a large grained Y. C. sugar, which grades in the New Orleans market from choice to ultra choice. The second product, boiled to wagons at a high string poof, is a fine-grained article which dries very slowly in the centrifugals. As high as fifty per cent commercial sugar was, in at least one instance, secured from second massecuite. With sufficient vacuum pan capacity, this product might, the present season, with its rich and pure juices, have probably better been grained in the pan. For the first time in the history of the establishment, the entire crop was re-boiled to a blank string proof for a third crystallization. Though the second molasses so re-boiled showed in some instances glucose to be already in actual excess of sucrose present, graining was rapid and copious and maturity rapidly attained. First sugars were washed with two pints of water, in which is dissolved a minimum of stannous chloride crystals. Seconds and thirds with one pint, more or less. Analyses of these sugars and of the molasses from them are given further on. The weights or gauges of all products being now ascertained, no estimates are incorporated in the returns to follow, and no allowances have been made for trash weighed as cane.

MECHANICAL CONTROL

The system of department reports referred to constitutes an excellent mechanical control. The amount of coal and cane consumed, the number of laborers employed in each department, the quantities of juice, syrup, sugar and molasses produced, and the number of packages used, give daily the amount

of work done by each department and the daily cost of each operation, and exhibits mechanical derangements and wastes before the loss from these can become important. The stop and start of all portions of the apparatus has been long recorded and the average possible hours of daily operation and the hourly capacity of each machine thus established. The causes of lost time, with means for their remedy, have also been carefully determined; the house is thus found to be remarkably well balanced throughout and correspondingly economical in operation. The average performance of mill and vacuum pan, per actual running hour, the last three seasons, expressed in pounds of commercial sugar, has been:

	1886-87	1887-88	1888-89
Mill	2,224.87	2,804.98	2,904.04
Vacuum pan	2,558.19	2,738.13	2,731.41

This indicates the maximum capacity of the establishment to be something over 60,000 pounds commercial sugar per diem.

Previous to my arrival at Calumet a general plan of work had been arranged for the chemist, in which the main features were experiments in connection with the mechanical filtration of cane juice.

With this end in view, a physical laboratory, equipped as a miniature sugar-house, had been added to the "plant." This included a small mill, small diffusion battery of the Hughes system, with defecators, filter-press, open evaporators and vacuum strike pan of corresponding capacity.

These experiments, the mechanical part of which was under the direction of Mr. B. Remmers, who worked most intelligently and persistently at them, were undertaken by myself with a great deal of reluctance. Knowing the amount of work already done on this subject and the uniformly unsatisfactory results, it was hardly possible that where much of the time had to be occupied with the affairs of the sugar-house that anything worthy of note could be accomplished.

However, that which was attempted was very thoroughly and systematically executed. Caustic lime, carbonate of lime, superphosphate of lime and many other re-agents, besides brown coal, wood char and other substances, were all tried in the cells of the small battery, not only as an aid in mechanical filtration, but also to assist in defecation.

While it was found that diffusion juices filtered much more easily than mill juices, none of the different clarifying agents employed seem to have assisted the subsequent filter-press filtration to any appreciable degree, and the analyses are not thought to be of sufficient value for publication.

Aside from the work on filtration, however, careful and systematic analyses of the raw, sulphured and clarified juices were

made three times daily, and of the syrup once daily throughout the season, and during two runs after the work on filtration had been discontinued a complete chemical control was maintained throughout the house, each stage of the manufacture being carefully gauged, samples taken, and analyses made.

The season's work was, for convenience, arbitrarily divided into five runs, two of them on stubble and three on plant cane.

FIRST STUBBLE RUN.

The cane of this run had nearly all been ground before my arrival at Calumet, and but few analyses of juices were secured. Judging, however, from the analyses made, the juices were the richest of the season, but the cane being second year stubble, contained a very high percentage of fiber. There was on this account not only a less quantity of juice in the cane, but also a poor extraction of that present, the woody-fibrous cane making good mill work impossible.

The yield, however, was very good, the ratio of glucose to sucrose in the final molasses being higher than any ever reported before by a Louisiana sugar-house. Its analysis gave sucrose double polarization 23.56 per cent, glucosh 42.09, and purity 29.70.

One thing worthy of much notice in this run, was the boiling of molasses for third sugar, in which the glucose was already in actual excess of the sucrose. This molasses contains 33.20 per cent sucrose and 33.74 per cent glucose, and gave a massecuite which grained excellently in the wagons, "swung" out well in the centrifugals and yielded 12.06 pounds of commercial sugar per ton of cane.

The extraordinarily high content of glucose compared with sucrose in the final molasses is probably due in part to a high percentage of glucose present in the raw juice. Owing to the non-arrival of the chemical apparatus no glucose determinations were made the first run, but since, in subsequent work the analyses of the final molasses showed as low percentage of sucrose without as high glucose content, it is reasonable to assume that the glucose in the molasses in question was derived from that originally present in the juice and was not a result of inversion.

SECOND STUBBLE RUN

On this run the data are more complete than on the previous one. The remarkably good work which had characterized the house in the first run was once or twice slightly interrupted during this run. The most serious mistake made was the neglect of the sulphur machine, by which moist air was admitted freely to the sulphur dioxide after it had passed over the wash-water, and, as the conditions were most favorable, there was, in all probability, quite an appreciable amount of sulphuric

acid formed. At any rate, the inversion in this run was much greater than in any other, amounting to 4,365.54 pounds of sucrose, being 1.32 per cent of sucrose present in raw juice. The analysis of the final molasses gave sucrose, 23.78 per cent; glucose, 32.68, with a purity of 30.87. The sucrose in the final molasses of the second stubble run, it will be noticed, is very little in excess of the sucrose of the first stubble, while there is nearly ten per cent less glucose, making the content of total sugar in the last run much lower.

It would seem from this work that the glucose present in the juice of the cane did not possess the power to restrain the crystalization of sucrose that it is commonly supposed to have. With much more glucose in the first run the amount of sucrose is a little less than in the second. Whether this glucose is different from artificially prepared grape sugar in its physical characteristics or whether the restraining power of the latter over crystallization has been greatly overestimated, are questions that this work would naturally suggest, and it is probable that, with the awakening interest of the Louisiana planter in scientific work, both these questions will, before many years, be settled.

These two runs are noticeable, not so much for the yield of sugar as for the point to which crystallization was carried. Molasses, which before would have been considered worthless, can now, in view of the work done at Calumet, be profitably boiled again for another crop of crystals.

In boiling for the lower grade sugars, the massecuite was boiled as stiff as possible without converting it into "taffy." This required a good deal of judgment on the part of the sugar boiler, and it is to the excellent manipulation of the material at this point that the high yield of sugar is due.

FIRST PLANT RUN.

This was much the largest run of the season, and had the richest cane. The work of the sugar-house was uniformly excellent, the mechanical loss between the juice and syrup being small as compared with the stubble cane, and in other parts of the house scarcely noticeable. Maceration, or the addition of water to the bagasse between the first and back mill was commenced in this run, and a remarkable increase in the yield was derived from it. This will be discussed further on under the head of "maceration." Available sugar, or sugar actually secured, expressed in terms of glucose present in the juice, was 0.82 times the glucose deducted from the sucrose. The final molasses contained 26.80 per cent sucrose, 30.85 glucose, with a purity of 33.49.

SECOND PLANT RUN.

This run, judging merely from the nicety with which the machinery worked, would have been pronounced the best of

the season. Careful chemical control showed, however, that the mechanical losses were proportionately larger than in any other run of the season.

The chemical control carried through thisrun was, I believe, one of the most complete, if not the most complete work of its kind ever attempted in Louisiana. All the products, from the raw juice to the final molasses, inclusive, were carefully analyzed, weights and measurements taken at each stage, and the sugar present compared with that of the previous stage. The work was extremely satisfactory, the losses being accurately located and the parts of the house which worked well noticed. The chief, and in fact, almost the only loss, after the juice had been expressed, occurred at the double effect. This, owing to the practice of maceration at the mills, was being so worked beyond its capacity that not over seven to eight inches of vacuum could be maintained in its first pan, while twenty-seven to twenty-eight were secured upon the second. The difference of the boiling points of the two pans being thus so great the juice from the first entered the second pan far above the latter's boiling point, and flashed, therefore, instantly into vapor, the excess of its sensible, being absorbed as latent heat. This instituted a current of vapor direct from the liquor feed-pipe towards the condenser, evidently sufficiently violent to entrain large amounts of the entering juice in the form of globular spray or mist which escaped the catch-all.

After the juice had passed the double effect there was only one other place where there was any appreciable loss, the work in the refinery being remarkably good and close. In boiling for third sugar some of the massecuite was boiled too stiff, and about six inches in the bottom of the wagons having been chilled by too low a temperature at or near the floor of the hot room during a spell of cold weather, could not be dug out, and had to be melted and run into the molasses. This accounts for the relatively high percentage of sucrose in the final molasses, the analysis of which gave 29.11 per cent of sucrose, 29.36 glucose and purity of 36.94.

THIRD PLANT RUN.

In this run, though the chemical control was carried as systematically as in the previous, the results were not quite so satisfactory, from the fact that a great deal of settlings from the first molasses were carried over from the first plant and worked in with this run. All this was, of course, measured, analyzed and deducted from the sugar present in the juice, but what the effect was on crystallization, added as it was to all the different grades of product, it would be impossible to state.

One very serious accident occurred during this run which delayed the work for three days. The shaft of the back or ba-

gasse roll of the front or three-roller mill, was broken, but as the season was so near the end the crop did not sufler from the delay.

The cane worked, being from new, back, stiff and inadequately drained lands, was comparatively poor, the sucrose being much lower and the glucose much higher than in the previous plant cane runs. A neutral defecation was carried throughout this run, and a good deal of glucose was destroyed, forming probably a compound with the lime, which was broken up and dissolved by the juice. The amount of first sugar secured was very large compared with the sucrose in the juice, and as a consequence the lower grade sugars did not crystallize as well as in the other runs, much of the grain in the seconds being so small that it passed through the sieves of the centrifugals. The final molasses contained 26.62 per cent of sucrose, 28.52 glucose and a purity of 34.44.

The last two runs, made with the idea of comparing a neutral with the ordinary Louisiana acid clarification, both as to the effect on yield and care of working, will be discussed further on.

SPECIAL INQUIRIES.

One of the things watched with special interest was the effect upon the juices from the use of sulphur dioxide as a depurator.

No data on this subject have ever been collected in Louisiana in practical sugar-house working. Laboratory practice has, of course, made us familiar with the danger attendant upon the use of sulphur, if not properly handled.

The Louisiana experiment station, under the direction of Dr. Stubbs, has strongly condemned its use, without suggesting anything to take its place, and, judging from the published reports of the station, the loss there was much greater than any sugar-house could afford.

In endeavoring to find out how great the inversion was at Calumet, analyses were made three times daily of the raw, sulphured and clarified juices throughout the season. Samples were also taken from each tank of syrup and from the different grades of sugars and the final molasses, and in two runs of all the intermediate products. As all these different products were carefully weighed or measured, any increase in the glucose would be quickly noticed. The analyses of both raw and sulphured juices are, I conclude from the season's work, unnecessary, and either the one or the other should be dropped, thus reducing the chemist's work a great deal and eliminating nothing essential.

Of course, where the sulphured juice is heated before being run into the clarifiers, both juices should be analyzed. Enough sugar would, however, be inverted by this treatment, I should say, to speedily induce anyone to stop its use.

As a result of Calumet's work, I cannot but be very favorably impressed with the use of sulphur as an aid in improving the quality of the output of a sugar-house.

The total inversion for the crop was 6,111.91 pounds sucrose, of which a loss of 4,865 pounds, as already mentioned, was sustained mainly through inattention, during the second stubble run. This is undoubtedly a smaller loss than would be occasioned by the use of a boneblack plant that can be operated on any Louisiana plantation.

The entire loss by inversion, with the exception of 317 pounds, was confined to two runs, and in another year's work will be almost entirely overcome by a new arrangement, designed by Mr. Daniel Thompson, for cooling the sulphur dioxide fumes as they come from the furnace.

This improvement was put in at Calumet the latter part of the season, and after its introduction the inversion was practically nothing.

It consists of a box about eighteen feet long by two in width and depth, and is divided into two parts, the first division containing about sixteen feet of six-inch lead pipe, through which the sulphur fumes passed, and around which cold water was kept continually circulating. This effectually cooled the fumes and allowed the absorption in the second division of the box of any sulphuric acid which had been formed. In this second division the fumes came in actual contact with water, allowing, as mentioned above, the absorption of sulphuric acid while, having been cooled by the previous treatment, the sulphur dioxide formed no fresh sulphuric acid. A further trap for sulphuric acid, which had been in use with the old sulphur-box, was kept in place and allowed any sulphuric acid present to drop perpendicularly down, on account of its specific gravity, into a suitable receptacle, while the lighter sulphur dioxide is drawn off by suction at right angles into the juice.

After the new arrangement for cooling the fumes had been put in, two runs were made, one with an acid defecation, the other with a neutral. Each run contained a little over 197,000 pounds of sucrose in the juice extracted, and with the acid defecation only 317 pounds of sucrose were lost by inversion, while in the neutral not a pound disappeared from this cause. From this I am led to believe that in another year the inversion caused by sulphuric acid will be entirely stopped, but, since to secure the best results with sulphur the juices must be left a little acid after defecation, there will always be a slight inversion, but the acidity will be from a weaker acid, and will amount to nothing.

That sulphur in cane juice can be made a dangerous and formidable enemy in the hands of untrained and unskilled workmen cannot for a moment be denied, but when properly

and scientifically handled it is one of the most, if not the most valuable aid in a mill-house. With diffusion it will not be as important, if used at all, as the diffusion juices are usually drawn from the cell at too high a temperature to admit of its use without great danger of inversion. With mill juices even, when sulphur is used, great care and celerity should always be exercised. Separate the sulphured juice at once, evaporate the juice to syrup immediately after defecation and from the syrup concentrate to massecute without stopping, and so on as fast as the lower grades will allow of good results. This, however, is true of any sugar-house, whether sulphur is used or not, and large losses, which are often attributed to some method of manufacture, are due to nothing else but delay in working up the juice after it has been soured. Certainly Calumet, with the highest average season's yield ever reported in Louisiana, and this with an extraction of from eighty to eighty-seven per cent of sucrose present in the cane, has no reason for changing its treatment of the juice as long at least, as it continues mill work. Cheapness and effectiveness are two as good recommendations as anything needs, and both of these can be applied to the use of sulphur at Calumet.

MACERATION AND ITS EFFECT ON YIELD.

Below is given a table showing the work done both before and after maceration was begun:

	Without water added.	With water added.
Cane ground, tons	3,993.26	3,388.31
" pounds	7,986,525	6,776,623
Sucrose in cane, pounds	1,016,365	843,486
Juice extracted, gallons	650,878	599,213
" pounds	5,786,909	5,327,383
Sucrose in juice, "	818,269	736,478
Sucrose in bagasse, pounds	198,096	107,008
Sucrose in bagasse, Per cent of total	19.49	12.69
Sucrose obtained, per cent of total	80.15	87.31
Sucrose obtained, per 1,000 pounds sucrose in cane, lbs.	805.1	873.1
Sucrose gained per 1,000 pounds by maceration, lbs		68
Sucrose lost in 1st part season by not macerating, lbs		69,113
Sucrose lost in 1st part season per ton of cane, lbs		17.31
Sucrose gained in 2d part season by maceration, lbs		57,357
Sucrose gained in 2d part season per ton of cane, lbs		16.93
Water added, per cent of normal juice, pounds		11.94
Mill extraction of juice, per cent of cane	72.45	78.61
Average tons crushed per hour	14.22	14.02

The addition of water was begun about the middle of the first plant run, and as it was thought unnecessary to divide the run, the actual yield of merchantable sugar cannot be given exactly, but since a pound of sucrose in the juice meant a pound of commercial sugar the return can be easily be figured from the table. At any rate, as the extra amount of sugar secured in the juice, is the only way to judge of the good maceration does, everything will be found in the table which is

necessary to form an opinion of the work. A gain of seventeen pounds of sugar per ton of cane by symply adding 11.94 per cent of water is an amount of sugar secured in such a way that no planter can afford to overlook it. The only extra expense entailed is the evaporation of the water added, and, as at Calumet, all the exhaust steam could not be used before maceration was begun, the extra yield was secured with almost no expense.

The method employed for adding the water is believed to have much in it to recommend itself, and since the manner of doing anything has as much to do with success as the mere fact of doing it, the method will be given in full. The water was ejected from a perforated pipe upon the bagasse as it was being released from the pressure of the front mill.

It was argued by Mr. Wibray J. Thompson, and rightly, too, in my opinion, that during the expansion which follows this pressure, the bagasse is more likely to thoroughly and uniformly absorb the added water, as it is known to do such juice as passes through the mill, than at any subsequent period, a minimum of water thus being made to produce maximum results, and a maximum of time afforded for diffusive and osmogenic action before entering the second mill. The water added and the juice present in the bagasse from the front mill should, he thought, become a homogeneous liquor practically resembling the normal juice in every particular except in having a lower specific gravity. It can readily be seen that this juice of a uniform quality would give a higher extraction of sucrose than if the water be added indiscriminately at any point of the intermediate carrier, supersaturating some of the bagasse and not reaching other parts at all, which would give a smaller extraction of sucrose with a higher dilution, since from that part of the bagasse which was supersaturated an excess of water would be expressed while an excess of juice would be left behind in parts insufficiently saturated or diffused.

By carefully observing these conditions the yield of sugar, as was mentioned before, was increased seventeen pounds per ton of cane. This is an enormous advance over ordinary mill work, but on an estimate of what diffusion would have done with the same cane and a ninety-six per cent extraction, which can easily be obtained, a net gain over maceration of twenty-three pounds of sucrose per ton of cane would have been made. Thus, while it can be seen that maceration is of great advantage, it is at its best only a temporary expedient to be used till plantation owners can prepare their rugar-houses for diffusion.

The most effective and economic maceration will require a dilution of about fifteen per cent on the weight of normal juice, while diffusion needs but little more. Multiple effect

evaporation is, then, as necessary for maceration as for diffusion, and without this aid the expense and loss of sucrose during evaporation would not be balanced by the return of sugar. The chances for extremes of dilution are much greater in maceration than by diffusion, allowing both to be in charge of inexperienced persons, and taken all in all, though the gain by good maceration is great where a house has to be changed at all for either of the two processes, there should not be the slightest hesitancy in choosing diffusion. Easy to handle and effective, the latter has everything in its favor, and, since it has been proven that the exhausted chips can be burned, there is nothing against it. Come it will sooner or later, and he who introduces it first will reap the greatest benefit.

AVAILABLE SUGAR.

While in my opinion it is unnecessary and useless in sugar-house work to have an arbitrary formula for predicting results, as from the very nature of the material nothing constant can be secured, still, as it has hitherto been customary by the Department to use some such standard, I will report Calumet's work in the same way. The formula which has been mostly used for this purpose has been one and a-half times the glucose present in the juice deducted from the sucrose. The product thus expressed is sugar of 100 deg. polarization, which should go to market as crystal.

At Fort Scott, Kan., campaign of 1887, working sorghum cane, the crystallized product obtained was expressed by deducting 1.42 times the glucose from the sucrose, this being slightly better work than according to the ordinary formula. The following table gives the results of each of the five runs into which the campaign was divided at Calumet. This table gives both the amount of sugar according to the regular formula and that which was actually secured; also a formula expressing the results. It will be seen that even in the one sugar-house the widest variations exist:

	Pounds of sucrose —1.60× glucose.	Pounds of sucrose actually secured.	Formula for available sugar.
First stubble	Analysis of juice not complete.		
Second Stubble	348,986.68	361,574.02	Sucrose—1.04×glucose.
First plant	696,189.62	727,071.90	Sucrose—.81×glucose.
Second plant	177,438.40	180,625.35	Sucrose—1.25×glucose.
Third plant	171,153.83	188,066.89	Sucrose—.53×glucose.
Total crop	1,393,768.53	1,457,398.16	Sucrose—.87×glucose.

This is up to the present time the best work with cane juice ever published, there being a difference of .55 between Calumet's average factor for available sugar and that of the Fort Scott works, the latter the best previously recorded.

NEUTRAL VERSUS ACID CLARIFICATION.

In all Louisiana sugar-houses where sulphur is used the juices are left slightly acid for the purpose of securing an improved color in all the products from first sugar to final molasses inclusive. This practice is followed both in open kettle and vacuum pan sugar-houses.

The great trouble in working such juices is, naturally, the inversion caused by the presence of a free acid. A very slight acidity is all that is necessary to secure the desired color in the production of yellow clarified sugars, but even in skilled hands this acidity is very difficult to control, and under the charge of the ordinary Louisiana clarifier-man the juice is left first at one extreme and then at the other, with a tendency always to the more acid juice.

In the manufacture of white sugar the evil is, of course, intensified by higher degrees of acidity sought. The lack of knowledge and care has been so marked in most cases that the owners themselves were ignorant even that it was possible for such a loss to occur.

Only in a very few places, and even in these but for a few years, have any attempts been made to give the juice a practical chemical treatment. In most places where this has been done a considerable inversion has been found in working the acid juices. To overcome this loss by inversion the juices are limed to neutrality. This practice, however, lowers the quality of the sugar, for as soon as the juice loses its acidity it fails to give so brilliant a sugar, because of the formation of calcic glucates and other dark colored compounds; hence it is necessary that a sufficient amount of additional sugar be recovered by the neutral clarification to overcome the difference in price of the sugar from an acid clarification.

The last two runs of the season were selected for a trial of the relative merits of the two methods of clarification, and a tabulated statement of the work done is give below:

	Acid run.	Neutral run.
Cane ground, tons	886.23	956.55
Mill extraction, per cent	78.48	80.31
Extraction of sucrose, per cent	87.21	89.16
Dilution due to maceration, per cent	13.98	15.49
Sucrose in diluted juice, per cent	12.54	11.46
Sucrose in juice, pounds	197,281	197,317
Sucrose in syrup, pounds	186,543	194.671
Mechanical loss between juice and syrup, pounds	10,632	2,646
Inversion of sucrose in whole run, pounds	317	None.
Sugar 100° polarization obtained, pounds	180,725	188,067

The selection of these two runs for the trial proved to be a very unfortunate one, the difference in the quality of the cane being very marked. With no other difficulty than this a strict comparison of results would be impossible, but coupled to this the mechanical loss at the double effect in the acid run was

the largest of the season, while in the neutral it was the smallest. This loss cannot, in my opinion, be attributed to the different methods of clarification, but merely to the handling of the double effect. Even if the different losses in the two runs were due to the different viscosity of the juice, as was suggested might be possible by Mr. W. J. Thompson, the loss itself will be entirely avoided in another year, and ought not to enter into a discussion of the results.

As far as loss by inversion is concerned, there need be no discussion, because by either process there was at Calumet no such loss, or practically none, the acid run having only 317 pounds, which is too small to be considered, and the neutral having none, of course. This absence of inversion in the acid run disposes of the most important objection to that method of clarification and reduces the discussion to the comparative amount of sugar recovered by the two methods and the market value of the product after it is recovered. In the acid run 91.61 per cent of the sucrose in the juice was put on the market as crystallized sugar, while in the neutral 95.31 per cent was recovered. If, however, the mechanical loss at the double effect, mentioned above, had been the same the sugar obtained would have been nearly equal, while all the products of the acid clarification had from .062 to .25 cents per pound the advantage in price on the gross sales.

As far, then, as this season's work was carried at Calumet the advantage lies entirely with the acid clarification. By careful and expeditious working of the juice inversion was almost prevented; as large an amount of sugar can be recovered from the juice and the market value of the products are invariably higher.

TABLE SHOWING COMPARATIVE PER CENTS OF ALBUMINOIDS IN RAW SULPHURED AND CLARIFIED JUICES.

No.	Raw juice.	Sulphured juice.	Clarified juice.
186	.10937	.10625	.06250
196	.11250	.10625	.06250
219	.12500	.10937	.05625
233	.10937	.10000	.06875
250	.13750	.12812	.07187
256	.13125	.10000	.06875
265	.11875	.10312	.05625
289	.15000	.....	.09375
379	.12187	.09375	.05625
396	.10937	.....	.06875
	.12250	.10586	.06656

It will be seen from the table that SO_2 combined with or destroyed some of the nitrogen present in the juice. Whether this is albuminoid matter or not I cannot say, but as all the nitrogen is calculated to albuminoids the percentage is very sensibly decreased in the sulphured juice. The clarified juice

contains but little over one-half the albuminoids present in the raw juice. This is about the same percentage of albuminoid matter removed as that at Magnolia plantation, reported in Chemical Bulletin 15 of this Department.

SUMMARY OF TOTAL CROPS.*

Solids in juice, per cent	16.40
Sucrose in juice, per cent	13.94
Glucose in juice, per cent	.93
Purity co-efficient	85.00
Sucrose in juice, pounds	1,548,975
Glucose in juice, pounds	103,332
Commercial sugar obtained, pounds	1,549,078
Sugar of 100° polarization obtained	1,458,876
Sucrose in final molasses	67,423
Inversion of sucrose, pounds	6,112
Mechanical loss of sucrose, pounds	30,431
Total los of sucrose,† pounds	36,543
Total loss of sucrose, per cent	2.36

The exceptionally fine record made by Calumet is worthy of more than passing notice. As mill work it is unprecedented, having surpassed anything which has heretofore been thought possible. The extraction of juice was not phenomenally high, though after maceration was begun it was much above the average, but the manipulation of the juice after it was once secured, was remarkably good. The machinery was well arranged and worked admirably, and to the arrangement is due much of the credit, as it allowed an ease and speed in working which otherwise could not not have been attained.

The one noticeable mechanical loss was at double effect. The loss here was larger than thought possible, but the most careful measurement and analyses of the material, both before and after entering the double effect, only confirmed the disappearance. During the campaign 30,431 pounds, or 1.97 per cent of the sucrose extracted disappeared at this place. A portion of this loss is really due to the press-cake, but as this was carefully lixiviated from two to three hours all through the campaign, the sucrose lost in this way was but a small amount. No analyses of cake were made, as the presses gave no trouble whatever at any time, and the other work was thought to be more important. Steps have been taken to stop this loss during the next campaign. A Helix separator is to be attached to the condenser pipe, and it is expected that this will arrest the spray and return it to the pan.

From the syrup to the final product it is hard to see how the work could be improved. The most noticeable feature, and the one, I think, to which the high yield may be attributed,

* This table does not include the first stubble run, as complete analyses of the juices were not made. Inclusive of this run the total commercial sugar was 1,733,421 pounds.

† The apparent excess of sucrose in the added products is due to the fact that that 12,429 pounds of sucrose are shown by double polarization of the molasses, which were present but not shown by the single polarization of the juice.

was the remarkable stiffness to which the massecuites were boiled. In all grades of the material as much water was driven off as was thought safe to do. By this remarkably good boiling an amount of sugar was recovered which leaves absolutely no room for comparison with the work of other Louisiana sugar-houses. This is a record to be proud of, and the enterprising proprietor of Calumet, Mr. Daniel Thompson, and his son, W. J. Thompson, director of the sugar-house, deserve unstinted praise for showing the possibilities of cane culture in Louisiana when the manufacturing is carried out on a rational basis.

What has been done can be done again, and when the Louisiana planter adopts diffusion and carries his sugar-house work to such a degree of perfection as has already been attained at Calumet, it will be no unusual thing to hear that 250 pounds of sugar have been obtained from a ton of cane.

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REPORT OF COMMITTEE ON METHODS OF SUGAR ANALYSIS OF THE LOUISIANA SUGAR CHEMISTS' ASSOCIATION, COMPRISING METHODS OF SUGAR ANALYSIS AND INSTRUCTIONS FOR THE GUIDANCE OF SUGAR CHEMISTS.

APPARATUS.

Polariscope, with observation tubes, polariscope lamp, funnels, beakers, sugar flasks graduated 100 c.c. to 110 c.c. and smaller size flasks graduated to 50 c.c. and 55 c.c.; burettes (with 1-10 c.c. graduations) and burette support, casseroles, porcelain evaporating dishes, water bath, retort stand, centigrade thermometer, set of Brix hydrometers with cylinder, litre flask, wash bottle, pipettes, glass tubing, filter paper, litmus test paper, pair of balances, set of weights silver sugar dish, wish counterpoise and normal sucrose weights, an alcohol lamp for heating purposes or a Bunsen burner, if a gas supply can be obtained,

CHEMICALS AND REAGENTS.

Lead acetate, litharge, copper sulphate, Rochelle salt, caustic soda, potassium ferrocyanide, anhydrous glucose, C.P., acetic acid, hydrochloric acid, sodium carbonate, boneblack, finely cut asbestos, solution basic lead acetate, Fehling's copper solution.

SELECTION AND ADJUSTMENT OF INSTRUMENTS, APPARATUS, ETC.

For all the ordinary analytical work in the sugar house, the polariscopes with the horizontal sugar scale of 100 parts are to be preferred to those in which the circular scale of degrees is employed, and in which the exact angle of rotation, and not the direct per cent of sugar is read. The instruments of this latter description are invariably constructed *a penombre* and require the use of a mono-chromatic (sodium) light in a dark room, and a consequent expenditure of more time and manipulation than in corresponding determinations with saccharimeters adapted to ordinary lamp light. Of the various makes and styles of instruments of the last named class, a large proportion have the same normal sucrose weight of 26.048 grams, with a normal length of 200 millimetres for observation tubes. The shadow polariscope, adapted to white light, is the form of instrument more generally used at present, but the color instruments, provided with a regulator for changing the tints of the field of the instruments, is frequently preferred by those who experience no difficulty in detecting slight shades of difference in color. The Schmidt & Haensch shadow instrument, with double compensating wedges, and with a capacity for 400 m.m. tubes is to be especially commended for its ease of manipulation and the accuracy of results, it being possible to check each individual reading four times by means of the duplicate scales, while any incidental errors are reduced one-half by the use of the 400 m.m. tubes. The Soleil-Ventzke and Scheibler instruments, and most especially, the shadow instrument of the latter, are extremely well adapted to the ordinary work of the sugar house laboratory and in the hands of a careful operator give results whose accuracy may be confidently relied upon.

In the adjustment of polariscopes, care should be taken that the sugar used in the preparation of the normal sucrose solution is of absolute purity. Either pure white rock candy, in well defined crystals, or the best loaf sugar, extracted with 85 per cent alcohol and well dried at a temperature slightly below 100 deg. c., should be used. The rock candy should be thoroughly pulverized and pressed between sheets of blotting or filter paper previous to weighing, or if the atmosphere is heavily charged with moisture, it will be best to dry it at a temperature just below the boiliug point of water.

The normal weight, 26,048 grams, of sucrose is weighed up, dissolved in pure distilled water, and diluted to a bulk of 100 c.c. The gauging of the sucrose solution should be performed as nearly as possible at 17.5 deg. C., as, in sugar analysis, that is the standard temperature for measurements and polariscope readings.

For ascertaining the correctness of the zero point of the instrument, the polariscope tube is filled with pure distilled water, and having obtained a uniform tint or shade in the field of the polariscope, the variation in the position of the two zeros is corrected by means of the key applied near the left hand extremity of the vernier scale. Having made this adjustment, the normal sucrose solution should give a reading of 100 if the analyzer and polarizer are in right position with regard to each other. If, however, no uniformity of shade or tint on both sides of the centre line, is observed for any position of the movable quarts medge, the analyzer and polarizer are out of adjustment with reference to each other. In order to effect a correct adjustment of the parts, the movable quartz wedge must be taken out by turning the milled head screw underneath until it can be easily slipped out; the stationary quartz wedge is next displaced by removing the screws which hold it in position and which are usually found almost underneath the screws which hold in place the apparatus for reading the scale. The compensation quartz plate is next removed by opening the cover of the chamber for the reception of observation tubes and unscrewing the plate at the end nearest the observer. The cover having been closed, and observation is taken, and the position of the analyzer is corrected by applying the polariscope key to the screw head on the right of the instrument, and just in the rear of the compensation plates. The key is turned until there is a uniformity of shade on both sides of the vertical centre line of the field of the apparatus. The compensation wedges and plates have been replaced, a reading with an empty tube is made and any deviation in the position of the two zeros is corrected as before explained.

The linear measure of all polariscope tubes should be carefully taken, as any variation from the standard length will cause directly proportional errors in results. This measurement, from end to end, should be effected by means of a pair of dividers or calipers, the divergence of the points of the instrument, when applied to a finely graduated metric scale, giving accurately the length of the tube. Tubes showing a perceptible variation from the normal length should be rejected, or else all readings made in them should be corrected in direct proportion to the error in length. Where instruments have a capacity for 400 m.m. tubes, the long tubes should be invariably used for juices and syrups, when practicable, and the 100 m.m. tubes should only be employed in polarization of dark or difficultly decolorizable solutions, as decrease in length of polariscope tubes is attended with a proportional increase in errors. For double polarizations, it is far preferable to use those tubes provided with a central tubulure, at right angles to their length,

for the insertion of a thermometer and the recording of temperature at the instant of reading. It is also preferred that the tubes be one-tenth longer than those used for direct readings, in order to compensate for the dilution of the solution. The Scheibler instruments generally employed, however, will not accommodate tubes of a greater length than 200 m.m.

In filling tubes with solutions for analysis, it is always best to first rinse them out with the juice or sugar solution under examination, and afterward fill the tube (holding it in a vertical position) until the liquid reaches the upper end and assumes a convex surface; the glass disk is then slipped on horizontally, and the screw cap is adjusted and tightened, absence of bubbles being thus almost invariably insured. The glass covers of the tube should, after filling, also be wiped free of any particles or drops of liquid, silk, chamois skin or filter paper being used for this purpose, instead of cotton or linen, small particles of which latter substance frequently attach themselves to the glasses. The tubes should be emptied of their contents as soon as the observation is completed, the retention in metallic tubes, of solutions, inverted by means of acid, being especially injurious.

The lamp best adapted to polariscope work is of the "German Student" pattern, supplied with a clay cylinder, with a side aperature, oil being preferred to gas as an illuminating agent. The end of the instrument should not be placed nearer than from two to two and one-half inches from the source of light, as the heat from the lamp tends to affect the cement used in holding the prisms in position.

In order to test the correctness of the calibration of measuring flasks used in the various operations herein described, it will be necessary to first dry the empty flask and then weigh it. Distilled water (whose specific gravity, corrected for temperature, has just been determined) is run into the flask until the lower edge of the meniscus at the surface of the liquid is on a line with the mark on the neck of the flask. The flask and contents are then weighed, the increase in weight divided by the specific gravity of water at that temperature, giving the correct capacity of the flask in centimetres.

DETERMINATION OF SUCROSE.

In weighing, the balances used need only be sensitive to within ten milligrammes, as that amount of variation in the weight of a sample would scarcely be appreciable in the readings of the polariscope. Transfer by means of a pipette, to the tared German silver sugar dish, the normal weight of the juice or syrup to be analyzed, a spatula or other device being used, in case the sample is not of a liquid consistency.

In the case of juices and thin syrups, the contents of the

dish are at once washed into the 100 c.c. flask; sugars, massecuite, heavy molasses, etc., however, are best dissolved in the dish previous to being transferred.

The solution in the flask is made up to 80 or 90 c.c. and the least amount of basic lead acetate solution, sufficient to decolorize the contents is added. The solution is then made up to the 100 c.c. mark and thoroughly shaken before filtering. In case much foaming and bubbling takes place, rendering gauging difficult, the addition of a few drops of ether is found advantageous. The solution is then poured upon a dry filter and the filtrate is collected in a dry beaker, the first portion to pass through being rejected. If it is found impossible to obtain a perfectly clear filtrate, it may be necessary to decolorize with dry, powdered boneblack, either mixed with the liquid itself, or placed upon the filter. Should it be desired to remove the excess of lead in the solution before polarizing, it can be precipitated out before filtering, by means of sodium carbonate or sulphate (preferably the latter). The tube is filled with the clear solution as before described, and the process of reading the instrument is conducted as usual.

DOUBLE POLARIZATION.

Fifty c.c. of the decolorized solution used in the direct polarization test is placed in a sugar flask, graduated to 50-to 55 c.c., and hydrochloric acid of Sp. gr. 1.18–1.20 is added until the liquid reaches the c.c. mark, the contents being well shaken. The flask and contents are then heated in a water bath at a temperature of 68 deg.–75 c. for about fifteen minutes. It is then allowed to cool, freed from the precipitate of lead chloride by filtration, the filtered solution being transferred to a tube of the form previously referred to as being especially adapted to the reading of invert solutions. The reading of the solution to the left is noted, and at the same time its temperature is carefully taken by means of a thermometer inserted in the central tubulure of the tube. In calculating the true per cent of sucrose from the data thus obtained, instead of Clerget's original constant of 144, the revised figure of 142.4 should be used, as the committee's experiments show conclusively that 26.048 grams of sucrose, inverted and made up to 100 c.c. gives a reading to the left of 42.4 at 0 deg. C. The correct expression of the formula used in the calculations will then be $R=\frac{100\ S}{142.4-\frac{1}{2}\ T}$, in which S= the sum of the right and left-handed readings of the solution; T= the temperature of the solution at the instant the left-handed reading is taken, while R is equal to the corrected per cent of sucrose. Where it is preferred, the simple proportion $142.4-\frac{1}{2}\ T : 100 :: S : R$—can be used.

In double polarization tests, the readings of the invert solutions should invariably be conducted at, as nearly as possible, the same temperatures as the direct readings.

SPECIFIC GRAVITY AND DENSITY.

Density of juices, syrups, etc., is most conveniently determined in the sugar-house by means of Beaume's or Brix's hydrometer or areometer, preferably with the latter, as the graduations of the scale give close approximations to the percentages of total solids. The Brix spindle should be graduated to tenths, the divisions of the scale being of sufficient length to enable the analyst to note exactly the point to which the stem sinks in the liquid. It is therefore desirable, for accuracy, that the range of degrees recorded by each individual spindle be as limited as possible, this end being best secured by the employment of sets, consisting of not less than three spindles. The solutions should be, as nearly as possible, of the same temperature as the air at the time of reading, and if the variation from the standard temperature of the graduation of the spindle, amounts to more than one deg. C., compensation therefor must be made by reference to the table of corrections for temperature on page 114, Tucker's Sugar Analysis.

Care should be observed in taking the density of a juice, to allow it to stand in the cylinder until all air bubbles have escaped, before reading the spindle. When it is desired to accurately determine the specific gravity of the sample, a specific gravity bottle or picnometer, of 50 c.c. capacity, is employed, and the weight of the amount required to fill the bottle at 15.5 deg. C, divided by 50 gives its correct specific gravity. When the temperature varies from the standard temperature for specific gravities, the weight of the juice must be compared with an equal volume of water, weighed at the same temperature.

TOTAL SOLIDS.

The per cent of total solids can be approximately ascertained directly from the reading of the Brix hydrometer, or knowing the reading of the Beaume spindle, or the specific gravity of the sample by reference to the table on pages 116–118 Tucker's Sugar Analysis, the desired percentage can be obtained.

In order to accurately estimate the proportion of total solids in a juice or syrup, from one to three grams (according to the density of the liquid) are run into a porcelain dish or glass schaelchen, containing about two grams of finely powdered, ignited silica. The whole is then placed on a water bath and heated until the contents are apparently dry, after which it is transferred to an air bath and dried to a constant weight at not exceeding 110 deg. C. The weight of the dish and silica subtracted from weight of disk and contents after drying, giving total solids.

Total solids may also be determined by Dr. Wiley's method of saturating a dried and weighed piece of filter paper (about twelve by two inches in size) with the sample of juice or molasses, and drying at 100 deg. and re-weighing.

DETERMINATION OF GLUCOSE.

In the analysis of juices, ten grams of the sample are weighed up, transferred to a graduated flask and made up to 100 c.c.; in estimations of glucose in molasses and syrups, five grams are weighed up and diluted to 500 or 1000 c.c., according as the proportion of glucose present is relatively small or large.

It is best that the diluted solution contain not more than two milligrammes of glucose to the centimetre of liquid. Ten cubic centimetres of Fehling's solution are next run into a casserole from a burette, and three or four times its bulk of water added; it is then placed over a flame and brought to a brisk boil, care being taken to observe whether or not any of the copper is precipitated as sub-oxide. If no precipitation is noticed, a few cubic centimetres of the solution under examination are added from a burette and the contents of the casserole are again boiled, stirred well, removed from the lamp and the precipitate allowed to subside. The process is thus continued, the sugar solution being run in at short intervals, and in small quantities at a time, the liquid in the casserole being boiled and allowed to settle each time. When the blue tint has almost disappeared from the liquid, and the dull red of the precipitate has changed to a scarlet, the solution is added very cautiously, stirring and settling as before. When the precipitate subsides readily and the supernatant liquid becomes clear and almost colorless, a test is made to ascertain whether or not all the copper is precipitated. A few drops of the liquid, when filtered and placed on a porcelain casserole cover or crucible top will, when acidulated with acetic acid, give a reddish brown precipitate with Potassium Ferrocyanide, if any copper remains in solution. The filtration of a small portion of the solution for testing, is best effected by means of Wiley's tubes —easily prepared by making a flange on one end of a piece of glass tubing, about three-eighths inch diameter and five or six inches in length, and covering the flanged end with a small piece of muslin. An asbestos pulp is next prepared by boiling finely chipped asbestos with water, and an amount sufficient to cover the muslin is then sucked up on the closed end of the tube. In testing the supernatant liquid in the casserole, a very small portion is sucked through the asbestos filter, the tube being at once inverted in order to drop the contents on the porcelain surface. Operators should be careful to remove as little of the solution as possible at one time from the casserole, and to only commence testing the solution when it is apparent to the eye that the liquid is almost completely decolorized. Frequent tests and the use of large quantities of the solution in making tests, tends to give results too high.

Instead of employing Wiley's tubes as explained above, a piece of tubing about the same dimensions is drawn out to a

small bore at a point about an inch from the end; a small plug of dry asbestos is now inserted in the short section of the tube next to the constriction, and the tube is ready for use in the manner before described.

In calculating results the following proportion can be used; no. c.c. of solution required to precipitate the copper in 10 c.c. Fehling's solution: amount in grams of glucose equivalent to 10 c.c., Fehling solution : : 1000 : x. If 10 grams of the sample diluted to 100 c.c. were used, x will give exact percentage of invert sugars in sample analyzed.

DETERMINATION OF SUCROSE BY INVERSION.

In analysis of syrups, molasses, etc., 5 grammes of the samples are weighed up, washed into a flash, and diluted to 200 or 300 c.c.; 5 c.c. strong hydrochloric acid is then added, and the flask and contents are heated in a water bath for fifteen minutes at a temperature of 65 deg.–75 deg C. The solution is then neutralized with sodium carbonate, made up to a volume of one litre and invert sugar is determined as before described. The total invert sugar minus glucose previously determined, gives amount of glucose equivalent to sucrose present; this amount multiplied by .95 gives amount of sucrose contained, as determined by inversion. When it is desired to decolorize juices previous to determining glucose, or to determine glucose in a solution prepared for polarization, the excess of lead used in clarifying should be precipitated out by means of pulverized sodium carbonate, and the solution diluted to the requisite volume, and filtered before making the estimation.

The essential data to be given in stating the results of an analysis of juice are as follows:

Specific gravity; density, degrees Brix or Beaume; total solids; sucrose; glucose; solids not sugars; co-efficient of purity; glucose ratio.

The proportion of solids not sugars is ascertained by subtracting the sum of the per cents of sucrose and glucose from per cent of total solids. The co-efficient of purity is obtained by dividing the per cent of sucrose by per cent of total solids and multiplying by 100. The glucose ratio, or ratio of glucose to sucrose, is obtained by dividing per cent glucose by per cent sucrose and multiplying by 100. The per cent of available sugar* is ascertained by subtracting 1½ times the per cent of glucose from the per cent of sucrose. "Pounds of available sugar per ton of cane" is obtained by multiplying 2,000 by the per cent of available sugar, and the product by the per cent of extraction. The per cent of extraction is obtained by dividing weight of juice by weight of cane and multiplying by 100.

* This is purely empirical, and practical factory results have, in many instances demonstrated that available sugar estimates are thus rendered too low.

REAGENTS—PREPARATION OF BASIC LEAD ACETATE.

Weigh up about 220 grammes normal lead acetate, and about 130 grammes of litharge; boil with 700 to 800 c.c. water for about one-half hour, stirring well to promote solution and prevent bumping. Cool, dilute to one litre and syphon or filter off the clear supernatant liquid. Instead of the above proportions of lead and acetate and oxide, 350 grammes of lead subacetate (basic acetate), dissolved in water and diluted to 1,000 c.c. may be employed.

FEHLING'S SOLUTION.

Weigh up accurately 39,640 grammes of crystallized copper sulphate, C. P., dissolve in about 200 c.c. water by the aid of a gentle heat and allow to cool. Also weigh up 180 grammes crystallized sodium potassium tartrate (Rochelle salt) and 70 grammes of caustic soda; dissolve in about 500 or 600 c.c. water, heating gently; cool, and pour into it slowly the copper sulphate solution, stirring mixture well. Transfer to a litre flask and dilute to a bulk of 1,000 c.c. Preserve in a tightly stoppered bottle in a dark place. Solutions which allow the formation of a precipitate of copper sub-oxide on standing, or when diluted with water and boiled, should be rejected as untrustworthy.

STANDARD GLUCOSE SOLUTION.

The glucose solution used in standardizing Fehling's copper solution is best prepared by dissolving two grammes of C. P. anhydrous glucose in distilled water, and diluting to a volume of one litre, thus giving a solution containing two miligrammes of glucose per cubic centimetre.

In order to determine the true strength of the copper solution, 10 c.c. are run into a casserole from a burette and are diluted to three or four times that bulk with water. The liquid is then heated to boiling, and the glucose solution run in gradually until the precipitation of the copper is complete, the end point of the reaction being determined as previously described under the head of glucose estimations. The no. of c.c. of the glucose solution taken, multiplied by two, will give the number of milligrammes of glucose required to precipitate the copper in 10 c.c. of the Fehling's solution.

The potassium ferrocyanide solution is prepared by dissolving eighty grammes in water and diluting to a bulk of one litre.

The dilute acetic acid used should be about twenty per cent to thirty per cent strength.

The hydrochloric acid used in inversion should have a specific gravity of 1.18–1.20.

DETERMINATION OF ASH.

Two to three grammes of the sample is ignited at a red heat in a weighed platinum or nickel dish until destruction of organic matter is complete.

The sample, previous to incineration in a platinum dish, may be treated with about one cubic centimetre of concentrated sulphuric acid, the heat being applied gradually at first, and then to full redness. One-tenth must be deducted from the weight of the ash thus obtained, on account of the increase in weight caused by the combination of the sulphuric acid with some of the ash constituents.

CALCULATION OF LOSSES FROM INVERSION.

In calculating losses from inversion, the formula given by Dr. Stubbs, in the *Louisiana Planter* of March 30, 1889, is recommended, as by its use the amount of sucrose inverted can be estimated very closely, even where the weight of the juice only, as it comes from the mill, is known. The only data required in this determination is the weight of juice, and the per cents of sucrose and glocose in the juice, and in the products of the different stages of the manufacture. The total amount of inversion, or the amount of sucrose inverted in any single operation, can be readily determined by the application of the formula as here given :

Let s=per cent sucrose in raw juice.

g=per cent glucose in raw juice.

s'=per cent of sucrose in clarified juice, syrup or massecuite.

g'=per cent of glucose in clarified juice, syrup or massecuite.

w=weight of raw juice.

Let x=sucrose inverted between raw juice and clarified juice, syrup or massecuite, as the case may be.

Then $\frac{1}{95}\frac{0}{0}\ x$=glucose gained at same time, as 95 parts of sucrose on inversion yield 100 parts of glucose.

Then $ws-x$=sucrose in clarified juice, syrup or massecuite.

And $wg+\frac{1}{95}\frac{0}{0}\ x$=glucose in same.

But in the clarified juice, syrup or massecuite, the total sucrose and glucose are to each other as s' is to g'; therefore,

$$ws-x : wg+\tfrac{1}{95}\tfrac{0}{0}x :: s' : g'\text{; from which } x=\frac{95\ w\ (ss'-s'g)}{95\ g'+100}$$

This method of calculation can even be applied to the molasses by subtracting from ws, before substitution, the amount of *pure* sugar obtained by weighing and polarizing as it comes from the centrifugal.

SAMPLING.

As the chief object in taking samples is to obtain small fractional portions of the juice and the products of the various processes of the sugar-house, representing as nearly as possible, in composition, the whole, care should be observed to conduct the sampling in such a manner, as regards time and quantity, as to secure analytical results of as comprehensive a character

as possible. In sampling juice, small quantities should be taken from the trough at equal short intervals, and thoroughly mixed, the mixture thus obtained being fairly representative of the juice extracted during the time occupied in taking the samples. In drawing samples of juice or syrup from tanks, the contents should be well mixed by stirring before taking out the desired quantity for analysis; if several of these tanks, however, are to furnish a sample for a single analysis, quantities proportional to the size of each tank should be taken and the whole well mixed. In sampling juice from clarifiers, a mixture of equal quantities taken from several successive fillings of the clarifier will represent fairly well the whole bulk of juice sampled.

It is recommended that samples for analysis be taken as follows:

Raw juice—a sample at least every six hours.

Sulphured juice—sample taken after heating; sampling before heating is considered unnecessary; tests should be made at same intervals as for raw juice.

Clarified juice—sample taken at same intervals as for raw juice.

Syrup—every tank should be sampled.

Sampling of massecuite is to be condemned, as it has been found well nigh impossible to obtain samples homogeneous in character and representative of the whole. The true percentages of sucrose and glucose contained in the massecuite can be closely determined by analyzing and weighing the sugar and molasses produced, and combining the results as follows:

Let w = weight of sugar.
w' = weight of molasses.
s = per cent sucrose in the sugar.
g = per cent glucose in the sugar.
s' = per cent sucrose in molasses.
g' = per cent glucose in molasses.

Then, by combining these terms in formulæ, we have the per cent of sucrose in the massecuite $= 100\,\frac{ws + w's'}{w + w'}$ and per cent of glucose $= \frac{100wg + w'g'}{w + w'}$

The control of diffusion work differs from that of mill work, in that, in addition to the sampling and analysis of the extracted juice, the sugar content of both the fresh and exhausted cane must also be determined.

The fresh chips are passed through an ordinary hand mill, and the analysis of the juice is conducted as usual. The per cent of the sucrose in the juice, multiplied by the estimated average per cent of juice in cane and divided by 100, gives per cent of sucrose in cane. The exhausted chips are also passed through the mill and the expressed juice tested. The per cent of sucrose in exhausted chips subtracted from the per cent

sucrose in the fresh chips, divided by the latter per cent and multiplied by 100, gives per cent ratio of sucrose extracted to the total sucrose present.

Samples of juices and chips should be analyzed as expeditiously as possible after the sample is drawn, as, on standing, changes frequently take place which affect the value of the analytical results.

DETERMINATION OF FIBRE.

Twenty grammes of fresh chips are weighed up and placed in a beaker or Erlenmeyer flask. The samples then washed repeatedly with water of a temperature of from 85 deg, to 90 deg. C., the washings each time being poured off. A temperature of the boiling point must be avoided in the early part of the operation, as coagulation of albuminoids will ensue and the extraction of soluble matters will thereby be hindered. The washings by decantation are continued until soluble albuminoids are dissolved out, when the contents of the flask are boiled with water several times, being treated with fresh portions after each decantation. The insoluble residue is now brought upon a weighed and dried muslin or asbestos filter, and the washing with boiling water is continued upon the filter. The filter and contents are then dried in air bath at 100 to 110 deg. C., and weighed; the increase in weight is amount of fibre. Per cent of fibre deducted from 100 gives per cent of juice.

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SUGARCANE SEEDLINGS.

From the Jamaica *Bulletin.*

ROYAL GARDENS, KEW, 9th August, 1889.

SIR:—With reference to your letter of the 8th December, 1885, and subsequent correspondence on the subject of the improvement of the sugarcane in the West India Colonies, I am desired by Mr. Thiselton Dyer to forward for the information of the Secretary of State, some of the results which have been lately obtained in furtherance of this object.

2. It will be within your recollection that in my letter of the 12th, May, 1866, extracts from which were circulated by the Colonial Office for the information of sugar producing colonies, it was suggested that the attention of botanists and sugar planters in such colonies should be directed to any variations appearing accidentally in the cane fields and that canes exhibiting such variations should be carefully cultivated with a view of testing their value.

3. The circulation of these and other suggestions emanating from Kew has apparently been the means of directing attention to the possibility of securing new varieties of sugarcanes and of generally improving their yield of crystallizable sugar.

Indeed, the correspondence received at this establishment has shown that the subject has received attention in such widely placed colonies as Fiji, Queensland and Mauritius, as well as in the West India Islands and British Guiana.

4. At Barbados a series of very interesting investigations has been carried on for the last four years at the Botanical Station of the colony, under the direction of Professor Harrison and Mr. Bovell. These investigations, supported by the intelligent action of the local Government, were in the first instance confined to trials of various sugarcanes introduced to the West Indies by the botanical establishments of Jamaica, Trinidad and British Guiana, and to the yield of these as compared with the yield of canes already known in the island. The experiments were also directed to test, in an exhaustive manner, the relative value of various manures and to determine under what conditions such manures were calculated to yield the best results.

5. A summary of the conclusions arrived at in these investigations has been regularly published by order of the House of Assembly of Barbados, and it is needless to refer to them here in detail.

6. These investigations, however, possess a special interest because in connection with them a fact has been elicited which it is hoped will have an important bearing upon the ultimate improvement of the sugarcane. It has been shown with some probability, by Messrs. Harrison and Bovell, that under certain circumstances it is possible to raise sugarcane from seed—an occurrence, owing to its extreme rareness, about which there has been so much doubt that it has been thought impossible.

7. The first announcement respecting the probability of sugarcanes having been raised from seed at the Barbados Botanical Station was made in the Kew *Bulletin* for December last. Since that time further information has been received which appears to show, in a perfectly natural and circumstantial manner, that certain varieties of sugarcanes still retain the power of producing mature seed. From a botanical point of view this is sufficiently interesting to require more than a passing notice. From the point of view of the sugar planter, it is a fact which, if established and intelligently followed up, is capable of effecting as much improvement in the sugarcane and in its yield in sugar as has been effected of late years in the beet. For the first time it has been shown that it may be possible to pursue such a system of selection by seminal reproduction in the case of the sugarcane as to greatly increase its value as an industrial plant.

8. The economic bearing of the discovery of seedling sugarcanes at Barbados will, however, depend very much upon the means taken to utilize it to the best advantage. From the ex-

perience gained in the improvement of other cultivated plants by means of seminal reproduction, this fact properly utilized cannot fail to yield results of an important character.

9. At present Mr. Thiselton Dyer is of opinion that Messrs. Harrison and Bovell should be encouraged to devote special attention to the subject of seedling sugarcanes, especially in testing the richness in sugar of the various seedling canes already established by them. It is hoped that the Government of Barbados, to whom great credit is due for the results already obtained will, in view of the importance of the subject, be disposed to support these investigations by such funds as are necessary for the purpose in view.

10. Now that the fact that certain varieties of sugarcanes may produce mature seed appears to be available for their improvement, it is desirable to carry out a series of detailed and systematic experiments to determine how far it is possible to cross one variety with another and produce a progeny possessing certain well marked and highly valued characteristics. This is a natural development of the present circumstances, and the results will entirely depend upon the skill and judgment brought to bear upon them.

11. To assist in this work it may be found desirable that experiments of the character suggested in the last paragraph be also carried on at the botanical establishments at Jamaica, Trinidad and British Guiana. With this view and the concurrence of the Government of Barbados, a few of the seedling canes, and if possible, some of the seed might be distributed to these establishments for the joint observation and investigation of the botanical and analytical officers connected with these colonies.

12. As considerable interest is taken in this matter outside the West Indies, Mr. Thiselton Dyer will be glad to receive a few seedling canes for experimental cultivation at Kew. Further, it is important from a scientific point of view to obtain specimens of what is known to be mature seed of the sugarcane, and that such specimens be placed for observation and safe-keeping in the herbarium attached to this establishment.

I am, etc. (Signed) D. Morris.

Edward Wingfield, Esq., C.B., Colonial Office.

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Genuine perique tobacco is said only to grow on a ridge situated about one mile from the Mississippi river in St. James parish, Louisiana—a ridge only about two miles wide and seven miles in length. The average crop is about 75,000 pounds.

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Topeka, Kan., January 1st.—The annual report of the State Sugar Inspector shows that 1,293,275 pounds were manufactured in 1889, as against 698,274 in 1888.

GREAT FRUIT MART. THE CONSUMPTION OF ALL KINDS IN NEW YORK CITY.

New York as a fruit market ranks first on the continent, yet the transactions in both the imported and domestic green fruits come so little under the observation of the general public, compared with those in other lines of business, that the extent of the trade is not appreciated. And when statistics are examined, and the arrivals here from all this country and Europe are considered, the disposal and consumption of such large quantities of fruit excite wonder. Even the merchants heavily in the trade express surprise at the capacity of New York and nearby cities to absorb the monstrous lots thrown upon the market. It is a remarkable fact that the fruit can be sold at a price even when arriving in unheard of quantities. In conversation with several large receivers of domestic fruit and importers of the foreign article a number of interesting facts have been learned.

LEMONS.

During the early summer the largest receipts of any fruit are in lemons, and this season the quantities imported have been remarkably heavy. In the month of June, during some very hot weather, prices advanced to $7 and $8 per box; but cables and steamers soon brought constantly increasing parcels here from Sicily and Italy, so that the arrivals in July figured up the exceptionally large total of 280,000 boxes, or say about 9,000 each day. Boston, Philadelphia and New Orleans also received some cargoes, and the people of the whole country can now enjoy their lemonade at very reasonable cost, as the late auction sales have shown $3.50 to $2.50 per box on choice sound fruit as the present market value.

ORANGES.

As to oranges, the Sicily fruit ends in June, but through the summer this market is supplied with fruit from Rodi, on the Adriatic, from whence very handsome oranges are imported. Prices at auction range now $5 to 4.50 per box. Some oranges also come from Sorrento, and they are bringing about $4.50 to $4. When it is remembered that over 1,000,000 boxes of this fruit arrived here last season from Sicily, outside of what came in cases from Spain, and besides all this the Florida fruit was in full supply, it will be seen that the trade in oranges is enormous. A large dealer in Florida oranges says that the prospects for a fine crop in that State were never better, and that while one and a quarter million boxes has covered the largest

crop so far grown, it is believed that during the next season, commencing in October, over two million boxes will leave the State, of course, allowing that nothing detrimental to the crop happens in the meantime. Arrangements are also said to have been made to market a part of this crop in England.

PEACHES.

Foremost among the fruits of this country is the peach, and from what can now be learned, nobody need go without the luscious fruit this season. The crops in nearly all sections promise a larger yield than ever before, and the quality of the fruit will be excellent. The outlook in Delaware indicates an enormous crop from that section alone. So large is the quantity, in fact, that the growers and receivers are anxious as to the disposition of it. Last year the production was 1,500,000 baskets in Delaware; this year the best estimates place the crop above 6,000,000 baskets. In New Jersey about half of the full crop is expected, and from the Hudson river and Connecticut full crops are promised. Small lots of Delaware peaches, amounting to about a carload a day, have been arriving for over a week, and double that quantity arrived during the last two days, for this fruit is not yet of choice quality. On Monday the first regular train of the season will be started from the lower Delaware peninsula, over the Pennsylvania Railroad, arriving in Jersey City Tuesday morning. Large lots will follow every day, and a good quality of fruit is promised. In about ten days from thirty to forty cars a day are expected. The canning establishments will take advantage of the large crop and put up more of the fruit than ever before.

CALIFORNIA FRUIT.

The peaches which have been seen in our fruit stores and on the corner stands since the middle of June, have come from California, and are certainly remarkably handsome and attractive. This trade with the great Pacific Coast fruit State was on a very small scale until last season, when the Fruit Union, of Sacramento, started its trains here, and the success which attended the virtual introduction of this fine fruit into our market has resulted in a largely increased demand, and as only six carloads of peaches, pears and plums were auctioned this week, the demand constantly exceeds the supply, and many dealers complain of their inability to fill their orders. The California people have sent most of their fruit to Chicago in the past, and do not seem to remember that there are some five million people within one hundred miles of our City Hall, or they would see that our market is fully supplied. However, as the results here are better than the sales in the West, there

is no doubt that quantities will be increased. Bartlett pears are selling at $4.50 and $4, prime peaches $2.75 and $2.25, large plums $1.75 and $1.50, when in sound condition. As it takes over six days of very rapid traveling to bring the fruit here, some of it is not quite sound on arrival, but the packers are gaining experience, and this will be remedied. It is a business which will grow to enormous proportions, not only because of the handsome fruit sent, but for the reason that all these fruits are about one month ahead of any similar kinds grown in the East.

GRAPES.

Following these come the grapes, and the quantities sold in this market are enough to stagger the belief of those unacquainted with the trade. This State produces nearly every variety known, and the crop this year will be enormous. Reports from the Cayuga and Seneca lake vineyards state that the crop is larger than ever before, and the quality better. There will be very few grapes that have been stung, and, owing to the heavy yield, only the best grapes will be sent to market. Up the Hudson large areas of new vineyars bear for the first time this year, and all the old vines are loaded. There will be three tons of fruit this year where one ton was gathered last year. The Delaware grapes ripen first and they are followed by the Concords and then by Catawbas. Those are the three principal varieties. The crop this year is nearly two weeks later than usual, and no shipments of any amount are expected before the 15th.

FROM THE PACIFIC.

From California, late in August and during September will come the celebrated Tokays—those large, handsome, purple grapes which have only been obtainable in the past at our fancy fruit stores at high prices. This season the crop is a large one and ample supplies will be forwarded here, so that all may enjoy them at reasonable prices—considerably below fifty cents per pound, which has been paid in the past for choice fruit. After September the white grapes from Almeria, which are erroneously called Malaga grapes, will arrive, and the crop there being large and of fine quality, it is confidently expected that receipts will be very heavy up to January. Last season over 200,000 barrels arrived in this city.

There will be fair crops of apples, pears, plums and quinces from the Hudson valley and New Jersey orchards. These fruits are sold by commission merchants, but oranges, lemons and grapes from the Mediterranean and Jamaica, and all fruits from California, are sold at auction here, and much of the crop of Florida oranges is sold in the same way.—*N. Y. Mail.*

THE DIFFUSION PROCESS.

The following details of the working of this process at the Cane Sugar Works, at Plantation Cugden, in New South Wales, will certainly interest our readers, especially those who may be intending to adopt this system. The plant in question was supplied by the Sangerhausen Manufacturing Co., Sangerhausen, Germany:

The diffusion plant supplied to us has given no trouble whatever, and the whole of the machinery worked to our entire satisfaction.

The cutter, with its horizontal cutting disc, answered its purpose very well, and we had no difficulty in feeding the cane into the feed hoppers, as this was being effected by an overhead carrier, on which the cane was thrown in the same manner as at the time when we worked with the mill.

We use the cutter knives twelve hours before re-sharpening them. However, this has to be done more frequently if the cane is of an inferior quality, and especially if it comes from the field with a large amount of roots and trash attached to it. Six hours may fairly be considered as the minimum length of time for which they can be used before they have to be replaced with another set.

The time occupied in changing knives occupies about five minutes.

The Stotz's patent chip elevator, which takes the chips up to the battery, works admirably. We can diffuse on an average seven diffusers per hour. This leaves about eight and one-half minutes' interval between the emptying of two diffusers. The valves, heaters, covers, and bottom doors of the diffusers keep absolutely tight, and the manipulation of this machinery is exceedingly simple.

We had during the whole season an average dilution of the diffusion juice of 26.25 per cent, but we may mention here that since the beginning of this season we have already succeeded in reducing the dilution to 16.5 per cent. This has been effected by a new system of operating the battery.

The loss of sugar in the battery amounted to 0.44 per cent on the weight of the cane. We determined this loss by deducting the amount of sugar by weight, which we found in the diffusion juice, from the amount of sugar by weight, which had actually been put into the battery with the fresh cane chips.

The diffusion juice was treated in the battery with carbonate of lime. We tried liming at first with ordinary quick-lime. However, we soon found that this process involves heavy loss in sugar unless great attention is paid to its execution; for this reason we are now converting the lime into carbonate of lime before we add it to the fresh cane chips.

The carbonic acid pump ordered at the same time serves to draw the combustion gas from our wood furnaces in its passage through the chimney, and at the same time to pump it into the lime tank which is filled with ordinary milk of lime of 20 deg. Beaume. Our chimney gasses carry about from 10 to 12½ per cent of carbonic acid. The gas passes through a gas washer on its way from the chimney to the pump.

The diffusion juice when it comes from the battery is neutral, and resembles in color and appearance Rhine wine; there is not a trace of flocculent or fibrous matter in it, as it has been well filtered through the cane chips on its way through the battery. The proportion of glucose to sucrose in the diffusion juice was the same as in the mill juice, no increase of the amount of glucose could ever be detected, though we were sometimes obliged to leave the juice in the battery some hours in consequence of a stoppage. Once we stopped the battery twelve hours without emptying it, and were very pleased in finding that the juice in the cells did not undergo any deterioration whatever. This we know now is entirely due to our new improved method of defecating in the battery.

The diffusion juice was taken direct to the triple effect without forming any excessive scale in the heating tubes, in fact we found this formation of scale to be even less than we had with the mill juice, the thin layer of scale which formed, consisted entirely of carbonate of lime, which could easily be removed on Saturday night by boiling slightly acid water in each vessel of the triple effect for about thirty minutes; no scraping of the tubes being required.

As we desire to turn out a better class of sugar for future sale in our local market, we are now sulphuring the juice after it comes from the battery, and with the object of securing a better result, we have recommended the use of Baur's filter-press, which commends itself to us as a machine well suited to the object in view, and it appears to us that a further improvement may be made by filtering the syrup through these presses also, before it is drawn into the vacuum pan.

The use of Bauer's filter-presses would, we think, be very advisable even for making ordinary sugar for refineries, and we think that in this case the diffusion juice should be rapidly boiled up for some minutes after it comes from the battery, in order to coagulate even the last traces of albuminoids, and to convert bi-carbonate of lime, which may be kept in solution in the juice, into insoluble carbonate of lime. These insoluble particles could then easily be removed by the sand in the Baur's filter-presses.

We found that we obtained in the massecuite 93.00 per cent of the total sugar in the cane. This was the average of the whole season's work.

We intend to use the exhausted cane chips as manure for our cane fields; our land contains rather little lime, and we prefer, therefore, to return the chips to the fields instead of burning them.

The triple effect and vacuum pan are doing us good service, and we consider especially the style of the triple effect superior to any other which we have seen in this colony. We find the arrangement as juice catchers, Hodek's safes, etc., provided for preventing the juice from boiling over, to be exceedingly practical and good.

The Burckhardt & Weiss dry vacuum pumps and air compressors, which latter is being used in connection with the diffusion battery, work smoothly and to our entire satisfaction.

As regards Bergreen's pug mill, and the small massecuite boxes, supplied to us for this season's use, we have, of course, only been able to use them for a short time, but so far as we are able at this time to judge, we may predict for these also an unqualified success.—*Sugarcane.*

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IRRIGATION IN THE GREAT VALLEYS.

Since the decision of the Supreme Court sustaining the constitutionality of the Wright Irrigation Law in the Turlock case, considerable activity has prevailed in those sections of the State where its operation is practicable and where systematic development of the resources of the soil is otherwise next to impossible. An election was recently held in Colusa for the organization in that county of an irrigation district under the provisions of the Wright law. The election resulted in an almost unanimous vote in favor of the measure, there being only eleven dissenting votes. Hanford, one of the towns located in what is known as the Mussel Slough country, is at present preparing to organize an irrigation district in that section. At Red Bluff, Tehama county, and in the Owens River Valley, Inyo county, the subject of organizing irrigation districts is also being discussed.

The organization of these irrigation districts in the drier sections of the State is a matter of the greatest industrial importance, considered from an agricultural standpoint. It contemplates not only a complete revolution in the nature of the uses of the soil and the form of its products, but it also means a sub-division of large tracts, a great increase in the number of land-owners and an extraordinary demand for labor in these districts.

Take, for instance, the case of Colusa county. It is in that county the Glenn ranch, embracing an area of about 60,000

acres is situated. About 55,000 acres of this land have been devoted to wheat every year for a long time past.' It is the largest wheat ranch in the State. When such a tract of land is embraced within an irrigation district, it becomes immediately available for more profitable uses than wheat growing. These new uses imply the employment of a much greater amount of labor in their development than has been employed in wheat culture. The tillage of so extensive a tract under these new conditions becomes of such gigantic proportions as to be absolutely unwieldly. Subdivision, therefore, resolves itself into the nature of a necessity. An industrial revolution then follows. Where one man has found irregular employment under the old state of affairs, ten will find permanent employment under the new.

It is not at all likely that the wheat farms embraced in these new irrigation districts will be converted into orchards and vineyards. Some of the land will probably go that way, but the majority of it is quite as likely to go into alfalfa and other products for the feeding of stock. The rich bottom lands of Yolo county, under this influence of irrigation, are being thus devoted. There are 75,000 acres of land in that county now covered by irrigation canals and specially adapted to alfalfa culture. Much of it is being gradually surrendered to this prolific and succulent grass, and it yields from ten to fifteen tons of hay per acre. Stock raising is, consequently, becoming one of the most promising industries of that section. It evidently pays quite as well, if not better than fruit or grape raising, for orchards and vineyards are making way for alfalfa fields all along the bottom lands of Yolo county. Notwithstanting there is a grosser growth of grapes and orchard fruits on these bottom lands under the influence of irrigation, the warm hillslopes on the adjacent ranges produce so much earlier and finer flavored fruits, in orchard and vineyard, without irrigation, that fruit and grape growing on the bottom lands are carried on under some disadvantages. Thus without any apparent design and almost unobserved, irrigation in the great valleys is bringing all forms of agriculture in the State within the lines defined by nature. The forest lands are proving most suitable to vineyards and orchards, which in reality are merely other forms of forest growths. Vineyardists and orchardists are, consequently, taking possession of the ranges in preference to the valleys, and the valley lands, under the influences of irrigation, are being gradually restored to the culture of the most valuable farm products in the greatest variety.—*Ex.*

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The *Fruit Trade Journal* speaking of California fruit declares "the Eastern taste is awakening to the fact that California fruit surpasses that from any other part of the world."

JAVA SUGARCANE DISEASE.

Letter from the Director of Kew Gardens to the Colonial Secretary, Jamaica.

ROYAL GARDENS, KEW. 20th July, 1889.

SIR:—I am desired by Mr. Thiselton Dyer to acknowledge the receipt of your letter of the 19th instant, forwarding an extract from a letter from the West India Committee, respecting the importation of sugarcanes to the West Indies from Java and elsewhere.

2. The disease of sugarcane known in Java as Sereh, appears to have been in existence there for many years, but it is only recently that it has assumed a serious aspect. At present it is confined to the western sugar growing district. Eastern Java is as yet free from it.

3. The exact nature of this disease does not appear to have been determined. It may not be infectious, but on the other hand, there can be no doubt that it is causing serious injury to the sugar industry in Java, and the Queensland Government has already taken action with the view of preventing infected canes being introduced into that colony.

4. The course suggested by the West India Committee is one which appeared to Mr. Thiselton Dyer to be justified by the present circumstances. No sugarcanes from the East Indies, Queensland or Mauritius should for the present, and until the nature of the Java disease has been determined, be introduced to the West Indies, and further, it would be well for planters as well as heads of botanic establishments in the West Indies to keep any recently introduced canes under observation with the view of preventing the spread of any disease that may appear amongst them.

I am, etc., (Signed) D. MORRIS.

It may be as well to state that the introduction of sugarcanes from Java and Mauritius is already forbidden by the following Proclamation by His Excellency, Sir H. W. Norman:

In virtue of the power vested in me in that behalf by the First Section of Law 4 of 1884, entitled "The Seeds and Plants Importation Law, 1884," I do hereby prohibit, until further Proclamation, the importation into this island of seeds or plants, or any description of earth or soil, or any article packed therewith, that may have come either directly or indirectly from any of the following countries: Natal, South India, Ceylon, Mauritius, Java and Fiji.

Given under my hand and the Broad Seal of this Island, at King's House, this Second day of December, in the Fifty-first Year of Her Majesty's Reign, Annoque Domini, 1887.

By Command,

J. ALLWOOD, Acting Colonial Secretary.