Edson: Record of experiments at the sugar experiment station on Calumet plantation ...
1889.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF CHEMISTRY.

BULLETIN No. 23.

RECORD OF EXPERIMENTS

AT THE

SUGAR EXPERIMENT STATION ON CALUMET PLANTATION,

PATTERSONVILLE, LA.

BY
HUBERT EDSON,
ASSISTANT IN LABORATORY.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

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PREFATORY NOTE.

SIR: In submitting to you the results of Mr. Hubert Edson's work at Calumet Plantation, La., during 1888, I desire to call your particular attention to the fact that the yield of sugar by the milling process reached the unprecedented amount of over 200 pounds per ton. This remarkable yield was the result of a rich crop and careful chemical and technical control of the factory.

It is believed that the data of this work here published will prove of great benefit to the sugar planters of the country.

Respectfully,

H. W. WILEY,
Chemist.

Hon. J. M. RUSK,
Secretary.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., August 3, 1889.

SIR: I have the honor to submit herewith the first report from Calu met sugar factory to the Department.

Respectfully,

HUBERT EDSON.

Dr. H. W. WILEY,
Chief Chemist.

REPORT OF EXPERIMENTS AT CALUMET SUGAR FACTORY, SEASON 1888-'89.

The present being the first report from Calumet plantation published in the bulletins of this Department, it will be useful, for a proper understanding of the data given, briefly to describe the machinery with which the recorded results were obtained.

The following is kindly furnished by Mr. Wibray J. Thompson, who, having for many years had entire control of the factory, is familiar with the apparatus in every detail of construction, capacity, etc.

I.

REPORT OF CALUMET SUGAR FACTORY, LOUISIANA.—CAMPAIGN 1888-'89.

This factory is located on the immediate bank of the Bayou Teche, 4¼ 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 neighboring 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 vacuum pan, affording 337 square feet heating surface, operated at 15 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 bagassee 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, 26 feet long, 42 inches diameter; flues 15$\frac{3}{4}$ inches diameter; (2) two 17-flue boilers, 22 feet long, 54 inches diameter; flues 6 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 24 inches diameter by 48 inches stroke. This is provided with Corless valves and the Joy expansion gear. The cut-off being ordinarily accomplished only at 42 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 4 pounds average pressure, in juice concentration by double effect. An average of 43 revolutions of the engine is maintained, under 95 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	16$\frac{1}{2}$

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 15 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 governor 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 mills "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 percents 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 sirup and molasses tanks and blowups, 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 sirups. 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 furnished 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 sirups.

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 lining 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 decantation of the clear, defecated juice. About 2 inches of juice are removed from the surface of each defecator by the skimming and brushing, and about 8 inches of settlings are left behind in the bottom of each 35 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 reheated 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 wash-outs and a scum-ditch. The filtered liquors join the juice from which derived in the double effect's receiver, and are concentrated to sirup 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 sirup, 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 60 pounds pressure were necessary to insure the last. Two hours were generally allowed for a cold-water lixiviation of the cake, a pressure some 10 pounds less than that employed for the juice being used and the sweet water being run to two and one-half or three degrees Baumé. 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 biweekly. 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 sirup-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 22 per cent. of the entire volume of juice passes through the presses.

The treatment of sirups is similar to that of other Louisiana establishments. It is not thought necessary to settle these, and they are not reheated 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-proof, is a fine-grained article which dries very slowly in the centrifugals. As high as 50 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 reboiled to a blank string-proof for a third crystallization. Though the second molasses so reboiled 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 2 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, sirup, 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 minature sugar-house, had been added to the "plant." This included a small mill, small diffusion battery of the Hughes system, with defacators, 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 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 reagents, 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 analysis 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 sirup 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, glucose 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 crystallization 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 sirup 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 front 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 this run 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 7 to 8 inches of vacuum could be maintained in its first pan, while 27 to 28 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 6 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 bagasse roll of the front or three-roller mill was broken, but as the season was so near the end the crop did not suffer 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 yield and care of working, will be discussed further on.

SPECIAL INQUIRIES.

One of the things watched with especial 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 sirup 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 any one to stop its use.

As a result of Calumet's work, I can not 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 bone-black 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 18 feet long by 2 in width and depth, and is divided into two parts, the first division containing about 16 feet of 6-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 can not 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 sirup immediately after defecation and from the sirup concentrate to massecuite 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 80 to 87 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
Do ....pounds..	7, 986, 525	6, 776, 623
Sucrose in cane ....do....	1, 016 365	843, 486
Juice extracted..........gallons..	650, 878	599, 213
Do..........pounds..	5, 786, 909	5, 327, 383
Sucrose in juice ....do....	818, 269	736, 478
Sucrose in bagasse ....do....	198, 096	107, 008
Sucrose in bagasse, per cent of total	19. 49	12. 69
Sucrose obtained. per cent of total	80. 51	87. 31
Sucrose obtained, per 1,000 pounds sucrose in cane ....pounds..	805. 1	873. 1
Sucrose gained per 1,000 pounds by maceration ....pounds..	....	68
Sucrose lost in first part of season by not macerating..........pounds..	....	69, 113
Sucrose lost in first part of season per ton of cane..........pounds..	....	17. 31
Sucrose gained in second part of season by maceration..........pounds..	....	57, 357
Sucrose gained in second part of season per ton of cane..........pounds..	....	16. 93
Water added, per cent of normal juice, pounds	....	11. 94
Mill extraction of juice, per cent cane ..	72. 45	78. 61
Average tons crushed per hour..........	14. 22	14. 03

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 can not be given exactly, but since a pound of sucrose in the juice meant a pound of commercial sugar the return can be easily 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 17 pounds of sugar per ton of cane by simply 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 17 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 96 per cent extraction, which can easily be obtained, a net gain over maceration of 23 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 sugar-houses for diffusion.

The most effective and economic maceration will require a dilution of about 15 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 slighest 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° polarization, which should go to market as crystal.

At Fort Scott, Kans., 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 — 1.50 × 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, 338. 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 given below:

	Acid run.	Neutral run.
Cane ground ....tons..	886.23	956.55
Mill extraction ....per cent..	78.48	80.31
Extraction of sucrose ....do....	87.21	89.16
Dilution due to maceration ....do....	13.98	15.49
Sucrose in diluted juice ....do....	12.54	11.46
Sucrose in juice ....pounds..	197,281	197,317
Sucrose in sirup ....do....	186,543	194,671
Mechanical loss between juice and sirup ....do....	10,632	2,646
Inversion of sucrose in whole run ....do....	317	None.
Sugar 100° polarization obtained ....do....	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 can not, 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 juices, 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 a 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 very 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 can not 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	do....	13.94
Glucose in juice	do....	.93
Purity coefficient		85.00
Sucrose in juice	pounds..	1,548,975
Glucose in juice	do....	103,332
Commercial sugar obtained	do....	1,549,078
Sugar of 100° polarization obtained	do....	1,458,876
Sucrose in final molasses		67,423
Inversion of sucrose	pounds..	6,112
Mechanical loss of sucrose	do....	30,431
Total loss of sucrose†	do....	36,543
Total loss of sucrose	per cent..	2.36

Analyses of molasses boiled for third sugar.

No.	Solids.	Sucrose.		Purity.	Glucose.
		Direct.	Indirect.		
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*
224	77.4	28.18	33.20	42.77	33.74
489	75.4	34.4	38.96	51.67	20.38
493	77.6	33.4	37.10	47.81	21.51
494	75.8	30.4	36.88	48.65	21.17
495	80.1	27.2	33.10	40.09	32.55
496	81.5	28.2	33.92	41.62	32.49
497	77.1	36.4	41.18	53.41	23.60
498	76.6	35.4	39.88	52.06	20.12
499	76.2	35.2	39.72	52.11	19.94
500	74.4	39.0	42.62	57.28	20.23
502	80.6	33.6	37.30	46.28	19.97
503	77.1	33.6	....	....	22.37

This table is given to show to what point crystallization can be carried. In one instance the glucose is already in excess of the sucrose, and in others the amount is nearly equal, and yet from all these a good crop of crystals was secured.

* 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 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.

Analyses of final molasses.

	Solids.	Sucrose.		Purity.	Glucose.
		Direct.	Indirect.		
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*
First stubble run	79.3	18.4	23.56	29.70	42.09
Second stubble run	78.3	17.6	23.78	30.37	32.68
First plant run	78.6	20.4	26.30	33.49	30.85
Second plant run	78.8	23.2	29.11	36.94	29.36
Third plant run	77.6	22.0	26.62	34.44	28.52
Means	78.52	20.32	25.87	32.99	32.70

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 masceration was began 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 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 campaigns, 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 sirup 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, 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 diffusions 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.

TABLE No. 1.—*Raw juice, second stubble run.*

Number.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
23	Nov. 8	15.97	12.77	79.96	1.19	9.32
29	Nov. 8	16.40	13.41	81.77	1.11	8.28
33	Nov. 8	16.38	12.91	78.81	1.33	10.30
37	Nov. 9	15.84	13.30	83.96	.98	7.37
42	Nov. 9	15.67	13.03	83.16	1.00	7.67
48	Nov. 9	15.79	13.00	82.33	.98	7.54
52	Nov. 10	16.10	13.49	83.76	1.02	7.56
56	Nov. 10	16.88	14.44	86.73	.92	6.37
59	Nov. 10	16.29	13.60	83.48	1.06	7.79
64	Nov. 11	16.79	14.31	86.47	.97	6.78
77	Nov. 13	16.01	13.79	86.13	.94	6.82
83	Nov. 13	16.60	14.36	86.51	.88	6.13
87	Nov. 13	16.40	13.88	84.63	.91	6.56
91	Nov. 14	15.99	13.55	84.74	.89	6.57
94	Nov. 14	16.54	13.85	83.67	.86	6.21
97	Nov. 14	16.32	13.96	85.54	.86	6.16
102	Nov. 15	16.80	14.66	88.57	.79	5.39
105	Nov. 15	16.87	14.56	86.31	.81	5.56
113	Nov. 15	16.44	14.17	86.19	.91	6.42
Means		16.32	13.78	84.43	.97	7.04

TABLE No. 2.—*Sulphured juice, second stubble run.*

Number.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
24	Nov. 8	16.09	12.87	79.99	1.17	9.01
30	Nov. 8	16.61	13.60	81.88	1.05	7.73
34	Nov. 8	16.81	13.20	78.64	1.23	9.32
38	Nov. 9	16.02	13.19	82.33	.98	7.45
43	Nov. 9	15.70	12.93	82.36	1.01	7.81
49	Nov. 9	16.01	12.90	80.57	.98	7.60
53	Nov. 10	16.15	13.27	82.18	1.03	7.76
57	Nov. 10	17.03	14.46	84.91	.91	6.29
60	Nov. 10	16.36	13.40	82.03	.90	6.72
65	Nov. 11	17.17	14.27	83.10	.98	6.87
78	Nov. 13	16.20	13.65	84.26	.93	6.81
84	Nov. 13	16.66	14.29	85.17	.85	5.97
88	Nov. 13	16.54	13.96	84.40	.90	6.44
92	Nov. 14	16.09	13.54	84.09	.86	6.35
95	Nov. 14	16.65	13.88	83.36	.88	6.34
98	Nov. 14	16.38	13.77	84.09	.88	6.39
103	Nov. 15	16.82	14.54	86.44	.79	5.43
106	Nov. 15	16.77	14.32	85.39	.81	5.66
114	Nov. 15	16.30	13.99	85.83	.92	6.57
Means		16.44	13.68	83.21	.95	6.94

TABLE No. 3.—*Clarified juice, second stubble run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
25	Nov. 8	16.71	13.42	80.19	1.29	9.61
31	Nov. 8	16.23	13.27	81.76	1.11	8.36
35	Nov. 8	16.85	13.26	78.82	1.30	9.65
39	Nov. 9	16.34	13.32	81.52	.96	7.21
44	Nov. 9	16.60	13.60	81.93	.92	6.76
50	Nov. 9	16.13	13.15	81.52	.98	7.45
54	Nov. 10	16.48	13.66	82.89	1.03	7.54
58	Nov. 10	17.08	14.68	85.89	.92	6.27
61	Nov. 10	17.04	14.09	82.10	1.16	8.23
66	Nov. 11	17.47	14.48	82.88	.97	6.70
79	Nov. 13	16.90	14.27	85.62	.93	6.51
85	Nov. 13	16.21	13.78	85.01	.91	6.60
89	Nov. 13	15.56	12.40	79.69	.77	6.21
93	Nov. 14	16.21	13.70	84.51	.87	6.55
96	Nov. 14	16.60	14.00	84.34	.86	6.14
99	Nov. 14	16.46	13.89	84.33	.88	6.34
104	Nov. 15	17.00	14.61	85.94	.79	5.41
107	Nov. 15	16.97	14.40	84.36	.79	5.49
115	Nov. 15	16.71	14.04	84.02	.95	6.77
Means		16.61	13.79	83.02	.97	7.03

TABLE No. 4.—*Sirup, second stubble run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
36	Nov. 8	57.90	46.10	79.76	3.84	8.33
51	Nov. 9	55.28	46.16	83.50	4.25	9.27
63	Nov. 10	57.06	48.76	85.63	3.92	8.04
90	Nov. 13	56.86	49.16	86.46	3.44	6.98
100	Nov. 14	54.86	48.58	88.55	3.12	6.42
116	Nov. 15	56.58	49.66	87.77	3.12	6.28
Means		56.42	47.79	85.72	3.62	7.57

TABLE No. 5.—*Sugars, second stubble run.*

No.	Description of sample.	Date.	Sucrose.	Glucose.
			Per cent.	*Per cent.*
20	First sugar	Nov. 6	98.2	....
445	....do	Dec. 29	98.4	....
446	....do	Dec. 29	99	....
	Mean		98.5	....
447	Second sugar	Dec. 29	88	3.63
448	....do	Dec. 29	86	3.33
449	....do	Dec. 29	90	3.22
	Mean		88	3.39
521	Third sugar	Feb. 18	80.4	7.13

TABLE No. 6.—*Third molasses, second stubble run.*

No.	Date.	Solids.	Sucrose.		Purity. Double polarization.	Glucose.	Glucose ratio. Double polarization.
			Single polarization.	Double polarization.			
		Per cent.	*Per cent.*	*Per cent.*		*Per cent.*	
521	Feb. 18	78.3	17.6	23.78	30.37	36.62	154.00

Summary.—Second stubble run.

Cane ground	
Cane ground ....tons..	1,945.04
Sucrose in cane ....pounds..	3,890,078
Juice extracted ....do....	482,447.44
Juice extracted ....gallons..	318,775
Sucrose in juice ....pounds..	2,831,535
Sucrose in bagasse ....do	390,185.52
Sucrose extracted, per cent of sucrose in cane ....do....	92,261.92
Glucose in juice	80.88
Available sugar at 1.50 × glucose deducted from sucrose..........pounds..	27,465.89
Total sugars in juice ....do....	348,986.68
Sirup obtained ....do....	413,120.95
Sirup obtained ....gallons..	75,606
Sucrose in sirup ....pounds..	799,155.42
Loss of sucrose between juice and sirup ....do....	381,916.38
Glucose in sirup ....do....	8,269.14
Inversion of sucrose ....do....	28,929.43
Commercial first sugar obtained ....do....	1,922.94
First sugar of 100° polarization obtained ....do....	260,663
Commercial second sugar obtained ....do....	256,753.06
Second sugar of 100° polarization obtained ....do....	96,145
Glucose in second sugar ....do....	84,607.60
Commercial third sugar obtained ....do	3,259.32
Third sugar of 100° polarization obtained ....do....	25,141
Glucose in third sugar ....do....	20,213.36
Third molasses obtained ....do....	1,792.55
Third molasses obtained ....gallons..	6,900
Sucrose in third molasses, single polarization ....pounds..	80,868
Sucrose in third molasses, double polarization ....do....	14,232.77
Glucose in third molasses ....do....	19,230.41
Gain in glucose between sirup and product ....do....	26,427.66
Inversion of sucrose between sirup and product ....do....	2,550.10
Inversion of extracted sucrose during entire run ....do....	2,422.60
Sucrose in sirup + that shown by double polarization ....do....	4,365.54
Sucrose obtained as sugar ....do....	386,914.02
Total sucrose obtained in sugars and molasses ....do....	361,574.02
Total glucose obtained in sugars and molasses ....do....	380,804.43
Mechanical loss of sucrose between sirup and product ....do....	31,479.53
Mechanical loss of sucrose during whole run ....do....	3,676.99
Loss of extracted sucrose during entire run by inversion and mechanically ....pounds..	10,023.19
Loss of extracted sucrose during entire run ....per cent..	14,388.73
	3.69

TABLE No. 7.—*Raw juice, first plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose. Ratio.
		Per cent.	*Per cent.*		*Per cent.*	
117	Nov. 16	16.98	14.69	86.63	....	....
123	Nov. 16	16.73	14.31	85.53	....	....
126	Nov. 16	16.87	14.39	85.30	....	....
129	Nov. 17	16.82	14.61	86.86	.70	4.79
138	Nov. 17	16.69	14.15	84.79	1.10	7.77
141	Nov. 17	17.07	14.83	86.88	.74	4.99
146	Nov. 19	17.55	15.27	87.01	.54	3.53
153	Nov. 19	16.68	14.25	85.24	.85	5.96
159	Nov. 19	17.16	14.83	86.42	.80	5.39
164	Nov. 20	17.21	14.45	83.96	....	....
168	Nov. 21	16.36	14.23	86.99	.68	4.77
171	Nov. 21	16.06	13.79	85.86	.94	6.82
174	Nov. 21	16.37	14.28	87.23	.90	6.30
180	Nov. 22	16.97	14.65	87.51	.74	5.05
183	Nov. 22	16.94	14.84	87.60	.73	4.91
187	Nov. 22	17.03	14.81	86.96	.72	4.87
193	Nov. 23	16.35	14.05	85.93	.99	7.04
196	Nov. 23	16.62	14.42	86.76	1.00	6.93
199	Nov. 23	16.83	14.83	88.01	.78	5.26
203	Nov. 24	16.87	14.53	86.13	.79	5.44
206	Nov. 24	16.51	14.28	86.49	.98	6.86
214*	Nov. 24	16.02	13.97	87.20	.88	6.30
227	Nov. 26	14.65	12.72	86.83	.61	4.79
231	Nov. 26	15.04	13.07	86.90	.61	4.67
236	Nov. 26	15.74	13.28	84.38	.67	4.29
241	Nov. 27	15.35	12.94	84.30	.89	6.88
245	Nov. 27	15.24	13.45	88.25	.56	4.16
253	Nov. 27	15.23	12.57	82.53	.68	5.41
258	Nov. 28	14.60	12.45	85.27	.71	5.70
264	Nov. 28	14.66	12.59	85.88	.92	7.31
268	Nov. 28	15.10	13.00	86.09	.94	7.23
273	Nov. 29	14.80	12.58	85.00	.99	7.87
280	Nov. 29	15.63	13.17	84.25	.85	6.45
289	Nov. 30	14.57	12.64	86.75	.94	7.44
298	Nov. 30	14.62	12.41	84.88	.84	6.77
302	Nov. 30	14.60	12.45	85.27	.89	7.15
306	Dec. 1	14.73	12.56	85.27	....	....
308	Dec. 1	13.83	11.81	85.52	....	....
310	Dec. 1	13.60	11.95	87.87	....	....
Means	....	15.92	13.69	85.99	.81	5.92

* Maceration begun.

TABLE NO. 8.—*Sulphured juice—first plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
118	Nov. 16	17.04	14.58	85.56	....	....
124	Nov. 16	17.02	14.30	84.02	....	....
127	Nov. 16	16.93	14.25	84.16	....	....
130	Nov. 17	16.87	14.47	85.77	.70	4.84
139	Nov. 17	16.72	14.18	84.81	.93	6.56
142	Nov. 17	16.90	14.58	86.27	.75	5.14
147	Nov. 19	17.48	15.12	86.50	.64	4.23
154	Nov. 19	16.72	14.37	85.94	.83	5.78
160	Nov. 19	17.14	14.56	84.95	.78	5.36
165	Nov. 20	17.06	14.47	84.82	....	....
169	Nov. 21	16.33	14.06	86.10	.68	4.84
172	Nov. 21	16.18	13.79	85.11	.91	6.60
175	Nov. 21	16.43	14.09	85.15	.88	5.54
181	Nov. 22	16.88	14.52	87.20	.70	4.82
184	Nov. 22	16.91	14.68	86.81	.72	4.90
188	Nov. 22	17.27	14.64	84.77	.72	4.92
194	Nov. 23	16.48	14.09	85.50	.99	7.03
197	Nov. 23	16.62	14.51	87.30	.84	5.78
200	Nov. 23	16.91	14.73	87.11	.79	5.36
204	Nov. 24	16.86	14.60	86.60	.81	5.55
207	Nov. 24	16.63	14.22	85.51	.97	6.82
215*	Nov. 24	15.96	13.98	87.59	.86	6.15
228	Nov. 26	14.67	12.74	86.84	.62	4.87
232	Nov. 26	14.81	12.74	86.02	.57	4.47
237	Nov. 26	15.54	13.49	86.81	.67	4.90
242	Nov. 27	14.65	12.29	83.89	.87	7.08
246	Nov. 27	14.81	12.67	85.55	.53	4.20
254	Nov. 27	15.22	12.63	82.97	.71	5.62
259	Nov. 28	14.54	12.49	85.93	.73	5.80
265	Nov. 28	14.57	12.05	82.70	.95	7.88
269	Nov. 28	15.08	12.74	84.48	.92	7.22
274	Nov. 29	14.79	12.48	84.18	.97	7.77
281	Nov. 29	15.97	12.88	80.65	.82	6.83
290	Nov. 30	14.39	12.06	83.81	.95	7.88
299	Nov. 30	14.58	12.51	85.80	.81	6.50
303	Nov. 30	14.72	12.45	84.58	.84	6.75
Means	....	16.05	13.70	85.36	.80	5.84

* Maceration begun.

TABLE NO. 9.—*Clarified juice—first plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	Per cent.		Per cent.	
119...........	Nov. 16	17.68	15.15	85.80	....	....
125...........	Nov. 16	16.87	14.27	84.58	....	....
128...........	Nov. 16	16.90	14.40	85.21	....	....
131...........	Nov. 17	16.62	14.50	87.24	.68	4.69
140...........	Nov. 17	16.70	14.43	86.41	.89	6.16
143...........	Nov. 17	16.71	14.48	86.65	.74	5.12
148...........	Nov. 19	17.57	15.09	85.88	.58	3.84
155...........	Nov. 19	16.87	14.61	86.60	.82	5.61
161...........	Nov. 19	17.22	14.85	86.23	.77	5.19
166...........	Nov. 20	17.40	14.66	84.25	....	....
170...........	Nov. 21	16.57	14.21	85.18	.72	5.07
173...........	Nov. 21	16.56	14.08	85.02	.88	6.24
176...........	Nov. 21	16.75	14.31	85.43	.85	5.94
182...........	Nov. 22	17.24	14.71	85.33	.73	4.96
185...........	Nov. 22	17.38	14.89	85.67	.72	4.83
189...........	Nov. 22	17.00	14.75	86.77	.69	4.68
195...........	Nov. 23	16.77	14.73	87.83	.95	6.45
198...........	Nov. 23	16.71	14.70	87.97	.81	5.51
201...........	Nov. 23	16.94	14.78	87.25	.75	5.07
205...........	Nov. 24	17.16	14.77	86.07	.81	5.48
208...........	Nov. 24	16.82	14.22	85.14	.91	6.40
216*..........	Nov. 24	16.31	13.91	85.28	.82	5.89
229...........	Nov. 26	14.75	12.83	86.99	.58	4.52
233...........	Nov. 26	15.06	13.01	86.39	.57	4.87
238...........	Nov. 26	15.81	13.64	86.27	.69	5.05
243...........	Nov. 27	14.77	12.40	83.95	.84	6.77
247...........	Nov. 27	14.74	12.85	87.18	.53	4.12
255	Nov. 27	15.40	12.76	82.86	.69	5.41
260...........	Nov. 28	14.94	12.77	84.81	.69	5.40
266...........	Nov. 28	15.01	12.98	86.47	.92	7.10
270...........	Nov. 28	15.20	13.08	86.05	.92	7.03
275...........	Nov. 29	14.65	12.58	85.87	.95	7.55
282...........	Nov. 29	15.41	13.13	85.20	.82	6.25
291...........	Nov. 30	15.13	12.44	82.22	.94	7.56
300...........	Nov. 30	15.00	12.55	83.67	.83	6.62
304...........	Nov. 30	15.07	12.53	83.15	.89	7.10
Means..	....	16.21	13.89	85.69	.78	5.62

* Maceration begun.

TABLE No. 10.—*Sirup, first plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
128	Nov. 16	55.42	48.41	87.35	2.55	5.05
144	Nov. 17	55.90	48.67	87.07	2.96	6.08
163	Nov. 19	54.60	48.94	89.63	2.50	....
179	Nov. 21	56.21	49.14	87.40	2.68	5.45
190	Nov. 22	53.95	47.39	87.84	2.36	4.98
202	Nov. 23	54.29	47.54	87.57	2.99	6.29
223	Nov. 24	53.86	47.30	87.82	2.86	6.05
239	Nov. 26	53.87	48.59	90.20	2.55	5.25
256	Nov. 27	49.50	44.83	90.56	2.40	5.35
271	Nov. 28	46.83	40.72	86.95	2.65	6.51
283	Nov. 29	48.92	41.97	85.79	2.82	6.72
Means	....	53.03	46.68	87.84	2.82	6.04

TABLE No. 11.—*Sugars, first plant run.*

No.	Description of sample.	Date.	Sucrose.	Glucose.
			Per cent.	*Per cent.*
453	First sugar	Dec. 2	99.	....
454	......do	Dec. 2	98.4	....
455	......do	Dec. 2	98.	....
456	......do	Dec. 2	98.2	....
457	......do	Dec. 2	98.2	....
458	......do	Dec. 2	97.6	....
459	......do	Dec. 2	99.	....
	Mean	....	98.34	....
461	Second sugar	Jan. 4	88.4	2.98
462	......do	Jan. 4	88.	2.93
463	......do	Jan. 4	87.4	3.07
464	......do	Jan. 4	86.	3.19
465	......do	Jan. 4	85.8	3.47
466	......do	Jan. 4	86.2	3.86
	Mean	....	87.4	3.25
511	Third sugar	Feb. 9	80.	6.92

TABLE No. 12.—*Third molasses, first plant run.*

No.	Date.	Solids.	Sucrose.		Purity.	Glucose.
			Single polariza-tion.	Double polariza-tion		
		Per ct.	*Per cent.*	*Per cent.*		*Per cent.*
514	Feb. 9	78.6	29.4	26.30	33.46	30.85

Summary—First plant run.

Cane ground	tons	3,593.75
Cane ground	pounds	7,187,490
Sucrose in cane	do	925,015.66
Juice extracted, without maceration	gallons	332,103
Juice extracted, with maceration	do	297,158
Total juice extracted	do	629,261
Juice extracted	pounds	5,582,114
Sucrose in juice	do	764,191.41
Sucrose in bagasse	do	60,824.25
Sucrose extracted, per cent of sucrose in cane		82.61
Glucose in juice	pounds	45,215.12
Available sugar, at 1.50 × glucose deducted from sucrose	do	696,189.62
Total sugar in juice	do	809,406.53
Sirup obtained	gallons	153,826
Sirup obtained	pounds	1,612,096
Sucrose in sirup	do	752,526.41
Loss of sucrose between juice and sirup	do	11,665
Glucose in sirup	do	45,461.11
Inversion of sucrose between juice and sirup	do	857.88
Mechanical loss of sucrose between juice and sirup	do	10,807.12
Commercial, first sugar obtained	do	493,456
First sugar, 100° polarization obtained	do	487,267.58
Commercial, second sugar obtained	do	210,713
Second sugar, 100° polarization obtained	do	183,594.24
Glucose in second sugar	do	6,648.17
Commercial third sugar obtained	do	54,480
Third sugar 100° polarization (1,728 pounds of 57.6° polarization)	do	43,196.95
Glucose in third sugar	do	3,770.02
Third molasses obtained	gallons	9,850
Third molasses obtained	pounds	115,540.50
Sucrose in third molasses, single polarization	do	23,570.26
Sucrose in third molasses, double polarization	do	30,387.15
Glucose in third molasses	do	35,644.24
Gain in glucose between sirup and product	do	601.32
Inversion of sucrose between sirup and product	do	571.25
Inversion of sucrose during entire run	do	1,429.13
Sucrose in sirup + that shown by double polarization	do	759,343.30
Sucrose obtained as sugar	do	714,058.77
Sucrose obtained in sugars and molasses	do	744,445.92
Glucose obtained in sugars and molasses	do	46,062.43
Sucrose carried into other runs as "tank bottoms"	do	13,448.09
Mechanical loss of sucrose between sirup and product	do	878.04
Mechanical loss of sucrose extracted during entire run	do	11,685.16
Loss of extracted sucrose during entire run by inversion and mechanically	pounds	13,114.29
Loss of extracted sucrose during entire run, per cent		1.72

TABLE NO. 13.—*Raw juice, second plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
325	Dec. 3	15.10	13.15	87.08	.82	6.24
330	Dec. 3	15.12	12.72	84.13	.74	5.82
334	Dec. 3	15.27	12.99	85.07	.91	6.92
339	Dec. 4	13.93	12.00	85.15	.85	7.08
344	Dec. 4	14.12	11.90	84.24	.84	7.05
348	Dec. 4	14.79	12.58	84.38	.89	7.07
354	Dec. 5	14.31	12.21	85.32	.84	6.88
358	Dec. 5	14.61	12.55	85.93	.80	6.37
363	Dec. 5	14.93	12.77	85.53	.84	6.58
Means		14.69	12.54	85.30	.84	6.70

TABLE NO. 14.—*Sulphured juice, second plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose, ratio.
		Per cent.	*Per cent.*		*Per cent.*	
326..........	Dec. 3	14.96	12.69	84.25	.77	6.07
331..........	Dec. 3	14.31	12.22	85.39	.73	5.97
335..........	Dec. 3	14.37	12.26	85.32	.71	5.63
340..........	Dec. 4	14.03	11.93	85.03	.81	6.79
345..........	Dec. 4	14.37	12.24	85.18	.82	6.70
349..........	Dec. 4	14.93	12.58	83.66	.91	7.23
355..........	Dec. 5	14.68	12.30	83.79	.87	7.07
359..........	Dec. 5	14.87	12.45	83.73	.79	6.36
364..........	Dec. 5	15.05	12.86	85.45	.85	6.61
Means...	....	14.62	12.39	84.75	.81	6.54

TABLE NO. 15.—*Clarified juice, Second plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
327..........	Dec. 3	15.19	13.06	85.98	.76	5.82
332..........	Dec. 3	14.77	12.42	84.02	.70	5.64
336..........	Dec. 3	14.83	12.70	85.64	.73	5.75
341..........	Dec. 4	14.38	12.17	84.63	.79	6.49
346..........	Dec. 4	14.95	12.65	84.62	.85	6.63
349..........	Dec. 4	15.24	12.84	84.25	.88	6.85
356..........	Dec. 5	14.46	12.42	85.89	.85	6.84
360..........	Dec. 5	15.00	12.54	83.60	.84	6.70
365..........	Dec. 5	15.25	13.06	82.36	.86	6.58
Means ...	....	14.90	12.65	84.90	.81	6.40

TABLE NO. 16.—*Sirup, Second plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
337..........	Dec. 3	49.60	42.89	86.47	2.61	6.09
351..........	Dec. 4	50.62	43.78	86.48	3.20	7.31
366..........	Dec. 5	48.50	41.55	85.67	2.88	6.93
Means ...	....	49.57	42.74	86.22	2.89	6.76

TABLE NO. 17.—*First massecuite, Second plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
376..........	Dec. 8	89.77	81.2	90.45	5.07	6.24
377..........	Dec. 8	89.76	81.6	90.91	5.53	6.78
425..........	Dec. 20	90.10	81.2	90.12	5.59	6.89
426..........	Dec. 20	90.70	82.2	90.63	6.48	7.89
427..........	Dec. 21	90.77	81.0	89.24	5.73	7.08
428..........	Dec. 21	90.84	80.4	88.51	5.65	7.03
429..........	Dec. 21	90.81	81.6	89.86	5.57	6.83
430..........	Dec. 22	89.93	80.6	89.62	5.67	7.01
431..........	Dec. 22	90.90	81.0	89.11	5.09	6.28
Means...	....	90.40	81.20	89.83	5.60	6.89

TABLE No. 18.—*Second massecuite, Second plant run.*

No.	Date.	Solids.	Sucrose, single polarization.	Sucrose, double polarization.	Purity.	Glucose.
		Per cent.	*Per cent.*	*Per cent.*		*Per cent.*
440...........	Dec. 26	84.78	65.6	69.18	81.60	12.45
441...........	Dec. 26	83.18	63.6	67.04	80.65	11.25
442...........	Dec. 26	85.30	64.6	68.18	79.94	12.55
443...........	Dec. 26	83.97	65.4	68.32	81.36	11.58
444...........	Dec. 27	84.40	62.4	64.84	76.82	13.51
Means...	....	84.32	64.32	67.51	80.06	12.27

TABLE No. 19.—*Sugars, Second plant run.*

No.	Description of sample.	Date.	Sucrose.	Glucose.
			Per cent.	*Per cent.*
435	First sugar ..	Dec. 24	98.8	....
436	....do	Dec. 24	99.0	....
437	...do	Dec. 24	99.0	....
438	...do	Dec. 24	99.0	....
439	....do	Dec. 24	98.8	....
	Mean	....	98.92	....
468	Second sugar ..	Jan. 7	83.8	4.71
469	...do	Jan. 7	85.2	4.41
	Means...	....	84.5	4.56
513	Third sugar ..	Feb. 9	78.8	6.43

TABLE No. 20.—*Molasses, Second plant run.*

No.	Description of sample.	Date.	Solids.	Sucrose. Single polarization.	Sucrose. Double polarization.	Purity.	Glucose
			Per cent.	*Per cent.*	*Per cent.*		*Per cent.*
433	First molasses.	Dec. 22	69.81	55.0	57.22	81.97	10.62
434	....do	Dec. 24	73.31	56.4	58.90	80.34	10.16
	Means ..	....	71.56	55.7	58.06	81.14	10.39
493	Sec'd molasses	Jan. 15	77.6	33.4	37.10	47.81	21.51
494	....do	Jan. 15	75.8	33.4	36.88	48.65	21.17
	Means ...	....	76.7	33.4	36.99	48.23	21.34
516	Third molasses	Feb. 10	78.8	23.2	29.11	36.94	29.36

Summary.—Second plant run.

Cane ground		
Cane ground	tons	886.23
Sucrose in cane	pounds	1,772,460.00
Juice extracted, as diluted	do	226,201.35
Juice extracted, normal	gallons	178,230.00
Juice extracted, as diluted	do	156,370.00
Juice extracted, normal	pounds	1,574,811.00
Sucrose in juice	do	1,391,145.00
Sucrose in bagasse	do	197,281.00
Sucrose extracted, per cent of sucrose in cane	do	28,920.34
Glucose in juice		87.21
Available sugar, at 1.50 × glucose deducted from sucrose	pounds	13,228.41
Total sugar in juice	do	177,438.40
Sirup obtained	do	210,509.41
Sirup obtained	gallons	42,540.00
Sucrose in sirup	pounds	436,460.00
Loss of sucrose between juice and sirup	do	186,543.00
Glucose in sirup	do	10,738.00
Inversion of sucrose between juice and sirup	do	12,613.65
Mechanical loss of sucrose between juice and sirup	do	106.57
Number of cubic feet of first massecuite obtained	do	10,631.63
First massecuite obtained		2,105.00
Sucrose in first massecuite	pounds	229,207.50
Inversion of sucrose between sirup and first masse cuite	do	186,116.48
Mechanical loss of sucrose between sirup and first massecuite	do	210.87
Glucose in first massecuite	do	215.65
Commercial first sugar obtained	do	12,835.62
First sugar of 100° polarization	do	126,616.00
Second massecuite obtained	do	125,248.55
Sucrose in second massecuite, single polarization	do	94,272.74
Sucrose in second massecuite, double polarization	do	60,646.23
Sucrose in second massecuite and first sugar	do	63,643.53
Excess of sucrose shown by double polarization	do	188,892.08
Glucose in second massecuite	do	2,997.30
Commercial second sugar obtained	do	11,567.27
Second sugar of 100° polarization	do	57,262.00
Glucose in second sugar	do	48,386.38
Second molasses obtained	do	2,611.15
Sucrose in second molasses, single polarization	do	42,367.45
Sucrose in second molasses, double polarization	do	14,150.73
Glucose in second molasses	do	15,671.72
Commercial third sugar	do	9,041.21
Third sugar of 100° polarization	do	8,998.00
Glucose in third sugar	do	7,090.42
Third molasses obtained	do	578.57
Third molasses obtained	gallons	2,550.00
Sucrose in third molasses, single polarization	pounds	29,962.50
Sucrose in third molasses, double polarization	do	6,940.28
Glucose in third molasses	do	8,722.08
Sucrose obtained as sugar	do	8,796.99
Sucrose obtained in sugar and molasses	do	180.725.35
Excess of sucrose due to error in sampling or analysis	do	189,447.43
Loss of extracted sucrose during entire run by inversion and mechanically	do	555.35
Loss of extracted sucrose during entire run	pounds	10,738.00
	per cent	5.44

TABLE No. 21.—*Raw juice—Third plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
368	Dec. 6	14.37	11.42	79.42	.80	7.00
372	Dec. 7	13.90	11.49	82.06	1.17	10.18
379	Dec. 10	13.51	11.40	83.64	.92	8.00
385	Dec 10	13.95	11.55	82.80	1.10	9.52
389	Dec. 10	14.05	11.78	83.13	1.04	8.83
396	Dec. 11	14.50	11.56	80.41	1.11	9.62
402	Dec. 11	14.24	11.39	79.84	1.08	9.48
408	Dec. 11	14.17	11.79	83.20	.84	7.12
413	Dec. 12	13.47	11.12	82.55	1.03	9.26
418	Dec. 12	13.32	11.09	83.26	.82	7.39
Means		13.95	11.46	82.15	.99	8.64

TABLE No. 22.—*Sulphured juice—Third plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
369	Dec. 6	14.38	11.38	79.14	.80	7.03
373	Dec. 7	13.97	11.44	81.89	1.20	10.49
380	Dec. 10	13.75	11.26	80.43	.95	8.44
386	Dec. 10	13.95	11.60	83.15	1.12	9.66
390	Dec. 10	14.20	11.88	83.66	1.04	8.76
397	Dec. 11	14.73	11.51	78.14	1.09	9.47
403	Dec. 11	14.35	11.34	79.02	1.08	9.52
409	Dec. 11	14.27	12.03	84.30	.93	7.73
414	Dec. 12	13.50	11.17	82.74	1.01	9.04
419	Dec. 12	13.37	11.18	83.62	.77	6.88
Means		14.05	11.48	81.71	1.00	8.71

TABLE No. 23.—*Clarified juice—Third plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
370	Dec. 6	14.85	12.39	83.43	.77	6.22
374	Dec. 7	14.35	11.92	83.07	1.12	9.40
381	Dec. 10	14.38	12.12	84.94	.91	7.51
387	Dec. 10	14.49	11.92	82.26	1.12	9.40
391	Dec. 10	14.47	12.17	84.11	.97	7.97
398	Dec. 11	14.91	12.40	83.17	1.08	8.71
404	Dec. 11	14.73	12.30	83.44	1.02	8.29
410	Dec. 11	15.00	12.54	83.60	.85	6.78
415	Dec. 12	13.82	11.56	83.65	.92	7.95
420	Dec. 12	13.44	11.58	86.16	.73	6.30
Means		14.44	12.09	83.72	.95	7.86

TABLE No. 24.—*Sirup—Third plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
375	Dec. 7	48.22	41.43	85.92	3.10	7.48
394	Dec. 10	47.41	40.22	84.84	3.35	8.33
411	Dec. 11	49.87	42.06	84.34	3.31	7.87
422	Dec. 12	48.22	40.78	84.57	2.88	7.06
Means	....	48.43	41.12	84.91	3.16	7.68

TABLE No. 25.—*First massecuite—Third plant run.*

No.	Date.	Solids.	Sucrose.	Purity.	Glucose.	Glucose ratio.
		Per cent.	*Per cent.*		*Per cent.*	
460	Jan. 3	89.17	80.8	90.61	4.97	6.15
467	Jan. 4	88.89	79.6	89.55	5.73	7.20
470	Jan. 7	89.97	80.0	88.92	5.45	6.81
477	Jan. 7	90.86	80.0	88.05	6.03	7.54
480	Jan. 9	90.48	80.4	88.86	5.81	7.23
481	Jan. 11	91.41	81.0	88.61	6.13	7.57
482	Jan. 11	90.95	80.8	88.83	5.87	7.26
483	Jan. 11	90.99	81.4	89.46	5.35	6.57
484	Jan. 11	90.54	80.8	89.24	5.25	6.50
485	Jan. 12	90.75	81.2	89.48	4.82	5.94
Means	....	90.70	80.6	89.16	5.54	6.87

TABLE No. 26.—*Second massecuite—Third plant run.*

No.	Date.	Solids.	Sucrose.		Purity.	Glucose.
			Single polarization.	Double polarization.		
		Per cent.	*Per cent.*	*Per cent.*		*Per cent.*
490	Jan. 15	83.7	64.8	66.90	79.92	13.51
491	Jan. 15	88.7	63.6	65.84	76.48	13.24
492	Jan. 15	85.0	63.2	64.82	76.26	15.58
Means	....	85.8	63.86	65.85	77.55	14.11

TABLE No. 27.—*Sugar—Third plant run.*

No.	Description of sample.	Date.	Sucrose.	Glucose.
			Per cent.	*Per cent.*
472	First sugar	Jan. 7	98.0	....
473	do	Jan. 7	99.0	....
474	do	Jan. 7	98.8	....
475	do	Jan. 7	98.8	....
476	do	....	99.2	....
	Mean	....	98.76	....
478	Second sugar	Jan. 8	83.2	4.55
517	Third sugar	Feb. 11	81.0	5.86

TABLE NO. 28.—*Molasses—Third plant run.*

No.	Description of sample.	Date.	Solids.	Sucrose. Single polarization.	Sucrose. Double polarization.	Purity.	Glucose.
			Per cent.	*Per cent.*	*Per cent.*		*Per cent.*
487	First molasses	Jan. 13	74.49	54.6	55.90	75.04	11.21
488	....do	Jan. 13	69.27	53.0	54.04	78.01	11.94
	Mean	....	71.88	53.8	54.97	76.53	11.57
500	Second molasses...........	Jan. 23	74.4	39.0	42.62	57.28	20.23
502	....do	Jan. 26	80.6	33.6	37.30	46.28	19.97
519	Third molasses	Feb. 11	77.6	22.0	26.62	34.44	28.52

Summary—Third plant run.

Cane ground	tons	956.55
Cane ground	pounds	1,913,100
Sucrose in cane	do	221,177.84
Juice extracted as diluted	gallons	199,855
Juice extracted, normal	do	173,040
Juice extracted as diluted	pounds	1,761,837
Juice extracted, normal	do	1,536,595
Sucrose in juice	do	197,317.13
Sucrose in bagasse	do	23,860.71
Sucrose extracted, per cent of sucrose in cane		89.21
Glucose in juice	pounds	17,442.20
Available sugar at 1.50 times glucose deducted from sucrose	do	171,153.83
Total sugars in juice	do	214,759.33
Sirup obtained	gallons	46,414
Sirup obtained	pounds	473,422
Sucrose in sirup	do	194,671.15
Loss of sucrose between juice and sirup	do	2,645.98
Glucose in sirup	do	14,960
Inversion of sucrose between juice and sirup		None.
Number of cubic feet of first massecuite obtained		2,760
First massecuite obtained	pounds	253,920
Sucrose in first massecuite	do	204,659
Excess of sucrose due to adding "tank bottom"	do	9,987.85
Glucose in first massecuite	do	14,067.17
Commercial first sugar obtained	do	140,431
First sugar of 100° polarization	do	138,689.66
Second massecuite obtained	do	102,789.04
Sucrose in second massecuite, single polarization	do	65,642.08
Sucrose in second massecuite, double polarization	do	67,686.58
Excess of sucrose due to double polarization	do	2,044.50
Glucose in second massecuite	do	14,503.53
Commercial second sugar obtained	do	56,742
Second sugar of 100° polarization	do	47,209.34
Glucose in second sugar	do	2,581.76
Second molasses obtained	do	50,779.77
Sucrose in second molasses, single polarization	do	18,433.06
Sucrose in second molasses, double polarization	do	20,291.60
Glucose in second molasses	do	10,206.73
Commercial third sugar obtained	do	18,742
Third sugar of 100° polarization	do	15,181.02
Glucose in third sugar	do	1,023.31
Third molasses obtained	do	36,603
Sucrose in third molasses, single polarization	do	6,952.66

Summary—Third plant run—Continued.

Sucrose in third molasses, double polarization	pounds	9,083.72
Glucose in third molasses	do	10,439.18
Excess of sucrose over second molasses due to "tank bottom"	do	3,973.14
Sucrose obtained as sugar	do	201,080.02
Sucrose obtained in sugars and molasses	do	210,163.74
Excess of sucrose during entire run due to "tank bottom"	do	13,448.09
Loss of extracted sucrose during entire run	per cent	1.34

TABLE NO. 29.—*Calumet Plantation totals, campaign* 1888-'89.

	Milling began.	Milling ended.	Actual running time of mill.	
			Hrs.	*min.*
Total stubble	Wednesday, Oct. 31, 7.20 a. m.	Friday, Nov. 16, 4.40 a. m.	214	45
Total plant	Friday, Nov. 16, 8 a. m.	Wednesday, Dec. 12, 5.40 p. m.	382	10
Total crop	Wednesday, Oct. 31, 7.20 a. m.	Wednesday, Dec. 12, 5.40 p. m.	596	55

	Total stubble.	Total plant.	Total crop.
Tons ground, no allowance for trash	2,943.39	5,436.53	8,379.92
Average tons ground per hour, actual running time	13.70	14.22	14.04
Per cent juice extracted on weight of cane	72.72	76.17	74.97
Weight of cane ground ... pounds	5,886,770	10,873,050	16,759,820
Juice extracted (maceration juices being reduced to normal)	481,694	931,316	1,413,010
Do ... gallons	4,281,420	8,282,747	12,564,167
Sirup produced ... pounds	114,411	242,780	357,191
Do ... gallons	1,183,187	2,484,797	3,667,984
First sugar produced ... pounds	390,645	760,503	1,151,148
Second sugar produced ... pounds net	138,459	324,717	463,176
Third sugar produced ... do	37,188	81,909	119,097
Total sugar produced ... do	566,292	1,167,129	1,733,421
Molasses produced ... do	10,750	15,550	26,300
Do ... gallons. Do ... (at 11.55 pounds per gallon) ... pounds	124,162	179,603	303,765
Average first sugar, per ton cane ... pounds	132.72	139.88	137.37
Average second sugar, per ton cane ... do	47.04	59.73	55.27
Average third sugar, per ton cane ... do	12.63	15.06	14.21
Average total sugar, per ton cane ... do	192.39	214.67	206.85
Average molasses, per ton cane ... do	3.65	2.86	3.14
Do ... gallons	42.18	33.04	36.25
Average commercial massecuite ... pounds. Average commercial massecuite, per ton cane ... do	234.57	247.71	243.10
Average total sugar, per gallon, normal juice ... do	1.17	1.25	1.23
Average molasses per 1,000 pounds sugar ... gallons	18.98	13.32	15.17
Per cent first sugar on cane	6.63	6.99	6.87
Per cent second sugar on cane	2.36	2.99	2.76
Per cent third sugar on cane	0.63	0.75	0.71
Per cent total sugar on cane	9.62	10.73	10.34
Per cent molasses on cane	2.11	1.65	1.81
Per cent commercial massecuite on cane	11.73	12.38	12.15
Per cent total sugar produced as—			
First product	68.98	65.16	66.41
Second product	24.45	27.82	26.72
Third product	6.57	7.02	6.87

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