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Report of the sugar house and laboratory for 1890

William Carter Stubbs

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BULLETIN

OF THE

SUGAR EXPERIMENT STATION,

AUDUBON PARK,

NEW ORLEANS, LA.

WM. C. STUBBS, PH. D., DIRECTOR.

REPORT OF THE SUGAR HOUSE AND LABORATORY FOR 1890.

ISSUED BY THE BUREAU OF AGRICULTURE.

T. S. ADAMS, COMMISSIONER.

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LOUISIANA SUGAR EXPERIMENT STATION,
Audubon Park, New Orleans, September, 1891.

Capt. T. S. Adams, Commissioner of Agriculture, Baton Rouge, La.:

DEAR SIR—I hand you herewith Report of the Sugar House and Laboratory for the past year. It has been delayed in order that I might embrace the results of wagon sugars not centrifugalled until a few days since. Please publish this Bulletin as No. 11, Second Series, and oblige

Respectfully,

WM. C. STUBBS,
Director.

REPORT OF OPERATIONS FOR YEAR 1890-91

IN THE

Sugar House and Laboratory of the Sugar Experiment Station.

Since our last report of work performed in the sugar house, the Station has been removed from near Kenner to Audubon Park, New Orleans. An iron sugar house, 40x100, with numerous openings for ventilation, had recently been erected for the reception of the machinery from Kenner. This house being much larger than our old sugar house, permitted the re-arrangement of the machinery and its adjustment in such a manner as experience had determined best suited to our wants. Mr. John Paul Baldwin was placed in charge of its erection, and so well was his work performed that little or no difficulty was experienced during the entire campaign.

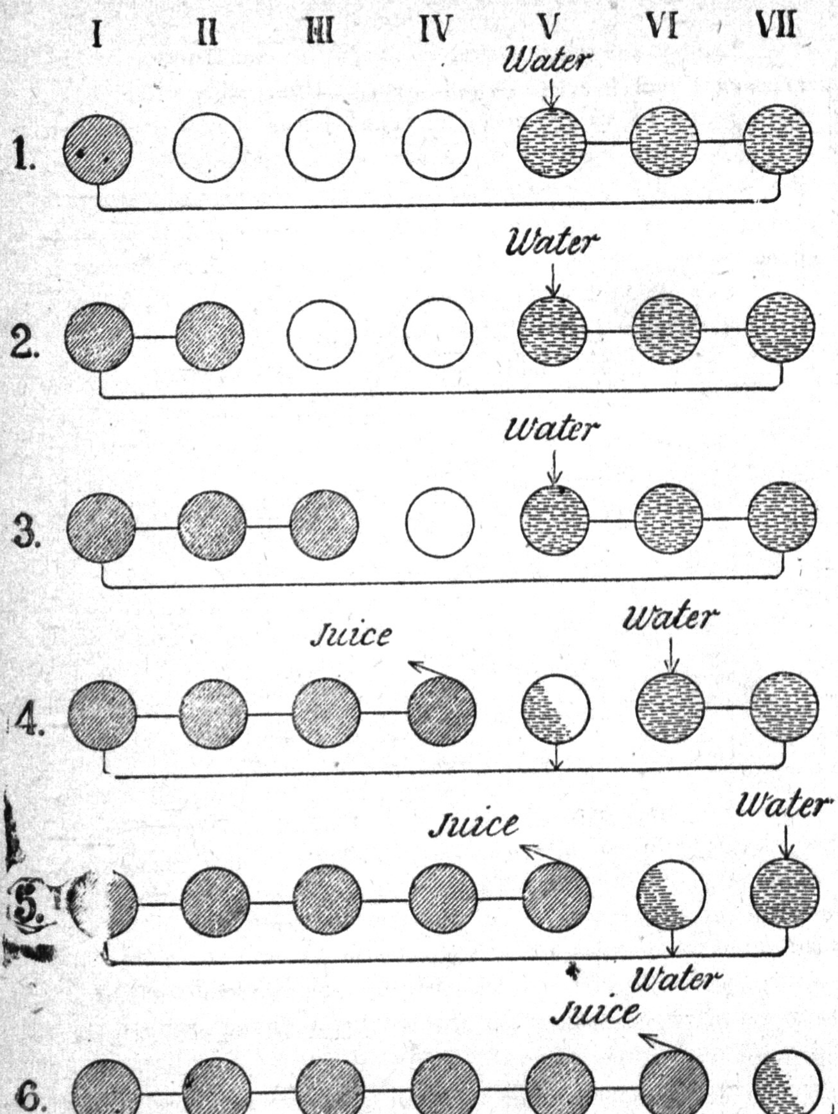
In the boiler house, 30x60 feet, 20 feet from the sugar house, are two boilers of sufficient size to furnish an abundant supply of steam for all the operations of the sugar house. The sugar house completed, may be thus summarized: The cane is conveyed by a carrier to an ensilage cutter with 4 knives 14 inches in length, and there cut into pieces of ¾ inch to 1 inch in length, and elevated by another carrier to a fan and shaker, when all the leaves, trash and dust are removed. This cutter and its carriers were made by the E. W. Ross Company, of Springfield, O., and by them donated to the station. The gearings of the carriers were not sufficiently strong for the heavy work which it was sometimes found necessary for the cutter to perform. This was especially true in handling some of the large foreign cane, this year worked for the first time. Otherwise the entire apparatus worked well, and replacing the linked belts with larger ones will, it is thought, give entire satisfaction in future work. The fan is entirely similar to those used for cleaning wheat, rice,

etc. Six paddles were arranged for in the construction of the machine, but in practice it was found that four were sufficient to perform the required work. The shaker was this year changed from a horizontal to a vertical motion, and gave good results. The ensilaged chips, cleaned by the fan and shaker, were dropped into a box, from which an endless screw conveyed them to a comminutor. The latter is an invention of Mr. M. A. Swenson, and was made and presented to the station by the Fort Scott Foundry Company, Fort Scott, Kan.

The comminutor had eight knives, and when not overfed did excellent work. Its capacity was however not as great as the ensilage cutter, and great care had to be exercised in feeding the latter, so as to prevent an overfeed and choking of the former: From the comminutor the chips were elevated on a trough by small drags attached at regular intervals to an endless link belt chain. From openings in this trough, over each cell, the chips are conveyed to the battery. The diffusion battery consists of 14 cells, each 47x28 and holding 13.56 cubic feet. It is a double line battery and has a maximum capacity of two tons of cane per hour. Diffusion batteries are located in a straight line, in a double line or in a circle. The number of cells used are from 9 to 16. It has been shown by a local experiment that 9 to 10 cells when properly worked, are abundant for good work. (See Bulletin 23, pages 349 and 350 of this station.) Sometimes double line batteries are worked as two batteries. This method gives increased time for diffusion.

EXPLANATION OF DIFFUSION BATTERY.

A diffusor is an iron cylindrical cell, made to close tightly at the bottom and top and supplied with pipes below and above. Nine or more of these cells are connected and called a battery. Believing that the diffusion battery will ultimately be the chief, and, perhaps, the only method of extracting juice from the cane, and that at present the chief objection to its use may be found in the ignorance of properly working it, it has been deemed proper to here insert several diagrams, by which the battery and its proper working may be easily understood.


I
II
III
IV
V
VI
VII
Water
1.
Water
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Juice
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Juice
Water
5.
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Juice
6.
Water

PLATE I.

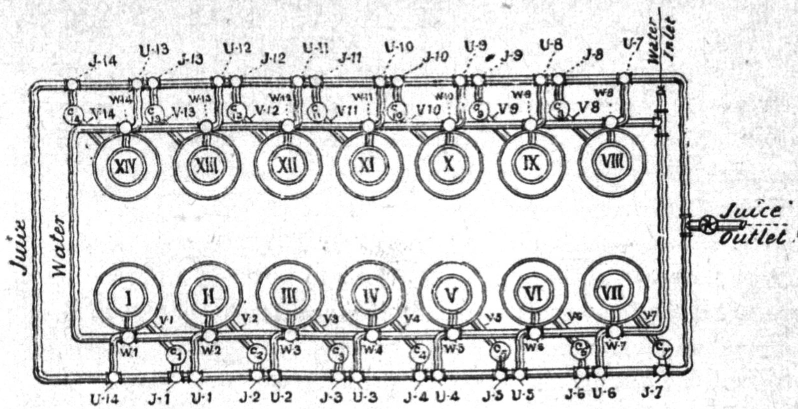

PLATE II.

In plate I is seen a single battery of seven cells, in the actual conditions which obtain from the filling of first cell till the battery gets in regular working order. The arrow shows the water entering, and finally the juice departing to the measuring tank or weighing machine. Figure 1 shows the condition of battery when first cell is filled with chips. Figure 2 when two cells are filled. Figure 3 when three cells are filled, etc. The horizontal shading means filled with water; the diagonal lines, chips, and the rest are empty.

Plate II gives a plan of our battery with its cells, calorisators, pipes and valves. The cells are numbered from I to XIV; the water valves, W to W14; the juice valves, J to J14; the valves connecting the cells, U to U14, the caloristors or heaters, C to C14, ond the pipes connecting the cells and heaters, V to V14.

In the beginning of work, the last three or four cells on the battery are filled with water and heated before being drawn on to the chips in the first cells.

In our sugar house, a large heater disconnected from the battery, aids in heating the water in its passage from the water tank in the roof of the house to the battery.

PROCESS OF WORKING THE BATTERY.

As soon as the machinery is in motion and the chips begin

to fall into cell No. 1, the last three or four cells are filled s owly with water, heating it in its passage with the calorisators. The water comes from the water tank directly through the big heater and then through tube W and valve w12 into diffuser XII from above; passes v12 to c12 and ascends the heater, through u12, over w13 into cell XIII, then on through v13, c13, over J13, through u13, over w14 into cell XIV, thence into v14 and c14, travels the short distance from J14 to J1 in the juice pipes, and runs into c1 from above, passes v1 and ascends into cell 1 from below, upwards through the first chips. As soon as the fluid has reached cell I the diffuser is closed, the air cock opened and kept opened until the water begins to come through, when it is closed.

While water is entering I, which should be done slowly to permit of its being heated "in transitu" through the heaters, cell II is being filled with chips. When filled, the water entering c14. passes over J14 through u14, over w1 into cell I from above, driving the juice through v1, c1, J1, J2. c2 and v2 into cell II. This process is repeated until you wish to draw juice from the battery. Suppose it is desired to draw the juice from cell IV. The juice now goes from c14 over J14, through u14 over w1, through I, v1, c1 over J1, through u1 over w2, through II, v2, c2 over J2, through u2 over w3, through III, v3, c3, J3, J4, c4, v4, and ascends into cell IV through the fresh chips. As soon as all air is expelled from this cell, the valves from c3 are changed. The juice now rising in c3, goes over J3 through u3 over w4, through IV, v4, c4, J4, and leaves the battery at J to enter the measuring tank or juice weigher.

This work is continued until sugar work is reached. From now on in our work one cell is being emptied while the other is being filled with chips. Before emptying a cell the entire water in the battery is driven forward, one cell by applying air pressure to the cell to be emptied. In this way the chips are released of much of their superabundant moisture. Before emptying a cell it is completely isolated from the rest of the battery. As a general rule the juice should enter every cell *from above except*

the one just filled with chips, and this invariably from below to drive out the air and prevent the accumulation of foam and steam in the cell. The temperature is controlled by the valves leading from steam pipe to calorisators.

REQUISITES FOR GOOD DIFFUSION.

1. Fineness of chips. To obtain this, the knives must be kept sharp and must project beyond the cylinder as little as possible to perform good work. With our common canes a projection of one-sixteenth of an inch gave a most excellent chip with rapid work, while many of the larger foreign canes, on account of their softness, could not be comminuted at all with this projection. To perform good work, the knives had to be given a projection of at least one-eighth of an inch. The solidity of the canes determine the projection of the knives, and to a large extent the size of the chip. It may be assured that the finer the chip, *ceteris paribus*, the better it diffuses.

2. Heat is essential to excellent work. How far a high heat may influence other extractive matter detrimental to crystallization and good clarification is a question yet to be definitely solved. For a high extraction of sugar by diffusion, heat as high as can be obtained is requisite.

3. With the above conditions secured, the time of diffusion can be greatly diminished. With a coarse chip and low heat, even a long diffusion fails to accomplish complete extraction. Time, then, is an important essential of diffusion.

BALDWIN'S JUICE WEIGHER.

From the battery the juice was discharged directly into the "juice weigher." This juice weigher was adjusted to weigh 365 pounds juice, and direct tests of the machine, made seventeen different times, showed variations from 364 pounds to 367 pounds, with an average of 365½ pounds. This juice weigher performed its part excellently, in the early part of the season as was shown by constant checks and measurements and weighings. Three weeks of constant use, however, without attention caused an accumulation of viscous matter on the sleeve, which prevented it from turning readily and thus delayed or hindered the autom-

atic discharge and readjustment of the machine. As soon as the irregularity was discovered and its causes located, the entire machine was cleansed and again put to practical work with the same excellent results.

This machine, like every other now in use in our sugar houses, must be kept in first-class order in order to obtain the best results. I am informed by the patentee that the machine had been further improved, with the probability of entirely overcoming the present apparent defects. This machine is also arranged to take a fair sample of each discharge. This was tried, with very unsatisfactory results. The hole, through which the small sample was discharged, frequently became more or less closed, causing very unequal discharges.

On a large scale in a sugar house working fairly uniform canes, the difficulty we experienced would hardly have been appreciated. But in an experimental sugar house, where in one experiment the discharges consisted of both the regular juice and the washings of the battery, such unequal discharges must vitiate the accuracy of the aggregation of samples. This defect, it is believed, can and will be easily remedied.

This machine has great merit and when perfected, as is believed it will be very soon, will constitute one of the most valuable additions to a modern sugar house, enabling one to exercise with comparative chemical ease a control over the juice and syrup.

CLARIFIERS.

The juice was next pumped to the clarifiers and there heated with chemicals for clarification. Connected with this clarifier was a sulphur machine by which a clarifier could be sulphured to any desirable extent. Arrangements are being made by which the scums from the clarifier can be sent directly to the diffusion battery or through a Pusey & Jones filter press. The latter was the course adopted in our experimental work, since an unknown quantity of juice with each return to the battery, entered the chemical problem which the daily experiment attempted to solve.

DOUBLE EFFECT.

The juice from the clarifier was concentrated to syrup in an

upright double effect of 400 square feet of heating surface. This double effect has, by the ordinary methods of running it, occasioned great loss by entrainment and overflow. It has been found that by lowering the juice in each effect that the loss diminished, until it was practically *nil*, when the tubes were kept about half full. The following method of working proved so successful that it will hereafter be followed: In starting the effects, juice is drawn in until the tubes are about half covered; then steam is turned on, and the juice kept at this constant level. Looking in through the lower glasses, two curves can be seen, the juices rising from the tubes and falling down the "*downtake*." The quantity evaporated was also largely increased.

STRIKE PAN.

The syrup thus made was sent to the strike pan of same size as one of the effects. Here it was cooked to grain, with little or no mechanical loss during the season. The masse cuite was taken to a *mixer*, and from it taken to a

HEPWORTH'S CENTRIFUGAL,

where it was purged of its molasses. The latter was cooked to string, and put into cars, and stored in the hot-room.

Besides the above complete outfit, a small miniature equipment consisting of a clarifier, an open evaporator, a very small strike pan and a hand centrifugal, was frequently used for making preliminary experiments with various chemicals, etc.

With this outfit, the campaign of 1890 was begun on the 11th of November. Fifteen distinct runs were made, analyzing the fresh and diffusion chips, the diffusion juices before and after clarification, the syrup, sugar and molasses; and weighing the cane, the diffusion juice, the syrup, the sugar and the molasses. Every check possible was adopted to determine mechanical or chemical loss, and later the merits of different kinds of clarification. The question of diffusion was also studied and every effort made to determine its merits. It is deemed best, for the public, to divide our work up and present it under different heads. The question first to be considered is

DIFFUSION.

Before giving the results it would be well to state how this work was controlled. The fresh chips going to the battery were pressed in a small, but powerful, three-roller hand mill, giving about 55 per cent. extraction of juice. This juice was carefully analyzed for total solids, sucrose, glucose, solids not sugar, and sometimes for ash and albuminoids. At same time the fibre in the fresh chips was frequently determined and the total juice calculated. The entire juice was assumed to be of same composition as that extracted (a fact not yet proven, however). The exhausted chips were treated in a similar way and the percentage of sucrose, fibre and water determined. There was always a small amount of wash water lost on opening the doors of the battery to empty the chips. This was several times analyzed and results showed it to be always lower in sugar than the chips from which it fell. It is, therefore, assumed, that much of the waste water came from spaces between the chips, while the juice extracted from the diffusion chips was a mixture of this wash water and the mixture of juice and water contained in the cells. The latter being richer in sugar, caused the mill juice to be correspondingly higher.

By taking these results as data, the problem of extraction is easily calculated for each run, as follows:

	Date.	Fibre.	Extraction per cent. On cane.	Extraction per cent. On sugar in cane.	Dilution on Normal juice.	Minimum sucrose in chips.
1st run	Nov. 11	8.05	86.09	93.58	150.92	.65
2d run	" 13.	7.43	87.55	94.58	136.39	.50
3d run	" 16.	8.23	87.67	95.15	128.88	.50
4th run	" 18.	8.67	85.95	94.12	141.73	.55
5th run	" 21.	8.00	86.91	94.47	145.64	.50
6th run	" 24.	8.00	88.32	96.00	137.00	.40
7th run	" 27.	8.00	86.57	94.10	145.00	.62
8th run	" 29.	8.00	87.74	95.40	152.00	.45
9th run	Dec. 1.	8.00	88.30	96.10	131.00	.40
10th run	" 3.	9.27	88.00	95.80	147.00	.45
11th run	" 5.	9.00	89.10	98.00	144.00	.20
12th run	" 8.	9.00	87.26	95.90	149.00	.40

The above dilution is calculated on the strength of the diffusion and mill juices. In the experiments, amounts of juice, varying from the weight of the chips in each cell, up to the weight of water added to each cell, were drawn off, and results showed that the extraction depended also upon conditions other than dilution—viz: density of chips in cell, fineness of chips, heat of battery and time of diffusion. In run No. 11, when extraction reached the maximum of the season the chips were fine, the heat good, dilution large. Besides all these, the time of diffusing each cell was unnecessarily long, caused by the delay incident to the clarification process followed that day. It may here be remarked that the exhausted chips contained an average for the season of 13 per cent. fibre. In winding up a run, and emptying a battery, a considerable loss of sucrose is inevitable. The following plan was found by experiment to give the least loss with the least dilution. The battery is first emptied completely with air and then six rearmost cells are filled again slowly with hot water and driven entirely through the battery. In this way the sucrose left over in the last cell rarely ever exceeds 2 per cent.

METHODS OF CLARIFICATION.

Lime Only.

Runs Nos. 1 and 2 were made by simply adding milk of lime to neutrality in each cell of the battery. In 1888 the addition of lime to the cell gave a clarification which permitted the sending of the juice directly from the battery to the double effect. Not so this year. In spite of every effort the clarifier had to be used. The juice in 1888 had a sucrage of 13 per cent. with glucage of .9 per cent., while the average of all the runs this year show less than 10 per cent. sucrose, and over 1.5 per cent. glucose. The clarification, on account of the green cane, had to be completed in the clarifier. The following are the laboratory notes of each run:

First Run—Five Tons Cane.

	Total solids.	Sucrose.	Glucose.	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	13.07	10.13	1.95	19.23	77 39	8.05
Diffusion juices	8.66	6.65	1.32	18.95	77.37	.....
Syrup	34.08	25.90	5.25	20.27	76.00	....
Sugar	......	95.60	.96	......	.....	......
Molasses	79.9	*40.00	25.00	......	......	......

*Double polarization, 42.15.

Yield of chemically pure sugar as firsts, 124 pounds per ton. No seconds made, the molasses being used for experimental purposes. The extraction was 86 per cent. on the cane, or 174 pounds sugar per ton, Of this amount 71 per cent. was secured as first sugars.

Second Run—Seven Tons of Cane Used.

	Total solids	Sucrose	Glucose	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	12.93	9.23	......	......	71 38	7.43
Diffusien juices	9.48	6.80	1.46	21.40	71.79	.....
Syrup	44.31	31.90	6.86	21.50	72.05	.. ..
Sugar	......	96.50	.80	......	......	......
Molasses	81.30	*38.00	25.00	......	......	......

*Double polarization, 40.64 per cent.

Yield of chemically pure sugar as firsts, 116 pounds per ton. No seconds made. Extraction, 87.55 per cent., or 162 pounds of sugar per ton. Of this amount 72 per cent. was secured as first sugars.

LIME AND BISULPHITE OF LIME USED AS REAGENTS.

Third Run- Eight Tons of Cane Used.

Milk of lime was added in slight excess in diffusion cells to the chips. The juice slightly alkaline was received in a settling tank, into which was emptied two gallons of bisulphite of lime to every 350 gallons of juice. This rendered the settled juice slightly acid, which was carefully neutralized in the clarifier. A pretty juice was made.

The following are the laboratory results:

	Total solids.	Sucrose.	Glucose	Glucose ratio	Purity co-effi.	Fibre.
Mill juices	12.18	9.00	1.77	19.66	73.89	8.23
Diffusion juices	9.32	6 99	1.19	17.09	75.00	......
Syrup	......	28.10	5.10	18.00	......	......
First sugars	......	94.65	1.39	......	......	......

Yield of chemically pure sugar as firsts, 99 pounds per ton; of seconds, 12 pounds; total, 111 pounds, or 70 per cent. sucrose extracted in the juice. Extraction of juice was 87.67 per cent. of the cane.

Fourth Run—Nine and One half Tons Cane Used.

Clarification same as above, with following results:

	Total solids.	Sucrose.	Glucose.	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	13.3	9.68	1.82	18.80	72.78	8.67
Diffusion juice	......	6.83	1.19	17.42	......	......
Syrup	43.2	30.95	5.71	18.40	71 6	......

Yield of chemically pure sugar as firsts, 128 pounds per ton; of seconds, 9 pounds; total, 137 pounds, or 82 per cent. of total sugar extracted. Extraction of juice was 85.95 on the cane.

Fifth Run—Twelve Tons of Cane Used.

Clarification same as above, with following results:

	Total solids.	Sucrose.	Glucose.	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	13.6	9.19	1.63	17.79	67.57	8.00
Diffusion juices	......	6.31	1.03	16.40	......	......
Syrup	51.0	36.40	6.65	18.27	71.37	......

Yield of chemically pure sugar as firsts, 101 pounds per ton; of seconds, 13 pounds; total, 114 pounds, or 73 per cent. of sugar extracted in the juice. Extraction of juice was 86.91 per cent of the cane.

The use of bisulphite in the manner described above gave a pretty juice, which was easily cleaned and worked. Its chief

objections are the large quantities necessary for good results and the amount of sulphite and sulphate of lime which enter into th juice and are finally left in the molasses. The exact action of these salts upon the crystallization of sugar is as yet not clearly known, but they are believed to be melassigenic. The bisulphite used in the above experiments was kindly donated by Mr. H. Bonnabel, 29 Bienville street, New Orleans, who manufactures it on a large scale.

Lime and Acid Phosphate of Calcium.

Three runs, Nos. 6, 12 and 13 were made with these as agents, the *modus operandi* being as follows: The milk of lime was added to alkalinity in the diffusion cells, and the acid phosphate of calcium to the juice in the settling tank or clarifier, and clarification completed in the clarifier.

Run No. 6—Nine and One-half Tons Cane were Used.

In this run the acid phosphate was used to slight acidity, there being required three quarts to every 350 gallons of juice. The chemical results show that it was left acid, since inversion took place from raw juice to masse cuite.

The following are the results:

	Total solids.	Sucrose.	Glucose.	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	13.95	9.685	1.88	19.51	69.45	8.00
Diffusion juices	......	7.060	1.27	17.90	......	......
Clarified juices	......	6.74	1.36	20.10	......	......
Syrup	42.97	30.95	6 67	21.70	69.70	......

The yield of chemically pure sugar was per ton of cane, firsts, 131 pounds; seconds, 12 pounds; total, 143 pounds, or 83 per cent. of sugar extracted in the juice. Extraction of juice was 88.32 per cent. of the cane.

Run No. 13.

In this run fourteen field experiments, aggregating thirteen tons, and covering nine varieties of cane, were used. It is quite difficult to give the exact average of the mill juices or the average extraction since it was impossible to determine fibre in every

variety. The mill juices had about 9.53 per cent sucrose. The following were carefully determined :

	Sucrose.	Glucose.	Glucose ratio
Diffusion juices	7.47	1.03	13.7
Clarified juices	7.29	.97	13.2
Syrups	38.90	5.25	13.5

There were 2080 pounds sugar in the syrup worked. Of this amount 1685 pounds of chemically pure sugar was extracted as first sugar, or 81 per cent. of the total contained in the syrup. The sugar was simply dried in the centrifugal without water and polarized 93 degrees.

The acid phosphate was used in the above experiment to as near neutrality on the acid side as could be done by the processes now generally used.

Run No. 14.

This run was even more complicated than No. 13. Thirty-six varieties of cane contributed to make up the 12½ tons used in this trial, and where separate determination of each mill juice was made, the varying weights and extraction of each tend to make accurate determination of the average mill juice an impossibility. It was somewhere between 8 per cent. and 9 per cent. The acid phosphate was again used here to slight excess. The following are partial results of laboratory :

	Total solids.	Sucrose.	Glucose.	Glucose ratio.	Purity co-effi.
Diffusion juices	......	6.4	1.39	21.7	......
Clarified juices	......	6.5	1.42	21.8	......
Syrups	57.3	33.4	7.69	23.0	65.1

There were in the syrups sent to this pan 1700 pounds sugar, of this amount 1187 pounds being secured as firsts, or 71 per cent. of total. A very fair yield considering the low purity and excessive *glucose* of the syrup.

The acid phosphate of calcium used in the above experiments was kindly donated by the Provident Chemical Works, of St. Louis, and was a liquid of 20 deg. Baume density.

Lime and Sulphur as Re-agents.

Milk of lime was added in excess in the diffusion cells, and the alkaline diffusion juices treated with fumes of sulphur in the clarifier.

Runs Nos. 7 and 8 were made with these re agents.

Run No. 7—Eleven Tons of Cane Used for this Trial.

The alkaline juices were made slightly acid with sulphur, with the following results:

	Total solids.	Sucrose.	Glucose	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	13.84	9.88	1.68	17.1	71.2	8.0[illegible]
Diffusion juices	.....	6.80	1.02	15.0	.....	.....
Clarified juices	.....	6.90	1.12	16.2	.....	.....
Syrup	48.1	35.20	6.25	17.7	.....	.....

The yield of chemically pure first sugar was 126 pounds per ton; of seconds, 13 pounds; total, 139 pounds, or 82 per cent. of sugar extracted in the juice. Extraction of juice was 86.57 per cent. of the cane.

Run No. Eight.

Eleven tons of cane used in this trial. The juice treated as No. 7, with following results:

	Total solids.	Sucrose.	Glucose	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	13.31	9.32	1.87	19.9	7.01	8.05
Diffusion juices	.....	5.90	1.14	19.5	.....	.....
Clarified juices	.....	6.10	1.19	19.5	.....	.....
Syrup juices	47.10	33.00	7.10	21.51	.....	.....

The yield of chemically pure first sugar was 122 pounds per ton. No seconds obtained, even after nine months. This is 75 per cent. of the sugar in the juice. Extraction of juice was 87.74 per cent. of the cane.

WILCOX'S ALBUMEN PROCESS.

Three runs were made with this process, in accordance with instructions given by the patentee, to Mr. B. Remmers, his agent, who assisted in executing the work.

The following instructions were given in writing:

First process—Run the sulphured juice into the defecator; into another vessel for every pound of juice in the defecator put 3½ grains of dried albumen. Add sufficient water to this to put it thoroughly in solution. Add the contents of this vessel to the defecator. Mix well and turn on steam. When the juice is about 190 degrees F. shut of steam and commence to add milk of lime until the juice shows perfectly *neutral.* When the neutral point is reached turn on steam again, and blanket off the scums. Shut off steam and add enough sulphurous acid to raise the acid point of the juice, so that it shows slight acid on litmus paper. Allow juice to settle one hour, and draw off the clean liquor and boil to sugar.

Second process—Run the sulphured juice into defecator as before, turn on steam and blanket. When the scum has been taken off, shut off steam and pour into the hot juice the albumen solution in same proportion as before and mix thoroughly. Let stand five or ten minutes, then add milk of lime to neutrality, boil for a few minutes, shut off steam, bring back to acid point as before and settle. The only point gained by this way is the heavy scum being first taken off, the albumen has a better chance to act on those impurities for which it is especially designed, than spending a part of its force in raising the heavy scums.

With these instructions, on the morning of December 1, the ninth run was begun with 11 tons of cane, Mr. Remmers directing the details.

Ninth Run.

Limed to alkalinity in cells; acidified in clarifier with sulphur, and then added about 1¼ pounds albumen to each clarifier of 350 gallons of juice, heated to 190 degrees F.: shut off steam and neutralized with lime; took off blanket and brushed clean; a very pretty juice was made, though all the albumen failed to dissolve. The process is a slow one and furnishes a large amount of scums and skimmings before cleaning the juice. The following are the results:

	Total solids	Sucrose.	Glucose	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	13.64	9.86	1.83	18.7	71.96	8.10
Diffusion juices	......	7.52	1.22	16.2	......	.....
Clarified juices	......	6.68	1.13	16.9	......	.....
Syrup	46.7	34.10	6.06	17.7	73.00	......

There were obtained 124 pounds of chemically pure sugar as firsts, or 71 per cent. of total sugar in the cane. There were 20 pounds seconds, making a total of 144 pounds, or 82 per cent. of total sugar. The extraction was 88.3 per cent. of the cane.

Tenth Run—Nine Tons of Cane Used.

Wilcox's process continued. This time no lime was used in the boiling. The raw diffusion juice was sulphured to acidity, 1¼ pounds albumen, well dissolved, added to each clarifier of 350 gallons, heated to 100 degrees F. and limed to neutrality, took off blanket and brushed. A pretty juice, but was sticky and gummy in the pan and centrifugal. Not as good as method used in ninth run. Following are the results:

	Total solids	Sucrose.	Glucose	Glucose ratio.	Purity co-effi.	Fibre
Mill juices	13.31	18.18	1.61	16.01	76.37	9.27
Diffufion juices	......	6.00	1.11	16.09	......	.....
Clarified juices	......	7.27	1.18	16.23	......	.....
Syrup	49.30	36.20	6.06	16.70	73.4	......

One hundred and seventeen pounds chemically pure sugar per ton of cane were obtained as firsts, or 71 per cent. on total sugar present in juice; and 16 pounds seconds; total, 133 pounds per ton, or nearly 80 per cent. on total sugar.

Eleventh Run—Twelve Tons of Cane Used.

On account of failure to meet expectations in Run 10, a return was made to liming in the cell. The alkaline juice was treated in the clarifier to acidity with sulphur and acid phosphate of calcium. The albumen solution added and limed to neutrality. This time a free sugar was made. The following are the results:

	Total solids.	Sucrose.	Glucose.	Glucose ratio.	Purity co-effi.	Fibre.
Mill juices	12.73	9.6	1 65	17.0	75.4	9.00
Diffusion juices	......	6.63	1.01	15.2	......	......
Clarified juices	......	6.53	.98	15.0	......	......
Syrup	48.7	36.50	5.55	15.2	74.9	......

There were extracted 126 pounds of chemically pure first sugars per ton out of a total of 171 pounds in the syrup, or 73 per cent. of sugar present; amount of seconds obtained, 15 pounds; total, per ton of cane, 141 pounds, or 82 per cent. of sugar present.

Lime, sulphur and acid phosphate of calcium were used with indifferent results in

Run No. 12—Eleven Tons Cane Used.

Limed to alkalinity in cells. In clarifier rendered distinctly acid. with sulphur and acid phosphate. Limed again to neutrality and cleaned. Slow work and very indifferent results. The following are the results:

	Total solids	Sucrose.	Glucose	Glucose ratio	Purity co-effi.	Fibre.
Mill juices	13.03	9.41	1.56	16.6	72.15	9.00
Diffusion juices	......	6.28	.93	14.7	......	......
Clarified juices	......	6.38	.86	13.4	.....	......
Syrup	47.70	34.30	5.12	14.9	......	......

There were recovered in first sugars, 126 pounds chemically pure sugar per ton of cane, out of a total of 164 pounds in the syrup, or 16 per cent. of total present. The sugar was, however, very indifferent. There were also 14 pounds seconds, making a total of 140 pounds or 85 per cent. of total sugars present. This gave the largest yield of sugar during the season, but the sugar was very indifferent and hard to dry—polarizing very low.

Sulphate of Alumina was used as a reagent in

Run No. 15—Eighteen Tons of Cane Were Used in the Trial.

The sulphate of alumina was kindly furnished by Mr. A. R. Shattuck, of the well-known firm of Shattuck & Hoffman, who

in person witnessed the progress of the experiment until convinced of its inefficacy. This substance was used in many ways. By adding 1¼ pounds to a clarifier, and neutralizing with lime, or reversing, and liming in cells to alkamity, and then 1¼ pounds of sulphate of alumina in clarifier. Then both lime and sulphate were increased and reversed, until excessive quantities of each were used. Every attempt to utilize it gave disastrous results. Juice could not be settled; made a poor syrup, which would not *settle*, and occasioned inversion. It was cooked to grain in the pan, and an attempt made to centrifugal it, with disastrous results. It was dumped into cars, and put in the hot room, and after remaining there nine months, on September 9th, ineffectual attempts were made by Mr. E. A. Newman, an experienced sugar maker, to dry it in the centrifugal. It would not purge by any methods known to us. As the United States government required the sugar house to be emptied of sugar and molasses before beginning another campaign, it was put in molasses barrels, and consigned to a commission merchant to do what he could with it.

Besides the above a partial experiment was made with *superphosphate of alumina* with very unsatisfactory results.

A REVIEW OF CLARIFYING AGENTS USED.

A clarifying agent to meet public demands, must perform excellent work, and admit of a reasonable amount of expedition in that work. It, too, must be inexpensive. The present low prices of sugars prohibit expenditure of one cent in its manufacture that is not absolutrly necessary. Lime and sulphur are the great reagents now extensively used in this State. They are both inexpensive, and when properly used make excellent sugars without much loss. Until something equally as inexpensive, and permitting in its use of as rapid work can be found to supplant them, they will doubtless remain, even though the reagents may have superior merits. The first cost and the delay occasioned by its use are inseparable objections to any new reagent, possessing decided merit. Any delay in the march of sugar making means a large expenditure for additional setting

and juice tanks or a curtailing of the daily output. Neither of these can at present be done, unless it is unequivocally shown, that the reagent is of permanent merit. Unfortunately none of the reagents used can be so classified, and therefore none can be unhesitatingly recommended for general use.

When simply unwashed sugars are made, lime seems to be the only agent needed, especially if the juices are worked as rapidly as they are made, but when white and high-grade yellows are desired, some bleaching agent is needed, which is at present supplied by the use of various kinds of acids or acid salts. Sulphur as at present used not only bleaches but aids in defecation. It acts also as a disinfectant and antiseptic. When properly made, sulphurous acid (for such is the name of the gas of burning sulphur), is the least harmful of the mineral acids, but the following precautions are necessary in its use: See that no sulphuric acid is also formed at the same time, which, if formed, should be speedily removed by well washing the gas with a stream of pure water. Juice, after being sulphured, should not be heated until it is *neutralized* with lime. Used in this way, its injurious effects are reduced to a minimum. Sulphured juices seem always to carry a goodly amount of sulphites and sulphates of lime into the molasses, with exactly what effect on the crystalization of sugar is as yet undetermined. In the place of sulphur may be used bisulphite of lime, with same chemical results and with the advantage of having the amount used entirely under control. Wilcox's process with albumen showed no special merit, with the decided objection of time required to perform the different operations. The entire sugar house was delayed by its use; it is, therefore, not to be recommended. It made a pretty sugar and a goodly quantity of it, but so did several other methods used, far less difficult to operate, and perhaps less costly.

For diffusion juice coming hot from the battery which takes sulphur with difficulty, the acid phosphate of calcium seems specially adapted. By liming to excess in the cells and neutralizing the juices at once in the clarifier with acid phosphate of calcium, excellent results are obtained. In mill houses where

sulphuring precedes the lime, the application of acid phosphate is not so easy nor so rapid. It is therefore of doubtful utility in these houses, especially at its present price. With weak diffusion juices it took 3 quarts of 20 deg. of B. density for 350 gallons. It would require at least one gallon for every 300 to 400 gallons of mill juices. A barrel of 50 gallons of this substance, I am told, costs abut $16 dollars, or about 32 cents a gallon. A mill working 100,000 gallons a day would require 300 to 400 gallons or 6 to 8 barrels, or $96 to $128 per day for this special reagent. At these figures, it will be hard to convince our planters that it should supercede our present practices or be a valuable addition to the already existing methods.

The use of alum, sulphate of alumina, and superphosphate of alumina are from our experience to be strongly condemed, as not only injurious to the juice, but strongly resistant to every effort of rapid settling. They make bright pretty juices when settled, but a large addition must be made to the settling tanks or filter presses of our sugar houses before they can be universally used. Our results are so disastrous as to condemn them in positive terms.

FANCHER AND CLARKE'S PATENT.

Early in the sugar campaign, the station received from a friend in Queensland a letter, enclosing a circular giver "Fancher and Clarke's patented process for the conversion of molasses into sugar. The process consists in reducing the molasses with water and treating it in clarifier with *boracic acid* and *powdered sulphur*, thoroughly boiling, then skimming off carefully the scums, sending the latter through filter presses, and the filtered liquor returns to the molasses. This molasses is then mixed with the cane juice. By this process it is claimed that no molasses is made and only sugar is obtained. What becomes of the molasses the patentee sayeth not. To test the question three experiments were made on a small scale.

No. 1. Twenty-five pounds of molasses, diluted with 19 pounds of water, and 100 grams of boracic acid, and 50 grams of sulphur added, boiled and skimmed; analyzed sample before and after. See analyses.

No. 2. **Same, with 100 boracic acid and 100 sulphur.**

No. 3. **Same, with 150 boracic acid and 100 sulphur.**

ANALYSES.

	Total solids.	Sucrose single.	Sucrose double.	Glucose.	Glucose ratio.
Original molasses	40.8	20.5	22.40	10.26	45.80
No. 1 after treatment	45.6	24.6	25.90	11.42	48.10
No. 2 after treatment	55.9	29.7	31.70	14.28	45.00
No. 3 after treatment	53.4	26.8	28.30	14.10	49.82

These three samples were cooked to masse cuite, and 7 pounds sugar obtained after nine months in hot room.

After a prolonged boiling little or no effect was produced whatever upon the glucose and solids not sugar, the molasses elements, and therefore it was useless to go further with the investigation.

The juice of our canes contains melassigenic elements, which, if not removed, will certainly form molasses. Could some substance be found which would unite with all the solids not sucrose, aud precipitate them so that they could be removed, sugar-making wauld be greatly simplified. But, unfortunately, such a discovery has not yet been made, and to return the molasses to the juice or syrup is simply to temporarily obscure it. It is bound ultimately to reappear, and may in its transit injure the juice syrup.

DESTRUCTION OF GLUCOSE.

In the work on the diffusion battery our attention was attracted to the decrease in the glucose ratio of the diffusion juice over the mill juice whenever an excess of lime was used in the battery. It has also been noted that in many sugar houses where the so-called neutral but really alkaline juices had been treated, a similar reduction of glucose occurred. Investigations on small scale showed that either dextrose or laevulose alone or together (as invert sugar, called glucose, in cane juices), when treated with an alkali or alkaline earth was destroyed. Accordingly a number of small experiments in the sugar house were made by treating molasses with an excessive quantity of lime—

boiling and brushing. Prof. Ross, Wipprecht, and Hutchinson followed us with careful chemical analyses. Second molasses was taken and treated with 1 per cent., 2 per cent., 4 per cent., 6 per cent., and 10 per cent. of lime with following results:

	Total solids.	Sucrose single.	Sucrose double.	Glucose
Original molasses	40.8	20.5	22.4	10.26
Same with 1 per cent. lime	43.8	23.0	23.3	8.88
Same with 2 per cent. lime	45.0	25.2	......	7.40
Same with 4 per cent. lime	43.1	23.8	23.8	4.82
Same with 6 per cent. lime	46.0	22.8	......	2.00
Same with 10 per cent. lime	49.4	23.2	......	1.23

Here the glucose had almost disappeared and repeated analyses showed but a slight difference in the double and single polarizations. The sugar was also determined by inversion and with Fehling's solution and found to corroborate polariscopic tests. The last experiment above was taken into the small vacuum pan to see if our chemical results would be established in the sugar house. Here great difficulties were encountered. Do what we would we could not get the stuff to cook. It was finally withdrawn and acid phosphate of calcium added to precipitate the lime used. An immense precipitate was obtained which contained 18 per cent sucrose and 1.3 per cent glucose besides much phosphate of calcium. The filtered liquid, however, after a slight dilution showed only 1.28 per cent glucose. This liquid was again used in the pan with the hopes it would grain. Failing in this we cooked to string and put in the hot room where it grained very slowly and indifferently.

Encouraged by this small experiment, two gallons each of a second molasses, holding nearly equal quantities of glucose and sucro e, were experimented upon, using the large vacuum pan for work. The glucose was readily destroyed, the lime precipitated with acid phosphate of calcium and filtered, and the filtered liquor sent to the pan to grain. All efforts at graining were abortive—so it was cooked into string, and put in the hot room. On September 12, nine months after, it was centrifugaled, with the following results: 889 pounds molasses and 135 pounds

sugar, or nearly one pound sugar from a gallon of the original molasses. The sugar is of a good grain, but very dark, and polarized low.

A sample of masse cuite was taken at the time of discharge and analyzed, and found to contain 12 per cent. of glucose, when only a trace had been discovered in the beginning. On trial the masse cuite was found to be quite acid, and glucose had been produced during the boiling under the influence of the acid.

The next day another trial was made with same amount acid phosphate of calcium added to only neutrality. This was sent to vacuum pan and an entire day consumed in trying to reduce it to masse cuite, without effect. On Christmas eve at 11 P. M. it was turned out of the pan with only a density of 38 deg. B. cold, after 15 hours cooking. Analyses showed it to contain a considerable amount of lime, which caused it to roll in waves in the pan, instead of the usual ebulition. Any overlimed juice offers obstacles to rapid cooking and should be avoided. During Christmas holidays our investigations were transferred to the laboratory, where a thorough chemical investigation was made, with following results:

Whenever a solution of glucose, or dextrose or laevulose is treated with an excess of lime, a darkening of the solution takes place with the conversion of these substances into acids which gradually neutralize the lime until finally, if enough lime be present, the entire glucose is destroyed and there remains in the black solution, soluble salts of lime. These acids have been named *glucinic* and *saccharic*, and they form with lime soluble salts. When the lime is precipitated from these solutions, the acids are left in a free state ready to destroy the sucrose whenever heat is applied. Could some way be found to precipitate these acids after precipitating the lime, valuable results could be obtained from this process, but unfortunately the only precipitant of these acids (oxides of mercury) are poisons and can not be used in the arts. In a laboratory experiment, after thoroughly removing the lime with acid phosphate, ammonia was added to neutralize the acids, and the molasses boiled to masse

cuite and analyzed as follows: Total solids, 87 per cent.; water, 13 per cent.; sucrose, 49 per cent.; lime, 1,46 per cent.; glucose, 4.21 per cent., and solids not sugar, 24 per cent. This failed to granulate. During the process of cooking with lime a large loss of albuminoids took place, which action was plainly discernable by the escape of free ammonia. In the laboratory experiments the albuminoids were reduced from 2.90 per cent. to .81 per cent. These experimonts are given to the public only to explain chemical and physical phenomena frequently occurring in the sugar house and with no result as yet of their practical use.

EXPERIMENTS IN CENTRIFUGALING.

The following experiments were made to determine the influence of wash water on the centrifugal: The masse cuite had a composition of sucrose, 73.1 per cent.; glucose, 7.69; moisture, 9.15; solids not sugar, 10.04.

It was taken hot from the pan. and put into a car, and from this weights were taken. This work continued until the masse cuite got so hard that it had to be handled with a spade. Nine different experiments were made, three without any water, and the rest with water varying from 2½ to 25 per cent. It was contemplated at the beginning of the experiments to use saturated (white) sugar solutions in different quantities, as with pure water; but before getting to them another influencing factor became visible, not counted on in the outset. As we proceeded the masse cuite cooled, and became harder, and gave relatively greater yields, until finally, by experiment No. 6, it was revealed that the cold masse cuite, washed with 5 per cent. of water, gave 7.8 per cent., and 5 per cent more than the unwashed in the beginning of the experiment. It was now apparent that an increase of crystals was taking place with the cooling, and any further experiments with a sugar solution as a wash could not be compared with those made while hot. Accordingly only three more were made, two with same quantity of water, and one without water.

The following are the experiments:

Number.	Amt. used. Lbs. masse cuite.	HOW TREATED.	Lbs sugar.	Analyses.	C. P. Sugar.
1	100	Without water	57.1	94.	53.76
2	100	" "	60.	90.5	54 30
3	100	With 12½ lbs. water	40.	97 2	38.88
4	100	" 25 " "	35.	98.5	34.47
5	100	" 2½ " "	60.62	94.8	57.46
6	100	" 5 " "	65.	95.2	61.88
7	100	" 7½ " "	45.60	93.8	42.76
8	100	Mixed with 7½ lbs. water before centrifugaling	55.34	95.2	52.68
9	100	Without water	70.20	90.	63.18

The centrifugal was taken to pieces and cleaned after each experiment, and in experiments three and four, after the masse cuite was dried and before adding the water, the basket was cleaned, and the subsequent washings caught, weighed and analyzed with following results:

No 3 gave 30.6 pounds of washings containing 48.2 per cent. sucrose, and 4.48 per cent. glucose.

No. 4 gave 56.2 pounds of washings containing 48.8 per cent. sucrose and 4 per cent glucose; 12½ pounds water then washed out of the centrifugal, 14.74 pounds sugar, and 1.37 pounds glucose, and 25 pounds water removed 27.42 pounds sugar and 2.24 pounds glucose.

From these experiments these conclusions can be drawn:

1. That masse cuite in cooling gives a greater yield in the centrifugal, and suggests the propriety, adopted by many planters, of dropping their masse cuite into wagons and keeping for several hours in the hot room.

2. That mixing the water with masse cuite, before centrifugaling, gives larger yields than using the same amount in the centrifugal.

3. That for every pound of water used in the centrifugal, more than a pound of sugar is dissolved.

The ash and albuminoids of the mill juices were determined several times during the season, and are here given.

	Ash.	Albuminoids.
Field Experiment 13, plat III	....	332
" " 14, " III	.563	.285
" " 15, " III	.480	.285
" " 16, " III	.572	.285
" " 3, " IV	....	.335
" " 5, " IV	....	.396
" " 7, " IV	....	.446
" " 8, " IV	....	.305
" " 17, " V	.51	.400
" " 18, " V	.53	.359
" " 19, " V	.50	.392

Experiment 13 above was manured with potash only.

Experiment 14 above was manured with potash and nitrogen.

Experiment 15 above was manured with potash, phosphoric acid and nitrogen.

Experiment 16 above was unmanured.

Experiment 3 above was manured with potash, phosphoric acid and nitrogen.

Experiment 5 above was manured with phosphoric acid only.

Experiment 7 above was manured with phosphoric acid, potash and nitrogen.

Experiment 8 was unmanured.

Experiment 17 above was manured with nitrogen only.

Experiment 18 above was manured with nitrogen and potash.

Experiment 19 above was manured with nitrogen, potash and phosphoric acid.

The object in analyzing above was to determine, if possible, the effects of the different ingredients of the fertilizers upon the ash and albuminoids of the juice. An inspection will show that little or no influence was produced by the different fertilizers upon these constituents of the juice.

The *final molasses* of different runs have been subjected to the following analysis with a view of additional light on the same subject:

Analysis of Molasses from Experiment Station Sugar House—1890.

FERTILIZERS USED IN THE FIELD.	No. of run.	Density by Brix.	Ash.	CaO in molasses.	CaO in ash.	P2 O5 in molasses.	P2 O5 in ash.	K2 O in molasses.	K2 O in ash.	Nitrogen in molasses.	Albuminoids.	PROCESS OF CLARIFICATION IN SUGAR HOUSE.
Kainite group..........	1	80.4	5.18	0.42	8.11	0.16	3.08	2.13	41.12	0.78	4.87	Lime.
Sulphate potash group..	2	73.7	3.97	0.31	7.80	0.21	5.29	1.46	36.77	0.66	4.13	Lime.
Muriate potash group .	3	76.9	4.71	0.86	18.25	0.03	0.64	1.83	37.86	0.67	4.19	Lime and bisulphite.
Soluble phosphate "	5	68.0	2.71	0.26	9.59	0.06	2.21	1.00	36.90	0.59	3.69	Lime and bisulphite.
Insoluble phosphate "	6	75.7	3.17	0.49	15.45	0.18	5.67	1.27	40.00	0.69	4.39	Lime and acid phosphate.
Organic nitrogen "	8	66 4	2.93	0.54	18.43	0.12	4.08	1.32	45.05	0.75	4.69	Lime and sulphur.
Mineral nitrogen "	9	74.7	3.27	0.16	4.90	0.20	6.11	1.58	48.31	8.81	5.06	Wilcox albumen.

Attention is called to the excessive amounts of lime present in Nos. 3, 6 and 8, where lime and bisulphite, lime and acid phosphate, and lime and sulphur were respectfully used in the clarification; also to the increased nitrogen in the Wilcox process.

BLEACHING MOLASSES.

On January 29, 1891, a firm in Boston wrote to the Department of Agriculture in Washington, complaining bitterly of the practice prevailing in New Orleans of bleaching molasses with chemicals. This letter was sent me by Dr. H. W. Wiley, with the request that I would find out all I could about the matter, particularly their methods of treating and bleaching molasses. Upon the receipt of this letter we started an investigation, and soon found that the R. R. Chemical Company, of New York, were selling compounds for bleaching molasses under the name of "Sulphine" and "Boxyde." Samples of these were obtained and examined, and the following report of Prof. B. B. Ross will show how thoroughly the work was performed. These substances are recommended to be used as follows: Three pounds sulphine, three ounces boxyde to 50 gallons of molasses.

PROF. ROSS' REPORT.

Samples of the two clarifying agents now largely used in brightening dark molasses, and sold under the name of "sulphine" and "boxyde" respectively, have been recently subjected to a careful analysis in this laboratory, and, in addition, quite a number of practical tests have been made to determine their utility as decolorizing agents. The sample marked "boxyde," was found on examination to consist of nearly chemically pure zinc, or "zinc dust," and in making clarification tests the pure zinc dust of the laboratory gave results identical with those obtained by the use of the "boxyde." The sample marked "sulphine" on analysis proved to be a solution of commercial bisulphite of soda, with a small quantity of sulphuric acid.

ANALYSIS OF SULPHINE.

	Per cent.
Sulphurous acid	21.25
Sulphuric acid	0.93
Chlorine	0.15
Soda	10.43
Sodium bisulphite	34.53

Quite a number of tests with molasses were made with the use of the "sulphine" alone, but in no instance was the clarification as good as where zinc was used in addition. In several tests, finely pulverized iron filings were used as a substitute for the "boxyde," but the results obtained by it were lacking in uniformity. Two or three clarifications with the use of "sulphine" and iron were extremely good, bnt the lengh of time consumed in securing a clear liquid was very considerable, and cn some subsequent tests made with other samples of molasses, the brightening effects were not nearly so apparent. It was found by quite a number of experiments that sodium bisulphate and zinc dust gave a clarification fully as good as that secured by the bisulphite and zinc, and that the sediment settled with equal rapidity.

Sodium sulphate, with a very small quantity of very dilute sulphuric acid, (not enough to correspond to the acidity of the bisulphate used in the test above mentioned) together with zinc dust, gave a very clear solution, fully equal in brightness to the bisulphate test. With sodium sulphite substituted for the sulphate, and with the addition of sulphuric acid and zinc dust as before, the degree of brightness secured was greater than that obtained by any other method, and this brightening also took place more rapidly. Dilute sulphuric acid and zinc, when used in the absence of the salts just named, gave in some experiments a very fair clarification and in others, only a moderate brightening was produced.

The samples brightened by the use of the "sulphine" gave quite a considerable reaction for sulphuric acid when tested, showing that, as might be presumed, the bleaching was accomplished by reduction, the sulphurous acid taking up oxygen from the coloring matters of the syrup and being converted into sulphuric acid.

The function of the zinc is also essentially that of a reducing agent, being especially active in the presence of free acids or of salts having an acid reaction, and in its use, in conjunction with "sulphine," appears merely to reinforce the

reducing influence of the latter substance. The samples of molasses, brightened by these agents, when diluted with water and exposed to the air, commenced darkening from the surface downward, confirming, by the restoration of color by the oxygen of the air, the presumption that the bleaching was due exclusively to reduction. Other reducing agents, including several metallic sulphides were used in the place of zinc dust, in conjunction with the "sulphine," but no satisfactory results followed the use of any of these substitutes. The superior reducing properties of zinc dust have long been utilized in the laboratory in the removal of oxygen from the most thoroughly oxidized substances, and it will be difficult to find a solid substance more active in producing these effects than zinc.

With this report before them, the planters can, if they wish, bleach their own goods. I see no reason why they should not reap the profit now going to the middle men.