CHEMICAL CONTROL
IN
CANE SUGAR FACTORIES

H. C. PRINSEN GEERLIGS, Ph. D.

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BY

H. C. PRINSEN GEERLIGS, Ph.D.,

Author of "Cane Sugar and its Manufacture"; "The World's Cane Sugar Industry—Past and Present"; Practical White Sugar Manufacture."

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PREFACE.

The present volume presents the most modern methods that are in use for the sampling and analysing of the several products, and the calculating and recording of the results, in cane sugar factories in almost every cane-growing country of the world. There are slight deviations practised in different countries, but, on the whole, the processes here described are universally adopted in all countries where Chemical Control in the sugar-houses is in regular use.

In this treatise the term "reducing sugars" is used to imply the total amount of glucose and fructose, without any attempt at distinguishing between the two.

Further, the term "polarization" is used in conjunction with that of "sucrose," and in this case a distinct difference exists. We understand by "sucrose" the chemical body $C_{12}H_{22}O_{11}$, such as is determined by double polarization before and after inversion, while we imply by "polarization" the total optical rotation of the juices, sugars, bagasse, and other products occasioned by the mixture of sucrose and reducing sugars contained therein. Generally speaking, the polarization is slightly less than the real sucrose content, as a consequence of the levo-rotation of the reducing sugars which neutralizes part of the dextro-rotation of the sucrose. In every case where great accuracy is required we recommend the determination of the real sucrose content by double polarization, and the use of that value for the basis of the chemical control. In the other cases, where only approximate accuracy is needed, we can content ourselves with the ordinary direct polarization value.

H. C. PRINSEN GEERLIGS.

AMSTERDAM,
1st November, 1916.

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PART I.

ANALYTICAL METHODS.

ANALYTICAL METHODS.

I. CANE.

1. Laboratory Samples.

SAMPLING.

It is very difficult, not to say impossible, to sample the cane crushed during one day or longer with such accuracy that reliable data can be obtained as to the analysis in a direct manner of this primary material. For this reason the data regarding the sucrose and the fibre contents of the cane are generally collected by indirect methods from the proportional amounts, and the analysis, of the juice and the bagasse.

Not only is the difference in constitution of the different kinds of cane crushed an impediment to any proper sampling, but like differences in the several stalks of one variety or of one field, and even in the different parts of the same stalk, all present obstacles to accurate sampling.

As it is, however, desirable sometimes to have a direct analysis in order to check the direct figures for special purposes, we give here a method for the sampling of cane crushed during a certain period: — From every cartload of cane entering the factory two canes are retained and placed in a cool spot protected from rain and wind. Early in the morning these canes are counted and one taken out of every ten, after which these selected stalks are cut into three parts, and alternately the bottom, the middle, and the top piece, is taken from every cane, these pieces constituting the average sample.

ANALYSIS.

Fibre.—Take from the pieces of the sample, without picking, as many as will weigh 25 kg., weigh them carefully, and crush them in a small test-mill, returning the bagasse at least three times, and extracting thereby juice equal to about 72 per cent. of the weight of the cane.

Weigh the resulting bagasse from this operation, chop it into coarse pieces, mix these well, and divide them into two parts. One of these latter is cut up very finely in some form of bagasse-cutting machine or with knives, good care being taken that all the bagasse is cut up and no hard parts are rejected. The other part is expressed in a hand press under a pressure of 40 atmospheres (about 600 lbs. to the sq. in.)

The weight of the resulting residue is carefully ascertained, so that the respective proportions of bagasse and juice are accurately known. The percentage of fibre in the bagasse is not determined directly by extracting the soluble from the insoluble matter with water or with alcohol, since the constituents of the bagasse are not entirely insoluble in either of these solvents, and hence the fibre content by extraction would be found too low. It is preferable to use an indirect method, in which the bagasse is considered to consist of fibre, water, and the dry substance of the residual juice. The water content of the bagasse may be found by drying a weighed portion of the same at 103° C in a hot air-bath; while the dry substance of the residual juice per cent. of bagasse may be calculated by dividing the sucrose content of the bagasse by the quotient of purity of the juice expressed by the hand press, and multiplying the quotient by 100. In this method we assume the purity of the residual juice remaining in the bagasse to be the same as that of the juice expressed from it by the hand press. The amount of fibre on 100 bagasse is represented by the difference between its dry substance content and the figure ascertained, as just mentioned, for the dry substance in the juice contained in the bagasse.

The determinations necessary to this end are therefore:—

Dry Substance in the Bagasse (see page 10).

Polarization of the Bagasse (see page 10).

Brix of the Juice expressed from the Bagasse (see page 19).

Polarization of the Juice expressed from the Bagasse (see page 27).

EXAMPLE :

Weight of cane crushed	25·12 kg.
Weight of bagasse	6·93 ,,
Weight of juice	18·19 ,,
Dry substance of bagasse	48·25 per cent.
Polarization of bagasse	7·40 ,,
Brix of expressed juice..	19·13 degrees.
Polarization of expressed juice..	17·24 per cent.
Quotient of purity of expressed juice	90·1 degrees.

The bagasse has a polarization of 7·40 per cent. in a juice of 90·1° quotient of purity, which is equivalent to $\frac{7 \cdot 40 \times 100}{90 \cdot 1} = \mathbf{8 \cdot 21}$ per cent. of dry substance from the residual juice; and as the total percentage of dry substance in the bagasse is 48·25, that of fibre is 48·25 — 8·21 = **40·04.**

The percentage of fibre in the cane is, therefore, calculated from the weight of the sample crushed and the bagasse obtained, viz., $\frac{40 \cdot 04 \times 6 \cdot 93}{25 \cdot 12} = \mathbf{11 \cdot 44}$ per cent. fibre.

Polarization.—The polarization of the cane is found in the same way from the combination of the polarizations of the bagasse and the juice based on the proportion of each constituent.

Suppose, in our instance, the polarization of the juice expressed in the test-mill to have been 17·65, we find for the polarization of the cane :—

			Kg.
18·19 kg.	of juice @ 17·65	=	3·211
6·93 ,,	of bagasse @ 7·40	=	0·513
25·12 ,,	of cane contain		3·724

of polarization or $\frac{3 \cdot 724 \times 100}{25 \cdot 12} = \mathbf{14 \cdot 82}$ per cent. polarization.

Observation.—This method will very rarely be resorted to, as it is a somewhat lengthy one, and moreover is of very little value, since the sample is obtained from clean and pure canes, while the cane crushed in the mills is generally accompanied by trash, earth, bamboo rope, and other ingredients which are not represented in the sample and will greatly affect the figure for the fibre content. All the materials mentioned cause a very much larger percentage of solids to pass over into the bagasse than the cane, and will therefore help to swell the amount of fibre recorded, so that comparisons between the fibre content of the common bagasse in which they are represented, and that of the sample of cane in which they are not, will not give a proper insight into the real state of affairs.

It has been suggested that the cane be brought into the test under exactly the same conditions as it encounters in the ordinary milling process, by adding to a sample of cane of known weight the same proportion of trash and other matter as it contains when being brought in. To this end a few cartloads are weighed carefully every day, the canes taken off, stripped of their trash and cleaned of their dirt and weighed again, thereby establishing the quantity of foreign matter adhering to a known quantity of cane just as clean as when used for the crushing in the test-mill. When making the experiment, that same proportion of trash is added to the weighed quantity of cane in order to find the gross weight.

If, for instance, the amount of trash adhering to 100 parts of clean canes has been found to be 1·20, the 25·12 kg. of cane weighed would require a quantity of $\frac{25 \cdot 12 \times 1 \cdot 20}{100} = 0 \cdot 301$ kg. of trash, making up to 25·421 kg. of the gross sample, and the resulting quantities would be divided by the gross weight.

The determination of the tare and the preparation of the sample require such a degree of rather superfluous labour and trouble that this method is very rarely applied; and, in fact, the direct determination of polarization and fibre in cane is supplanted by the indirect methods to be discussed in a later section.

2. Factory Samples.

SAMPLING.

From every cartload of cane entering the factory retain one or two bundles, and pile up those of each field on their own special heap, so that every heap contains the canes cut that day from a given field. Once a day these heaps are crushed separately by the factory mill, and the first mill juice is continually sampled by taking up small quantities of the juice with a small measuring glass and pouring them into a bottle, a can, or a kerosene tin.

ANALYSIS.

In the samples determine the Brix, the polarization, and the quotient of purity.

The percentage of polarization is found by multiplying the figure for the polarization of the undiluted juice by the factor shown on page 76.

The amount of available sugar in the juice and in the cane is found by multiplying the figures for the polarization by that of the quotient of purity of the undiluted juice and then dividing by 100. Thus, if a juice of 19·25° Brix and 17·24 per cent. polarization has been obtained from a cane having the factor of 80·9, the polarization of the juice would be 17·24, and that of the cane $17{\cdot}24 \times 0{\cdot}809 = 13{\cdot}95$; while the quotient of purity equals $\frac{17{\cdot}24 \times 100}{19{\cdot}25} = \mathbf{89{\cdot}56}$.

The available sugar on 100 parts of juice is $\frac{17{\cdot}24 \times 89{\cdot}56}{100} = \mathbf{15{\cdot}44}$, and that on 100 parts of cane $\frac{13{\cdot}95 \times 89{\cdot}56}{100} = \mathbf{12{\cdot}49}$.

Carried out thus, no absolutely accurate figures are obtained, since neither is the factor the real proportion between the polarization of the juice and the cane, nor is the quotient of purity the exact ratio between the figure for the polarization and that of the commercial sugar actually turned out ultimately. The figures are, however, mutually comparable, and at the end of the grinding season the real production of each field can be found by multiplying the approximate figures thus obtained by the factor representing the proportion between the sugar actually produced over the whole estate, and the sugar calculated to be obtained from all the fields in the above-mentioned way.

3. Field Samples.

At the outset of the cane growing season, the canefields are divided on a map into plots which have been planted and manured at the same time and in the same manner. After 10 months of growth, select from each plot 40 normally grown cane plants, and mark and number them.

At the time when the cane is ripening, one cane-stalk is cut every fortnight from each of the marked stools, and the resulting bundle carried to the laboratory, where the green tops are removed, and the canes are measured, weighed, and crushed in a small test-mill, after which the juice is analysed, determining the Brix and polarization, and calculating the quotient of purity and available sugar on 100 parts of juice.

The analytical data from each analysis of the same plot are entered down, so that an increase or the reverse of polarization, or purity, or available sugar, can be detected at once. As soon as the polarization and the quotient of purity cease to augment, the cane of the plot under consideration has attained its point of maturity, and should be cut in order to prevent deterioration from standing too long in the field.

The results are entered in the following table, in which the percentage of diseased or worm-eaten canes is also recorded:—

Number or name of Field............ Year............

Date of planting.	Date of analysis.	Number of canes analysed.	Length of the cane, average.	Weight of the cane, average.	Per cent. attacked by Borers.	Per cent. attacked by Disease.	Analysis of the Juice.				Observations.
							Brix.	Polarization.	Quotient.	Available Sugar.	

II. BAGASSE.

Sampling.

Sampling from the First and Second Mills for the Control of the Milling Work.—Every hour, after having shut off the maceration water, a large sample is taken from the full width of the carrier. If the maceration pipe keeps leaking, the water flowing out is caught by a small gutter.

Sampling from the Last Mill for the Chemical Control.—A large sample from the last mill's bagasse is taken, by sampling the bagasse coming out of the mill uninterruptedly during a quarter of an hour. The best way is to start every quarter before the full hour, so as to have 24 hourly samples a day.

When sampling, good attention should be paid to the fact that the bagasse at the end of the rollers is generally less completely crushed than that at the middle, that the top side of the blanket may differ in juice content from that at the bottom; and good care should be taken to have as many small as large pieces of the bagasse represented in the sample.

Combination of the two ways of Sampling.—When sampling the bagasse from more than one mill of the train, the large sample from the last mill, viz., that intended for the chemical control, should be taken first during a quarter of an hour, while the usual rate of maceration in the ordinary way is carried on in order to get as complete a representation as possible of the work done. Next that of the mill immediately preceding has to be sampled, and furthermore that of the one preceding the latter, so that stopping the maceration water for the sake of the sampling for the control of the milling work done does not affect the constitution of the bagasse from the last mill which has to serve as a basis for the chemical control of the extraction.

Preparation of the Samples.

Samples for the Control of the Mill Work.—From every one of the large samples a subsample is prepared, representing as nearly as possible the average constitution, and weighing about 4 lbs. This subsample is divided up in a cutting machine or with knives to pieces of the length of 3 mm. This finely divided portion is well mixed, and part of it is packed in a hand press, where it is expressed at a pressure of 40 atmospheres (600 lbs. to sq. in.) The expressed juice is collected, sieved, and analysed.

Samples for the Chemical Control.—The large sample from the last mill is treated in exactly the same way as that from the other mills, as mentioned under (I),* and also part of the finely divided bagasse expressed in a press. Further, 200 grms. of that divided bagasse are cut in a cutting machine to a length of 1 mm., and the material thus obtained is used for the determination of dry substance and polarization.

Analysis.

Dry Substance.—20 grms. of the finely divided bagasse are weighed, and dried for four hours at a temperature of 100° to 105° C. in a hot air-bath. The bagasse is spread on an enamelled iron dish, 5 in. square, having a rim 1 in. high.

From time to time it is necessary to ascertain if after four hours' drying the weight has really become a constant one. If, after cooling, the dry bagasse appears yellow or brown, it is evidence of the temperature having been too high, and the analysis must be repeated.

The best drying bath is one heated by steam to a temperature of 105° C., in which the bagasse is dried by means of a current of dry air conducted through the bath, which rapidly takes off the water vapour from the bagasse, reducing the drying time from four to one, or, at the most, to two hours.

Polarization.—The polarization of the bagasse is ascertained by aqueous digestion after one or other of the two methods given here.

I. Method of the Hawaiian Sugar Experiment Station.†

The digestion of the finely divided bagasse with hot water takes place in a "double cooker" (*see Figure*), consisting of:

A, an exterior cylindrical vessel for boiling water, 6 in. in height and $5\frac{1}{4}$ in. in diam., crimped in at the top, so that the inside vessel fits into it snugly;

---

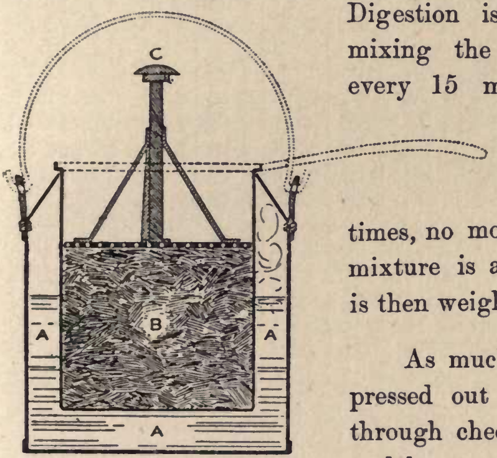
* See page 4.

† Bulletin 32, 1910, Agric. and Chem. Series, Expt. Station Hawaiian Sugar Planters' Association; and *Int. Sugar Journal*, 1910, 641.

B, an interior cylindrical vessel, 4¼ in. in height and 4¼ in. in diam., in which the sample is digested, with

C, a tamp made of a disc of heavy metal with numerous holes in it, and a rigid handle for pressing down on the bagasse. The latter should fit rather tightly into the interior vessel, so that it may serve as a cover when not being used for pressing.

100 grms. of bagasse are weighed into the inner digestion cup *B*, 500 c.c. of hot water containing 5 c.c. of a 5 per cent. solution of sodium carbonate are added, the bagasse is pressed down with the tamp, and the inner vessel placed in its outer case *A*, containing boiling water. Digestion is continued for an hour, mixing the solution with the bagasse every 15 minutes by pressing down with the tamp, and using the latter for a cover for the digestion cup between times, no more water being added. The mixture is allowed to cool a little, and is then weighed.



As much of the solution as can be pressed out of the bagasse is filtered through cheesecloth into a flask, cooled to laboratory temperature, 99 c.c. of the solution poured into a 100 c.c. flask, made up to 100 c.c. with basic lead acetate solution, filtered, and polarized in a 400 mm. tube, the polarization being found from the formula:—

$$\text{Polarization in bagasse} = \frac{r\,(w - f)}{2 \times \frac{99}{26{\cdot}048} \times 100} = \frac{r\,(w - f)}{2 \times 3{\cdot}8 \times 100}$$

in which r = polariscopic reading in a 400 mm. tube;

w = weight of bagasse plus solution, corresponding to 100 grms. of bagasse; and

f = per cent. fibre in bagasse.

This latter may always be taken as 50 or 45, according to the average fibre content of the bagasse in the factory, slight differences being of very little consequence. The polarization may be read from the following table:—

Table showing the Polarization of Bagasse from the Polariscope Reading and the Weight of Bagasse plus Solution. Polarized in the 400 mm. Tube.

$$\text{Polarization in bagasse} = \frac{r\,(w - f)}{2 \times \frac{99}{26\cdot048} \times 100}$$

(This Table is calculated for 100 grms. of bagasse containing 50 per cent. fibre and about 500 c.c. of water.)

Weight of bagasse plus solution.	Readings in the 400 mm. tube.										
	2·5	2·6	2·7	2·8	2·9	3·0	3·1	3·2	3·3	3·4	3·5
520	1·54	1·60	1·66	1·72	1·78	1·85	1·91	1·97	2·03	2·10	2·16
525	1·55	1·61	1·68	1·73	1·80	1·87	1·93	1·99	2·05	2·12	2·18
530	1·57	1·62	1·69	1·75	1·82	1·89	1·95	2·01	2·08	2·14	2·20
535	1·59	1·64	1·71	1·77	1·85	1·91	1·97	2·03	2·10	2·16	2·24
540	1·61	1·66	1·73	1·79	1·87	1·93	1·99	2·06	2·13	2·19	2·26
545	1·62	1·68	1·75	1·81	1·88	1·95	2·01	2·08	2·15	2·21	2·28
550	1·64	1·70	1·77	1·83	1·90	1·97	2·04	2·10	2·17	2·23	2·30
555	1·66	1·73	1·80	1·85	1·92	2·00	2·07	2·13	2·19	2·25	2·32
560	1·68	1·74	1·82	1·88	1·94	2·02	2·09	2·14	2·21	2·27	2·34
565	1·69	1·76	1·83	1·91	1·96	2·04	2·11	2·16	2·23	2·29	2·36
570	1·71	1·78	1·85	1·94	1·98	2·06	2·13	2·19	2·26	2·32	2·39
575	1·72	1·80	1·87	1·96	2·00	2·08	2·15	2·21	2·28	2·35	2·42
580	1·74	1·82	1·89	1·97	2·03	2·10	2·17	2·24	2·31	2·38	2·45
585	1·75	1·83	1·90	1·98	2·05	2·11	2·18	2·25	2·33	2·40	2·47
590	1·77	1·84	1·91	1·99	2·07	2·13	2·20	2·27	2·35	2·42	2·50
595	1·79	1·86	1·93	2·00	2·08	2·15	2·22	2·29	2·37	2·44	2·52
600	1·81	1·88	1·95	2·02	2·09	2·17	2·24	2·31	2·39	2·46	2·54

Weight of bagasse plus solution.	Readings in the 400 mm. tube.										
	3·6	3·7	3·8	3·9	4·0	4·1	4·2	4·3	4·4	4·5	4·6
520	2·22	2·29	2·35	2·41	2·47	2·53	2·59	2·65	2·72	2·78	2·84
525	2·25	2·31	2·37	2·44	2·50	2·56	2·61	2·67	2·74	2·81	2·86
530	2·27	2·33	2·39	2·47	2·52	2·59	2·64	2·69	2·76	2·83	2·89
535	2·31	2·36	2·42	2·49	2·55	2·61	2·66	2·72	2·79	2·85	2·92
540	2·33	2·40	2·44	2·52	2·58	2·63	2·69	2·75	2·82	2·88	2·95
545	2·35	2·43	2·46	2·54	2·60	2·66	2·73	2·78	2·86	2·92	2·98
550	2·37	2·45	2·49	2·56	2·63	2·70	2·76	2·82	2·89	2·95	3·02
555	2·40	2·47	2·52	2·59	2·66	2·72	2·79	2·85	2·92	2·98	3·05
560	2·42	2·49	2·56	2·62	2·68	2·75	2·82	2·88	2·95	3·02	3·08
565	2·44	2·51	2·58	2·64	2·71	2·78	2·85	2·91	2·98	3·05	3·11
570	2·46	2·53	2·60	2·67	2·74	2·81	2·88	2·95	3·01	3·08	3·15
575	2·48	2·56	2·63	2·69	2·77	2·84	2·91	2·98	3·04	3·11	3·18
580	2·51	2·58	2·65	2·72	2·80	2·87	2·94	3·01	3·08	3·15	3·22
585	2·54	2·62	2·68	2·75	2·82	2·89	2·96	3·03	3·11	3·18	3·25
590	2·57	2·65	2·72	2·78	2·84	2·91	2·98	3·06	3·14	3·21	3·28
595	2·59	2·67	2·74	2·81	2·87	2·94	3·01	3·09	3·17	3·24	3·33
600	2·61	2·69	2·76	2·83	2·90	2·97	3·04	3·11	3·19	3·26	3·34

TABLE SHOWING THE POLARIZATION OF BAGASSE FROM THE POLARISCOPE READING AND THE WEIGHT OF BAGASSE PLUS SOLUTION. POLARIZED IN THE 400 MM. TUBE.

(Continued.)

Weight of bagasse plus solution.	Readings in the 400 mm. tube.										
	4·7	4·8	4·9	5·0	5·1	5·2	5·3	5·4	5·5	5·6	5·7
520	2·90	2·96	3·02	3·08	3·14	3·20	3·27	3·33	3·39	3·46	3·50
525	2·92	2·98	3·04	3·10	3·16	3·23	3·30	3·36	3·42	3·48	3·54
530	2·95	3·00	3·06	3·12	3·19	3·26	3·33	3·39	3·45	3·50	3·58
535	2·98	3·04	3·10	3·17	3·24	3·30	3·37	3·42	3·49	3·55	3·62
540	3·01	3·08	3·15	3·22	3·28	3·35	3·41	3·47	3·53	3·60	3·66
545	3·05	3·12	3·19	3·26	3·31	3·38	3·44	3·50	3·57	3·63	3·70
550	3·09	3·16	3·22	3·28	3·35	3·41	3·48	3·54	3·60	3·67	3·74
555	3·12	3·19	3·26	3·32	3·39	3·45	3·52	3·59	3·65	3·72	3·79
560	3·15	3·22	3·30	3·36	3·43	3·50	3·56	3·63	3·70	3·78	3·83
565	3·18	3·25	3·32	3·39	3·46	3·53	3·59	3·66	3·73	3·79	3·87
570	3·22	3·28	3·35	3·42	3·49	3·57	3·62	3·69	3·76	3·83	3·89
575	3·25	3·32	3·38	3·45	3·53	3·60	3·66	3·73	3·80	3·87	3·94
580	3·29	3·36	3·42	3·48	3·57	3·64	3·70	3·76	3·85	3·92	3·99
585	3·32	3·39	3·46	3·51	3·59	3·66	3·73	3·79	3·88	3·96	4·03
590	3·35	3·42	3·49	3·54	3·61	3·68	3·75	3·82	3·91	4·00	4·07
595	3·38	3·45	3·52	3·58	3·65	3·72	3·79	3·86	3·94	4·02	4·10
600	3·41	3·48	3·55	3·62	3·69	3·76	3·84	3·91	3·98	4·05	4·13

Weight of bagasse plus solution.	Readings in the 400 mm. tube.										
	5·8	5·9	6·0	6·1	6·2	6·3	6·4	6·5	6·6	6·7	6·8
520	3·56	3·63	3·70	3·76	3·82	3·88	3·94	4·00	4·06	4·12	4·17
525	3·61	3·67	3·74	3·80	3·86	3·92	3·98	4·04	4·11	4·17	4·22
530	3·65	3·72	3·78	3·84	3·90	3·96	4·02	4·09	4·16	4·22	4·28
535	3·69	3·76	3·82	3·88	3·95	4·01	4·07	4·14	4·21	4·27	4·33
540	3·73	3·80	3·86	3·93	4·00	4·06	4·12	4·19	4·26	4·32	4·38
545	3·77	3·84	3·90	3·96	4·03	4·09	4·16	4·23	4·30	4·36	4·42
550	3·81	3·88	3·94	4·00	4·07	4·13	4·20	4·26	4·34	4·39	4·46
555	3·86	3·90	3·98	4·05	4·12	4·19	4·26	4·32	4·38	4·45	4·52
560	3·90	3·98	4·03	4·09	4·16	4·25	4·32	4·38	4·43	4·50	4·57
565	3·93	4·00	4·06	4·13	4·20	4·28	4·35	4·42	4·47	4·54	4·61
570	3·95	4·02	4·10	4·17	4·24	4·31	4·38	4·44	4·50	4·58	4·65
575	4·00	4·07	4·15	4·22	4·29	4·36	4·43	4·49	4·55	4·63	4·70
580	4·06	4·12	4·20	4·27	4·32	4·41	4·47	4·54	4·60	4·68	4·75
585	4·10	4·16	4·23	4·30	4·35	4·44	4·50	4·58	4·64	4·73	4·79
590	4·14	4·20	4·26	4·33	4·39	4·47	4·53	4·61	4·68	4·76	4·84
595	4·16	4·23	4·30	4·37	4·43	4·51	4·58	4·65	4·73	4·81	4·89
600	4·18	4·26	4·34	4·41	4·48	4·55	4·62	4·70	4·78	4·85	4·92

TABLE SHOWING THE POLARIZATION OF BAGASSE FROM THE POLARISCOPE READING AND THE WEIGHT OF BAGASSE PLUS SOLUTION. POLARIZED IN THE 400 MM. TUBE.

(Continued.)

Weight of bagasse plus solution.	Readings in the 400 mm. tube.										
	6·9	7·0	7·1	7·2	7·3	7·4	7·5	7·6	7·7	7·8	7·9
520	4·25	4·32	4·38	4·44	4·51	4·58	4·64	4·70	4·76	4·82	4·87
525	4·30	4·36	4·42	4·49	4·56	4·62	4·68	4·74	4·80	4·87	4·92
530	4·34	4·40	4·47	4·55	4·60	4·66	4·72	4·78	4·85	4·92	4·98
535	4·40	4·46	4·53	4·60	4·66	4·73	4·79	4·84	4·92	4·98	5·04
540	4·45	4·52	4·59	4·65	4·71	4·80	4·86	4·90	4·98	5·04	5·10
545	4·49	4·56	4·63	4·69	4·76	4·84	4·90	4·96	5·02	5·08	5·15
550	4·53	4·60	4·67	4·73	4·79	4·88	4·94	5·01	5·06	5·12	5·19
555	4·59	4·66	4·73	4·79	4·85	4·93	4·99	5·06	5·12	5·19	5·26
560	4·63	4·72	4·78	4·84	4·91	4·98	5·05	5·12	5·18	5·27	5·30
565	4·67	4·75	4·82	4·88	4·95	5·02	5·09	5·16	5·22	5·29	5·35
570	4·70	4·78	4·86	4·92	4·99	5·06	5·13	5·20	5·27	5·34	5·41
575	4·75	4·83	4·90	4·98	5·04	5·11	5·18	5·25	5·32	5·39	5·46
580	4·81	4·88	4·94	5·01	5·09	5·16	5·23	5·30	5·37	5·44	5·52
585	4·86	4·94	5·01	5·08	5·15	5·23	5·30	5·37	5·43	5·50	5·57
590	4·92	5·00	5·07	5·15	5·22	5·30	5·37	5·43	5·50	5·55	5·62
595	4·95	5·03	5·11	5·18	5·25	5·33	5·41	5·48	5·54	5·61	5·67
600	4·98	5·07	5·15	5·22	5·29	5·37	5·45	5·52	5·59	5·66	5·73

Weight of bagasse plus solution.	Readings in the 400 mm. tube.										
	8·0	8·1	8·2	8·3	8·4	8·5	8·6	8·7	8·8	8·9	9·0
520	4·93	5·00	5·06	5·12	5·18	5·24	5·30	5·37	5·44	5·50	5·56
525	4·98	5·05	5·12	5·18	5·23	5·28	5·34	5·41	5·48	5·54	5·61
530	5·04	5·11	5·18	5·23	5·28	5·33	5·38	5·45	5·52	5·59	5·66
535	5·10	5·16	5·22	5·28	5·33	5·38	5·44	5·51	5·58	5·65	5·71
540	5·16	5·21	5·26	5·32	5·38	5·44	5·50	5·57	5·64	5·70	5·76
545	5·21	5·27	5·33	5·39	5·45	5·51	5·57	5·64	5·71	5·77	5·83
550	5·26	5·33	5·39	5·46	5·52	5·59	5·65	5·72	5·78	5·84	5·90
555	5·31	5·38	5·44	5·52	5·58	5·64	5·70	5·77	5·84	5·90	5·97
560	5·36	5·43	5·50	5·57	5·64	5·70	5·76	5·83	5·90	5·97	6·04
565	5·42	5·49	5·56	5·63	5·70	5·77	5·83	5·90	5·96	6·03	6·10
570	5·48	5·55	5·62	5·69	5·76	5·83	5·90	5·96	6·02	6·09	6·16
575	5·52	5·61	5·68	5·75	5·82	5·88	5·95	6·02	6·09	6·16	6·23
580	5·60	5·67	5·74	5·81	5·88	5·94	6·01	6·08	6·16	6·23	6·30
585	5·65	5·72	5·79	5·85	5·93	5·99	6·06	6·13	6·21	6·28	6·36
590	5·69	5·77	5·84	5·90	5·98	6·04	6·11	6·18	6·26	6·34	6·42
595	5·74	5·82	5·89	5·95	6·03	6·10	6·16	6·25	6·32	6·39	6·47
600	5·80	5·87	5·94	6·01	6·08	6·15	6·23	6·32	6·39	6·45	6·52

TABLE SHOWING THE POLARIZATION OF BAGASSE FROM THE POLARISCOPE READING AND THE WEIGHT OF BAGASSE PLUS SOLUTION. POLARIZED IN THE 400 MM. TUBE.

(Continued.)

Weight of bagasse plus solution.	Readings in the 400 mm. tube.									
	9·1	9·2	9·3	9·4	9·5	9·6	9·7	9·8	9·9	10·0
520	5·62	5·68	5·74	5·80	5·86	5·92	5·98	6·04	6·10	6·16
525	5·67	5·73	5·79	5·85	5·92	5·98	6·05	6·11	6·17	6·22
530	5·72	5·78	5·84	5·90	5·98	6·04	6·12	6·18	6·23	6·28
535	5·77	5·84	5·90	5·96	6·04	6·12	6·17	6·24	6·30	6·36
540	5·83	5·90	5·96	6·02	6·10	6·16	6·23	6·30	6·37	6·44
545	5·90	5·97	6·03	6·10	6·17	6·24	6·30	6·37	6·44	6·50
550	5·97	6·04	6·11	6·18	6·25	6·32	6·38	6·44	6·50	6·56
555	6·03	6·12	6·17	6·24	6·31	6·38	6·45	6·52	6·58	6·64
560	6·10	6·16	6·23	6·30	6·37	6·44	6·52	6·60	6·66	6·72
565	6·16	6·22	6·30	6·37	6·44	6·50	6·59	6·66	6·72	6·78
570	6·23	6·29	6·37	6·44	6·50	6·56	6·65	6·72	6·79	6·84
575	6·30	6·36	6·44	6·51	6·58	6·64	6·73	6·79	6·85	6·90
580	6·37	6·44	6·51	6·58	6·66	6·73	6·80	6·86	6·91	6·96
585	6·43	6·50	6·58	6·64	6·73	6·79	6·86	6·92	6·97	7·02
590	6·49	6·56	6·64	6·71	6·80	6·84	6·91	6·98	7·03	7·08
595	6·53	6·61	6·69	6·76	6·87	6·90	6·97	7·04	7·10	7·16
600	6·60	6·67	6·74	6·81	6·91	6·96	7·03	7·10	7·17	7·24

Weight of bagasse plus solution.	Readings in the 400 mm. tube.								
	10·1	10·2	10·3	10·4	10·5	10·6	10·7	10·8	10·9
520	6·22	6·28	6·35	6·42	6·48	6·54	6·60	6·66	6·72
525	6·28	6·34	6·41	6·48	6·54	6·60	6·66	6·73	6·79
530	6·34	6·40	6·47	6·54	6·60	6·66	6·72	6·79	6·85
535	6·42	6·48	6·55	6·62	6·68	6·74	6·80	6·87	6·92
540	6·50	6·56	6·63	6·70	6·76	6·82	6·88	6·94	7·00
545	6·57	6·63	6·70	6·76	6·83	6·89	6·95	7·02	7·08
550	6·63	6·70	6·76	6·82	6·89	6·96	7·03	7·10	7·16
555	6·71	6·77	6·83	6·91	6·98	7·05	7·11	7·17	7·25
560	6·79	6·86	6·93	7·00	7·07	7·14	7·20	7·27	7·34
565	6·85	6·92	6·99	7·07	7·13	7·20	7·27	7·33	7·40
570	6·91	6·98	7·05	7·13	7·20	7·27	7·34	7·40	7·47
575	6·98	7·05	7·12	7·19	7·27	7·35	7·41	7·48	7·55
580	7·04	7·13	7·20	7·28	7·35	7·42	7·49	7·56	7·63
585	7·11	7·19	7·27	7·34	7·42	7·48	7·53	7·63	7·70
590	7·19	7·26	7·34	7·41	7·48	7·55	7·59	7·70	7·76
595	7·25	7·32	7·40	7·46	7·53	7·61	7·66	7·76	7·83
600	7·31	7·38	7·45	7·52	7·59	7·68	7·74	7·82	7·90

This Table is calculated for a fibre content of 50 per cent. but may be used also for one of 45. In this case the figures of one horizontal line lower are taken.

If, for instance, the fibre content of the bagasse is 50, the weight of bagasse plus solution is found to be 570 grms. and the polariscope reading 6·2, the polarization of the bagasse is, according to the Table, 4·24.

The amount of solution was in this case 570 — 50 = 520. If the percentage of fibre had been 45, then the amount of liquid would be 570 — 45 = 525, or 5 more; and thus the polarization is to be looked for as if the weight of bagasse plus solution had been 5 grms. more; we find it given as 4·29.

This shows clearly how little influence is exerted by the fibre content between the limits met with in practical working.

II. Method of the Java Sugar Experiment Station.

20 grms. of the finely divided bagasse are weighed in a tared metal beaker, treated with 250 c.c. of water, and at once put to the boil. A pipette of 50 c.c. is fixed over the boiling mass, and water from it is allowed to trickle through a rubber tube, closed with a pinch-cock, at a sufficiently slow rate that the addition of the water just keeps pace with the evaporation. This addition of water starts as soon as the liquid boils and is continued through the whole duration of the boiling, viz., a quarter of an hour. The inflow of water should be such that boiling is not interrupted, and the amount of water added remains about 250 c.c. at the end of the operation. Next, the beaker is cooled, and 5 c.c. of basic lead acetate solution are added; then the whole is weighed, the contents well stirred and filtered, the filtrate being polarized in a 400 mm. tube.

Once a day, a test is made to see if really sufficient acetate of lead has been added, by pouring a drop of basic lead acetate solution into the filtrate. If a further precipitate be formed, it is proof that enough of the clarificant had not been used, and in subsequent determinations 10 c.c. of the reagent should be employed instead of 5.

The amount of water added is found by subtracting the weight of the beaker with the bagasse from the ultimate weight of the beaker with its contents after being cooled down. To this weight of liquid added we must reckon also the weight of the juice contained in the bagasse itself, which is taken to be 55 per cent. or 11 grms.

Table for the Determination of the Sucrose Content of Bagasse from the Polariscope Reading and the Weight of the Extract.

$$S = P \times \frac{26\cdot048}{20} \times \frac{\text{Sp. Gr.}}{100} \times \frac{1}{2}.$$

Weight of Extract, grms.	Polariscope reading in the 400 mm. Tube.										
	2·0	2·1	2·2	2·3	2·4	2·5	2·6	2·7	2·8	2·9	3·0
200	2·59	2·72	2·85	2·98	3·11	3·24	3·37	3·50	3·63	3·76	3·90
205	2·66	2·80	2·92	3·05	3·19	3·32	3·46	3·59	3·72	3·85	3·99
210	2·72	2·87	3·00	3·13	3·27	3·40	3·54	3·68	3·81	3·95	4·09
215	2·79	2·93	3·07	3·20	3·34	3·48	3·62	3·76	3·90	4·04	4·19
220	2·85	3·00	3·14	3·28	3·42	3·56	3·70	3·85	4·00	4·14	4·29
225	2·91	3·07	3·21	3·36	3·50	3·65	3·80	3·94	4·09	4·23	4·38
230	2·99	3·14	3·28	3·42	3·58	3·72	3·88	4·02	4·18	4·33	4·48
235	3·05	3·20	3·36	3·50	3·67	3·81	3·97	4·11	4·27	4·42	4·59
240	3·11	3·28	3·43	3·58	3·73	3·90	4·06	4·20	4·37	4·51	4·68
245	3·18	3·34	3·50	3·65	3·81	3·97	4·13	4·29	4·45	4·60	4·78
250	3·24	3·40	3·57	3·73	3·90	4·06	4·21	4·38	4·55	4·70	4·88
255	3·31	3·48	3·64	3·80	3·98	4·14	4·30	4·48	4·64	4·80	4·98
260	3·38	3·55	3·71	3·88	4·05	4·22	4·39	4·57	4·73	4·90	5·07
265	3·44	3·61	3·79	3·96	4·13	4·30	4·47	4·66	4·82	4·99	5·17
270	3·51	3·68	3·86	4·03	4·20	4·39	4·55	4·75	4·91	5·08	5·27
275	3·58	3·75	3·93	4·10	4·29	4·47	4·63	4·84	5·00	5·18	5·37
280	3·64	3·82	4·00	4·18	4·36	4·55	4·72	4·93	5·10	5·27	5·46
285	3·70	3·89	4·08	4·26	4·44	4·63	4·80	5·02	5·19	5·37	5·56
290	3·78	3·96	4·15	4·33	4·52	4·71	4·90	5·11	5·28	5·46	5·66
295	3·84	4·02	4·22	4·41	4·60	4·79	4·97	5·20	5·37	5·55	5·76
300	3·90	4·10	4·29	4·48	4·68	4·87	5·06	5·30	5·46	5·65	5·86

Weight of Extract, grms.	Polariscope reading in the 400 mm. tube.									
	3·1	3·2	3·3	3·4	3·5	3·6	3·7	3·8	3·9	4·0
200	4·02	4·15	4·28	4·41	4·54	4·68	4·80	4·95	5·08	5·21
205	4·12	4·26	4·39	4·52	4·66	4·80	4·92	5·07	5·20	5·34
210	4·22	4·36	4·50	4·64	4·78	4·91	5·04	5·19	5·33	5·46
215	4·32	4·47	4·60	4·75	4·89	5·04	5·16	5·32	5·46	5·60
220	4·42	4·57	4·71	4·86	5·00	5·15	5·28	5·44	5·58	5·73
225	4·52	4·67	4·81	4·97	5·11	5·27	5·40	5·56	5·71	5·86
230	4·62	4·78	4·92	5·08	5·23	5·39	5·53	5·69	5·84	6·00
235	4·72	4·89	5·04	5·20	5·34	5·51	5·64	5·81	5·96	6·12
240	4·83	5·00	5·15	5·30	5·45	5·61	5·77	5·94	6·09	6·25
245	4·93	5·09	5·24	5·40	5·56	5·72	5·88	6·06	6·22	6·38
250	5·03	5·19	5·35	5·51	5·68	5·84	6·00	6·18	6·34	6·51
255	5·13	5·29	5·46	5·62	5·79	5·96	6·14	6·31	6·47	6·64
260	5·23	5·40	5·57	5·73	5·90	6·08	6·26	6·43	6·60	6·77
265	5·33	5·50	5·67	5·85	6·02	6·20	6·37	6·55	6·73	6·90
270	5·43	5·60	5·78	5·96	6·13	6·30	6·49	6·68	6·85	7·03
275	5·53	5·70	5·89	6·07	6·25	6·42	6·60	6·80	6·97	7·16
280	5·64	5·81	6·00	6·18	6·36	6·54	6·73	6·92	7·11	7·29
285	5·74	5·91	6·10	6·29	6·48	6·66	6·84	7·05	7·23	7·42
290	5·84	6·02	6·21	6·40	6·59	6·78	6·97	7·17	7·36	7·55
295	5·94	6·12	6·32	6·50	6·70	6·90	7·10	7·30	7·49	7·68
300	6·04	6·23	6·43	6·63	6·81	7·01	7·20	7·42	7·61	7·81

Calculated for 20 grms. of Bagasse and about 300 c.c. of Water.

The sucrose polarization of the bagasse is found from the Table given on page 17, making use of the polariscope reading and the weight of the liquid present.

EXAMPLE :

	Grms.
Weight of beaker with 20 grms. of bagasse and the weight of water unevaporated	362
Weight of the beaker with 30 grms. bagasse ..	118
Water added	244
Juice in the bagasse	11
Total liquid	255

Polariscope reading in the 400 mm. tube = 2·6.

Polarization of the bagasse from the table = **4·30** per cent.

It is necessary from time to time to control the time of boiling the bagasse, since sometimes very hard cane will yield a bagasse which does not give up all its sugar after quarter of an hour's boiling. To this end, once a day a duplicate analysis is made of the same bagasse; in the one case it is boiled during a quarter of an hour, and the second time for half an hour. If in these two analyses a greater difference is found than 0·2 per cent. polarization in the bagasse to the detriment of the shorter boiling time, the latter is increased to half an hour in future, so long as such hard canes are being crushed.

Fibre.—The percentage of fibre is no longer determined in a direct manner, either by digestion or by extraction, but is calculated from the difference between the total dry substance and that of the residual juice still left in the bagasse.

In so doing it is presumed that the quality of the residual juice left behind in the bagasse is the same as that of the juice which can be expressed from it in the hand press at a pressure of 40 atmospheres. The quotient of purity of that juice is determined, and so the proportion between the dry substance and the polarization of the juice is known, and also that between the dissolved dry substance and the polarization of the bagasse. On multiplying the polarization of the bagasse by 100 and dividing the product by the quotient of purity of the expressed juice, the percentage of dry substance belonging to the juice is found, and by subtracting the latter from the total dry substance, the fibre content of the bagasse is also ascertained. Thus

$$\text{Fibre in bagasse} = \text{dry substance in bagasse} - \frac{\text{Polarization of bagasse} \times 100}{\text{Quotient of purity expressed juice.}}$$

Analysis of the Expressed Juice.—The juice obtained from the hand press is sieved in order to remove the floating particles of fibre, and collected in a sampling bottle, in which 25 mgrms. of mercuric chloride (corrosive sublimate) have previously be placed for every 100 c.c. of juice expected. The sample, representing equal parts of the hourly samples, is well shaken and analysed once per shift.

In case the amount of juice is sufficient to fill a glass cylinder for the Brix spindle, the Brix is determined in the ordinary way, as described on page 20; after which 0·05° is subtracted as a correction for the mercuric chloride. If, however, the quantity is too small, the specific gravity is ascertained with the pycnometer, the Brix figure being looked up in the Table,* and the correction for the temperature applied, after which 0·05 is deducted for the sublimate.

The polarization is found in the usual way, and the quotient of purity similarly.

III. MILL JUICES.

Sampling.

The mill juices are sampled continuously, preferably by revolving scoops, water wheels, or other devices moved by the flow of the juice itself. Their construction should be such that, as much as possible, proportionate samples are obtained. The places where the samples are taken must be situate in such a position that the juices from the different mills are well mixed there, an effect that may be obtained by the use of baffle plates or sieves interposed in the current of the juice.

The water wheels and gutters, along which the juice runs, are replaced every hour by clean ones, while the dirty ones are carried to the laboratory to be cleaned and disinfected.

The juice is collected in jars or enamelled cans or pails, in which previously 100 mgrms. of mercuric chloride (corrosive sublimate) have been placed for every litre of juice to be expected. The samples are carried to the laboratory every hour, and treated in the same way as is described on page 20 under the heading "Raw Juice."

* See pages 108 to 120.

IV. RAW JUICE.

Sampling.

From every filled measuring or weighing tank an equal quantity of juice is taken such that, at the end of one hour, sufficient is collected for the analysis. The sampling tins, pails, or cans are replaced by clean ones after the hour's sample has been dealt with, and are carefully washed and disinfected.

Before filling the sampling cans 100 mgrms. of corrosive sublimate are placed in the receptacles for every litre of juice to be expected.

Preparation of the Sample.

The hour's sample is mixed thoroughly, and filtered through a fine copper gauze funnel into a copper or tin cylinder, in which is fitted a thin tin discharge tube about 3 in. from the bottom. This latter is provided with a rubber tube and glass outlet, and may be shut off by a pinch-cock.

The juice filtered into the cylinder is allowed to subside for half an hour, during which time the mud sinks to the bottom, and the air bubbles collect on the surface, a clear subsided juice filling the part of the cylinder between those layers.

The clear juice is run off into a glass cylinder, in which the Brix spindle is inserted, while 250 c.c. of the same juice are poured into a collecting bottle, to which are added per litre of juice another 150 mgrms. of mercuric chloride, thus bringing the total amount of that preserving material up to 250 mgrms. per litre.

Brix.

A Brix hydrometer verified at 17·5° C is plunged into the juice, the temperature and the scale of the hydrometer read, and the latter corrected from the reading of the thermometer, using the Table opposite.

TABLE FOR THE CORRECTION OF THE BRIX HYDROMETER FROM DIFFERENT TEMPERATURES TO 17·5° C.

(THE HYDROMETER IS TESTED AT 17·5° C.)

Temperature of the Juice.	Degrees Brix.												
	0	5	10	15	20	25	30	35	40	50	60	70	75
	Subtract from the readings:												
15	0·09	0·11	0·12	0·14	0·14	0·15	0·16	0·17	0·16	0·17	0·19	0·21	0·25
16	0·06	0·07	0·08	0·09	0·10	0·10	0·11	0·12	0·12	0·12	0·14	0·16	0·18
17	0·02	0·02	0·03	0·03	0·03	0·04	0·04	0·04	0·04	0·04	0·05	0·95	0·16
	Add to the readings:												
18	0·02	0·03	0·03	0.03	0·03	0·03	0·03	0·03	0·03	0·03	0·03	0·03	0·02
19	0·06	0·08	0·08	0·09	0·09	0·10	0·10	0·10	0·10	0·10	0·10	0·08	0·06
20	0·11	0·14	0·15	0·17	0·17	0·18	0·18	0·18	0·19	0·19	0·18	0·15	0·11
21	0·16	0·20	0·22	0·24	0·24	0·25	0·25	0·25	0·26	0·26	0·25	0·22	0·18
22	0·21	0·26	0·29	0·31	0·31	0·32	0·32	0·32	0·33	0·34	0·32	0·29	0·25
23	0·27	0·32	0·35	0·37	0·38	0·39	0·39	0·39	0·40	0·42	0·39	0·36	0·33
24	0·32	0·38	0·41	0·43	0·44	0·46	0·46	0·47	0·47	0·50	0·46	0·43	0·40
25	0·37	0·44	0·47	0·49	0·51	0·53	0·54	0·55	0·55	0·58	0·54	0·51	0·48
26	0·43	0·50	0·54	0·56	0·58	0·60	0·61	0·62	0·62	0·66	0·62	0·58	0·55
27	0·49	0·57	0·61	0·63	0·65	0·68	0·68	0·69	0·70	0·74	0·70	0·65	0·62
28	0·56	0·64	0·68	0·70	0·72	0·76	0·76	0·78	0·78	0·82	0·78	0·72	0·70
29	0·63	0·71	0·75	0·78	0·79	0·84	0·84	0·86	0·86	0·90	0·86	0·80	0·78
30	0·70	0·78	0·82	0·87	0·87	0·92	0·92	0·94	0·94	0·98	0·94	0·88	0·86
35	1·10	1·17	1·22	1·24	1·30	1·32	1·33	1·35	1·36	1·39	1·34	1·27	1·25
40	1·50	1·61	1·67	1·71	1·73	1·79	1·79	1·80	1·82	1·83	1·78	1·69	1·65
50	..	2·65	2·71	2·74	2·78	2·80	2·80	2·80	2·80	2·79	2·70	2·56	2·51
60	..	3·87	3·88	3·88	3·88	3·88	3·88	3·88	3·90	3·82	3·70	3·43	3·41
70	..	5·17	5·18	5.20	5·14	5·13	5·10	5·08	5·06	4·90	4·72	4·47	4·35
80	..	..	6·62	6·59	6·54	6·46	6·38	6·30	6·26	6·06	5·82	5·50	5·33
90	..	..	8·26	8·16	8·06	7·97	7·83	7·71	7·58	7·30	6·96	6·58	6·37
100	..	..	10·01	9·87	9·72	9·56	9·39	9·21	9·03	8·64	8·22	7·76	7·42

Analysis.

The total analysis of the raw juice is made once per shift of 8 hours. To this end, the 8-hour samples, each of 250 c.c., which have been gathered in the collecting bottle, are well shaken and used for the determination of the Brix.

The Brix degrees are read in the collective sample as a check on the individual ones, while a correction is applied for the influence of the mercuric chloride by subtracting 0·05° from the final figure.

Determination of the Dry Substance by the Refractometer.

Instead of determining the apparent dry substance with the Brix hydrometer, the refractive index may also be used to that end. The refractive index of the juice is determined by the refractometer, and the readings converted into per cents. of dry substance by the Tables on pages 23, 24, and 25, which are compiled for the temperature of 28° C, the result being corrected for the temperature of the prisms of the apparatus at the time of analysis according to the Correction Table on page 25.

The refractive dry substance in most cases more closely approaches the real dry substance content than the gravity dry substance determined with the Brix hydrometer, although the differences are not very large in juices of so high a purity as the ones under consideration.

When making use of the dry substance figures found from the index determined at 28° C, and transposed by the Tables made at 28° C, the figure should be converted into readings at 17·5° C whenever this lower temperature is used for reading the polarization by Schmitz's Tables, in which the density of the juice is based on 17·5° C. The Table on page 26 is used for doing this.

Example.—If at 28° C the refractive index of a juice is found to be 1·3565, the refractive dry substance is 16·2 at 28° C (or 16·2 — 0·7 = 15·5 at 17·5° C); and if the polariscope reading of that juice is 50·3, the polarization is found in Schmitz's Table in the line under "15·5," and equals 13·53, and not 13·50 as would be the case if the uncorrected figure had been used.

TABLE FOR THE COMPARISON OF THE REFRACTIVE INDEX (AT 28° C) WITH THE SUCROSE CONTENT OF PURE SOLUTIONS IN WATER.[1]

Refractive Index.	Per cent. Sucrose.	Refractive Index for tenths of a per cent.	
1·3335	1	0·0001 = 0·05	0·0010 = 0·75
1·3349	2	0·0002 = 0·1	0·0012 = 0·8
1·3364	3	0·0003 = 0·2	0·0013 = 0·85
1·3379	4	0·0004 = 0·25	0·0014 = 0·9
1·3394	5	0·0005 = 0·3	0·0015 = 1·0
1·3409	6	0·0006 = 0·4	....
1·3424	7	0·0007 = 0·5	....
1·3439	8	0·0008 = 0·6	....
1·3454	9	0·0009 = 0·7	....
1·3469	10	....	....
1·3484	11	0·0001 = 0·05	....
1·3500	12	0·0002 = 0·1	....
1·3516	13	0·0003 = 0·2	....
1·3530	14	0·0004 = 0·25	....
1·3546	15	0·0005 = 0·3	....
1·3562	16	0·0006 = 0·4	....
1·3578	17	0·0007 = 0·45	....
1·3594	18	0·0008 = 0·5	....
1·3611	19	0·0009 = 0·6	....
1·3627	20	0·0010 = 0·65	....
1·3644	21	0·0011 = 0·7	....
1·3661	22	0·0012 = 0·75	....
1·3678	23	0·0013 = 0·8	....
1·3695	24	0·0014 = 0·85	....
1·3712	25	0·0015 = 0·9	....
1·3729	26	0·0016 = 0·95	....
1·3746	27	0·0001 = 0·05	0·0016 = 0·8
1·3764	28	0·0002 = 0·1	0·0017 = 0·85
1·3782	29	0·0003 = 0·15	0·0018 = 0·9
1·3800	30	0·0004 = 0·2	0·0019 = 0·95
1·3818	31	0·0005 = 0·25	0·0020 = 1·0
1·3836	32	0·0006 = 0·3	0·0021 = 1·0
1·3854	33	0·0007 = 0·35	....
1·3872	34	0·0008 = 0·4	....
1·3890	35	0·0009 = 0·45	....
1·3909	36	0·0010 = 0·5	....

[1] *International Sugar Journal*, 1908, 68.

Refractive Index.	Per cent. Sucrose.	Refractive Index for tenths of a per cent.	
1·3928	37	0·0011 = 0·55	....
1·3947	38	0·0012 = 0·6	....
1·3966	39	0·0013 = 0·65	....
1·3984	40	0·0014 = 0·7	....
1·4003	41	0·0015 = 0·75	....
1·4023	42	0·0001 = 0·05	0·0014 = 0·7
1·4043	43	0·0002 = 0·1	0·0015 = 0·75
1·4063	44	0·0003 = 0·15	0·0016 = 0·8
1·4083	45	0·0004 = 0·2	0·0017 = 0·85
1·4104	46	0·0005 = 0·25	0·0018 = 0·9
1·4124	47	0·0006 = 0·3	0·0019 = 0·95
1·4145	48	0·0007 = 0·35	0·0020 = 1·0
1·4166	49	0·0008 = 0·4	0·0021 = 1·0
1·4186	50	0·0009 = 0·45	....
1·4207	51	0·0010 = 0·5	....
1·4228	52	0·0011 = 0·55	....
1·4249	53	0·0012 = 0·6	....
1·4270	54	0·0013 = 0·65	....
1·4292	55	0·0001 = 0·05	0·0013 = 0·55
1·4314	56	0·0002 = 0·1	0·0014 = 0·6
1·4337	57	0·0003 = 0·1	0·0015 = 0·65
1·4359	58	0·0004 = 0·15	0·0016 = 0·7
1·4382	59	0·0005 = 0·2	0·0017 = 0·75
1·4405	60	0·0006 = 0·25	0·0018 = 0·8
1·4428	61	0·0007 = 0·3	0·0019 = 0·85
1·4451	62	0·0008 = 0·35	0·0020 = 0·9
1·4474	63	0·0009 = 0·4	0·0021 = 0·9
1·4497	64	0·0010 = 0·45	0·0022 = 0·95
1·4520	65	0·0011 = 0·5	0·0023 = 1·0
1·4543	66	0·0012 = 0·5	0·0024 = 1·0
1·4567	67	....	....
1·4591	68	....	....
1·4615	69	....	....
1·4639	70	....	....
1·4663	71	....	....
1·4687	72	....	....
1·4711	73	0·0001 = 0·0	0·0015 = 0·55
1·4736	74	0·0002 = 0·05	0·0016 = 0·6
1·4761	75	0·0003 = 0·10	0·0017 = 0·65
1·4786	76	0·0004 = 0·20	0·0018 = 0·65
1·4811	77	0·0005 = 0·2	0·0019 = 0·7

Refractive Index.	Per cent. Sucrose.	Refractive Index for tenths of a per cent.	
1·4836	78	0·0006 = 0·20	0·0020 = 0·75
1·4862	79	0·0007 = 0·25	0·0021 = 0·8
1·4888	80	0·0008 = 0·3	0·0022 = 0·8
1·4914	81	0·0009 = 0·35	0·0023 = 0·85
1·4940	82	0·0010 = 0·35	0·0024 = 0·9
1·4966	83	0·0011 = 0·4	0·0025 = 0·9
1·4992	84	0·0012 = 0·45	0·0026 = 0·95
1·5019	85	0·0013 = 0·5	0·0027 = 1·0
1·5046	86	0·0014 = 0·5	0·0028 = 1·0
1·5073	87	....	....
1·5100	88	....	....
1·5127	89	....	....
1·5155	90	....	....

Corrections for Temperatures of the Prisms deviating from 28° C.

Temperature of the Prisms in °C.	Solids from the Table.												
	0	5	10	15	20	25	30	40	50	60	70	80	90
	Subtract from the figure :												
20	0·53	0·54	0·55	0·56	0·57	0·58	0·60	0·62	0·64	0·62	0·61	0·60	0·58
21	0·45	0·47	0·48	0·49	0·50	0·51	0·52	0·54	0·56	0·54	0·53	0·52	0·50
22	0·40	0·41	0·42	0·42	0·43	0·44	0·45	0·47	0·48	0·47	0·46	0·45	0·44
23	0·33	0·33	0·34	0·35	0·36	0·37	0·38	0·39	0·40	0·39	0·38	0·38	0·38
24	0·26	0·26	0·27	0·28	0·28	0·29	0·30	0·31	0·32	0·31	0·31	0·30	0·30
25	0·20	0·20	0·21	0·21	0·22	0·22	0·23	0·23	0·24	0·23	0·23	0·23	0·22
26	0·12	0·12	0·13	0·14	0·14	0·14	0·15	0·15	0·16	0·16	0·16	0·15	0·14
27	0·07	0·07	0·07	0·07	0·07	0·07	0·08	0 08	0·08	0·08	0·08	0·08	0·07
	Add to the figure :												
29	0·07	0·07	0·07	0·07	0·07	0·07	0·08	0·08	0·08	0·08	0·08	0·08	0·07
30	0·12	0·12	0·13	0·14	0·14	0·14	0·15	0·15	0·16	0·16	0·16	0·15	0·14
31	0·20	0·20	0·21	0·21	0·22	0·22	0·23	0·23	0·24	0·23	0·23	0·23	0·22
32	0·26	0·26	0·27	0·28	0·28	0·29	0·30	0·31	0·32	0·31	0·31	0·30	0·30
33	0 33	0·33	0·34	0·35	0·36	0·37	0·38	0·39	0·40	0·39	0·38	0·38	0·38
34	0·40	0·41	0·42	0·42	0·43	0·44	0·45	0·47	0·48	0·47	0·46	0·45	0·44
35	0·46	0·47	0·48	0·49	0·50	0·51	0·52	0·54	0·56	0·54	0·53	0·52	0·50

Table of Corrections for finding the Sucrose Content by Means of Schmitz's Tables, when the Dry Substance has been determined by the Refractometer at 28° C.

Temperature in °C.	Per cent. Solids.								
	0	5	10	15	20	25	30	40	50
20	0·64	0·68	0·70	0·73	0·74	0·76	0·78	0·81	0·83
21	0·62	0·67	0·70	0·73	0·74	0·76	0·77	0·80	0·82
22	0·61	0·66	0·71	0·73	0·74	0·76	0·77	0·80	0·82
23	0·60	0·65	0·69	0·72	0·74	0·76	0·76	0·79	0·82
24	0·58	0·64	0·68	0·71	0·72	0·75	0·76	0·78	0·82
25	0·57	0·62	0·68	0·70	0·73	0·75	0·76	0·78	0·82
26	0·55	0·64	0·67	0·70	0·72	0·74	0·76	0·77	0·82
27	0·56	0·64	0·68	0·70	0·72	0·75	0·76	0·78	0·82
28	0·56	0·64	0·68	0·70	0·72	0·76	0·76	0·78	0·82
29	0·58	0·65	0·68	0·70	0·72	0·77	0·77	0·78	0·82
30	0·58	0·66	0·69	0·71	0·73	0·77	0·77	0·79	0·82
31	0·58	0·67	0·69	0·73	0·73	0·77	0·77	0·79	0·82
32	0·60	0·68	0·71	0·73	0·75	0·79	0·78	0·79	0·82
33	0·61	0·68	0·72	0·73	0·76	0·79	0·79	0·79	0·82
34	0·62	0·68	0·72	0·74	0·78	0·79	0·80	0·80	0·82
35	0·64	0·70	0·73	0·75	0·80	0·81	0·81	0·81	0·83

Direct Estimation of the Dry Substance by Desiccation.

It would be a valuable asset in controlling operations in sugar-houses if the *real* dry substance of the various juices and products could be continually ascertained directly, instead of calculating this value from the readings of hydrometers or refractometers with the aid of tables, which have not been made for the real dry substance of those juices, but only for one of their constituents, viz., the sucrose.

The direct estimation of the dry substance by desiccation is feasible for juices, syrups, or massecuites, in short for such substances which do not contain much of the decomposition products of sucrose and of reducing sugars. When determining the dry substance in final molasses by desiccation, the figure arrived at will certainly be found too low, because of the fact that the primary decomposition products prevailing in the molasses will be further broken up at the high temperature of the oven and will escape as gaseous products.

Both for this reason and because the determination is rather a delicate one, it is only made in such cases where the greatest accuracy is desired, while in routine work one resorts to the indirect estimation by means of the hydrometer or the refractometer.

The direct method may be performed as follows :—

A rosette of filtering paper is made by hand from a narrow strip of a total length of about 6 ft. This rosette is placed in a metal drying saucer and dried for one hour in a hot air-bath at a temperature of 102°—105° C. Then a tightly fitting lid is fixed on the saucer, after which it is allowed to cool in a desiccator. The saucer with the lid and the rosette are tared, the rosette is taken out of the saucer, and 5 to 10 grms. of juices, or 2 to 3 grms. of more concentrated products are carefully weighed into it. In the case of the more concentrated products about 5 c.c. of hot water are poured over, and the substance dissolved therein, a process which may be promoted by stirring with a tiny glass rod. The rod is rinsed with a few drops of water, and the rosette replaced in the saucer. The liquid is absorbed by the paper, and the saucer with the moist rosette is dried for four hours on a hot air-bath at a temperature of 102°—105° C.

After that stage is complete, the lid is carefully replaced over the saucer, which is then cooled in a desiccator and weighed. The difference between the weight of saucer with its lid, the rosette, and the weighed material on one side, and the ultimate weight after drying on the other, represents the amount of moisture in the weighed substance. As a control, the saucer without its lid may be dried again for an hour, and weighed after that time under the same conditions as on the first occasion, in order to ascertain whether all of the moisture has actually been driven out.

Polarization.

A 100/110 c.c. flask is filled with the juice to the lowest mark, 3 c.c. of a solution of basic lead acetate are added, and the contents made up with water to the 110 c.c. mark, being well shaken, filtered, and polarized in the 200 mm. tube. The polarization of the juice is found from the polariscope readings, and the uncorrected Brix using the Tables of Schmitz (pages 100–107).

Sucrose.

If it be desired not only to determine the polarization, but also the actual sucrose content of the juice by the double polarization method, a 100/110 c.c. flask is rinsed with a little of the juice to be analysed and filled with the same to the lower mark; 5 c.c. of a solution of neutral lead acetate (30 per cent.) are added, the liquid made up to the upper mark, and the contents of the flask well shaken, filtered, and polarized.

I. Method of the Java Experiment Station.*—50 c.c. of the filtrate used for the polarization are placed in a 100 c.c. flask, with 30 c.c. of hydrochloric acid of 1·10 specific gravity (23·7 Brix†), well shaken, and laid aside for auto-inversion at ordinary temperature. At any temperature of the laboratory between 20° and 25° C, the inversion is completed at the end of three hours and at temperatures above 25° C after only two hours' standing. The contents are filled up to the mark; if necessary the liquid is decolorized by means of a pinch of washed, powdered decolorizing carbon, and filtered and polarized in a water-jacketed tube. Directly after reading the polarization the temperature is observed by means of a thermometer divided into tenths of a degree.

The figure read on the polariscope after inversion is calculated to the real polarization by the factor $\frac{rp}{\frac{1}{2}p}$ in which $r\,p$ stands for the real polarization before inversion, and p for the polariscope reading before inversion. If the polarization after inversion takes place in a 400 mm. tube, the factor becomes $\frac{rp}{p}$.

The real sucrose content is found from the polarizations before and after inversion, according to the formula: Sucrose $= \frac{S}{C - \frac{1}{2}t}$ in which

$S =$ sum of polarizations before and after inversion;

$t =$ temperature of the inverted liquid in the tube in degrees;

$C =$ a constant as recorded in the table given here.

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* Langguth Steuerwald. *Int. Sug. Journ.*, 1913, 489.

† The hydrochloric acid ordinarily used as a reagent (sp. gr. = 1·188) is diluted with an equal volume of water.

Table of Constants for different Temperatures and Conditions to be used in Steuerwald's Method of Polarization at Ordinary Temperature.

Reading after inversion in the 200 mm. tube.	Temperature of the polarized solution in degrees Centigrade.						
	32	30	28	26	24	22	20
18....	—	—	—	—	—	145·51	145·54
17....	—	—	—	145·39	145·42	145·46	145·49
16....	—	145·27	145·30	145·34	145·37	145·41	145·44
15....	145·18	145·22	145·25	145·28	145·32	145·35	145·39
14....	145·12	145·16	145·19	145·23	145·26	145·30	145·34
13....	145·06	145·10	145·13	145·17	145·21	145·25	145·29
12....	145·00	145·04	145·08	145·12	145·16	145·20	145·24
11....	144·94	144·98	145·02	145·07	145·11	145·15	145·19
10....	144·88	144·93	144·97	145·01	145·06	145·10	145·14
9....	144·82	144·87	144·91	144·96	145·00	145·05	145·10
8....	144·77	144·81	144·86	144·90	144·95	145·00	145·05
7....	144·71	144·75	144·79	144·84	144·90	144·95	145·00
6....	144·65	144·70	144·74	144·79	144·84	144·89	144·95
5....	144·59	144·60	144·69	144·74	144·79	144·84	144·90
4....	144·53	144·57	144·63	144·68	144·74	144·79	144·85
3....	144·47	144·52	144·58	144·63	144·69	144·74	144·80
2....	144·41	144·46	144·52	144·58	144·63	144·69	144·75
1....	144·35	144·41	144·46	144·52	144·58	144·64	144·70

Example:

Degrees Brix (uncorrected) .. .. 17·5

Polariscope reading before inversion .. .. .. 54·2

Real polarization before inversion from Schmitz's Tables (see pages 100–107) .. .. .. 14·46

Polariscope reading after inversion in the 200 mm. tube at a temperature of 27·2° C. .. .. — 9·1

Real polarization after inversion: $-9{\cdot}1 \times \dfrac{14{\cdot}46}{\frac{1}{2} \times 54{\cdot}2} = -4{\cdot}85$

$$\text{Sucrose} = \frac{14{\cdot}46 + 4{\cdot}85}{144{\cdot}94 - (\frac{1}{2} \times 27{\cdot}2)} = \mathbf{14{\cdot}72} \text{ per cent}$$

II. Herzfeld's Method.—The liquid for the direct polarization is prepared exactly as has been described in the above-mentioned method, and 50 c.c. of the clarified juice, having served for the direct polarization, are placed in a 100 c.c. flask, with 5 c.c. of hydrochloric acid of 1·188 specific gravity and about 20 c.c. of water. This flask is placed in a water-bath having a temperature of 71° C, and possessing such dimensions that the liquid in the flask attains the temperature of 67°—70° C within three to five minutes. The temperature of the liquid is maintained between these two limits so long that the total time of immersion is just 10 minutes. The flask is rapidly cooled to the temperature of the laboratory, the thermometer which had been placed in the liquid carefully rinsed and removed, and the contents filled up to the mark, being decolorized if necessary with a pinch of washed charcoal, and then polarized in a tube provided with a water-jacket. Directly after polarization the temperature is observed by means of a thermometer divided into tenths of a degree.

The calculation of the sucrose from the polarizations before and after inversion is made just as in the first method, the only difference being the value of the constant, which is lower in this case owing to the much smaller amount of hydrochloric acid present in the liquid after inversion.

The constants for use in the Herzfeld method for solutions of different concentrations are as follows:—

Sucrose in 100 c.c. before inversion, grms.	Constant.	Sucrose in 100 c.c. before inversion, grms.	Constant.
1 ..	141·85	14 ..	142·73
2 ..	141·91	15 ..	142·79
3 ..	141·98	16 ..	142·86
4 ..	142·05	17 ..	142·93
5 ..	142·12	18 ..	143·00
6 ..	142·18	19 ..	143·07
7 ..	142·25	20 ..	143·13
8 ..	142·32	21 ..	143·20
9 ..	142·39	22 ..	143·27
10 ..	142·46	23 ..	143·33
11 ..	142·52	24 ..	143·40
12 ..	142·59	25 ..	143·47
13 ..	142·66	26 ..	143·54

Reducing Sugars.

25 c.c. of the liquid used for the direct polarization are transferred to a collecting bottle, and in the mixed sample of the three 8-hour samples the reducing sugars are determined once every 24 hours.

In so doing, 20 c.c. of the mixed sample are pipetted into a 100 c.c. flask. The lead is precipitated by means of Striegler's reagent,* the contents being made up to the mark, shaken, and filtered.

The filtrate is poured into a burette, and used for the precipitation of 10 c.c. of Fehling's test solution of half strength (so-called "half-normal" Fehling's solution).

The 10 c.c. of that half-normal solution are pipetted into an Erlenmeyer flask, 40 c.c. of water as well as a few drops of strong caustic soda solution being added, and the whole boiled.

Then run into the solution from the burette a little less of the prepared juice than is thought necessary, raise to the boiling point, and keep boiling during one minute. After allowing the red precipitate to settle, observe the coloration of the clear liquid; if it is still blue, a little more of the juice is added; if colourless, then the proper end-point is reached; but if the liquid is yellow, the test is "over-done," and should be repeated with a smaller quantity of the juice. If the discoloration is only obtained after two or more additions of juice, there is danger that a little of the red cuprous oxide has been redissolved, and that therefore the result will indicate too low a figure for the reducing sugars. In order to avoid this, the experiment should be repeated with so much juice that the total precipitation is obtained after (at the most) three additions of juice. If the red precipitate does not settle quickly, add about 10 c.c. of a solution of gypsum in water and boil again.

The total disappearance of the blue colour of the supernatant liquid can be observed by experienced operators by simply looking through it. At any rate, it may be controlled by taking out a drop with a glass rod, and mixing it with a drop of solution of potassium ferrocyanate lying on a porcelain plate acidified with acetic

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*Striegler's reagent is prepared by dissolving 25 grms. of oxalic acid in 250 c.c. of water and neutralizing with sodium carbonate. A heavy precipitate of bicarbonate is thrown down, after which the solution is made up to 500 c.c. and filtered.

acid just before the addition of the drop to be tested. A brown coloration reveals the presence of dissolved copper in the liquid, and shows that in the next test more of the juice should be used.

Good care ought to be taken that none of the precipitate passes over in the drop to be tested when being taken out of the liquid, and if the total absence of parts of the precipitate cannot be relied upon, a small quantity of the liquid should be filtered through paper and a drop of the filtrate tested.

The percentage of reducing sugars may be found from the c.c. of juice used and the density of the original juice, after reference to the Table on page 33.

V. CLARIFIED JUICE.

The best way of obtaining a good average sample is to fix a small cock in the cover of the pump cylinder from which at every stroke a small quantity of juice is expelled, and is conducted into a pail, marked with a level. As soon as the juice has reached that level, the pail is replaced by a fresh one, and the filled receptacle is carried to the laboratory.

After the sample has cooled down, determine the Brix in each sample, and transfer 100 c.c. into a collecting bottle in which 250 mgrms. of mercuric chloride are placed for every litre of juice to be expected.

Brix, Polarization, Sucrose, and Reducing Sugars are determined as has been described under the heading "Raw Juice."

Alkalinity of the juices obtained at carbonatation is determined by titration with N/28 sulphuric acid, using phenolphthalein as an indicator.

The alkalinity of the juice after the first carbonatation is determined in 10 c.c., and that of the second in 100 c.c. In the former case, 1 c.c. of the test acid corresponds to 0·01 per cent. of calcium oxide (CaO), in the latter to 0·001 per cent.

Acidity of the juice after sulphitation is determined by titration with N/32 soda with phenolphthalein as indicator. The acidity is determined in 100 c.c. of the juice and 1 c.c. of the test solution corresponds to 0·001 per cent. of sulphur dioxide.

TABLE SHOWING THE PERCENTAGE OF REDUCING SUGARS IN JUICES, DILUTED SYRUPS, MASSECUITES, AND MOLASSES FROM THE NUMBER OF C.C. OF PREPARED SOLUTION AND THE DEGREES BRIX OF THE ORIGINAL LIQUID.

The liquid used for the Polarization is diluted five times and tested with 10 c.c. of half-normal Fehling's Test Solution (= 25 mgrms. of Reducing Sugars).

CUBIC CENTIMETRES.

Degrees Brix	10·0	10·2	10·4	10·6	10·8	11·0	11·2	11·4	11·6	11·8	12·0	12·2	12·4	12·6	13·1	13·3	13·6	13·8	14·1	14·4	14·7	15·1	15·4	15·7	16·1	16·5	16·9	17·5	18·0	18·5	19·0	19·6	20·1
10	1·32	1·30	1·27	1·25	1·22	1·20	1·18	1·16	1·14	1·12	1·10	1·08	1·07	1·05	1·02	0·99	0·97	0·96	0·94	0·92	0·90	0·88	0·86	0·84	0·82	0·80	0·78	0·75	0·73	0·71	0·70	0·67	0·66
11	1·32	1·29	1·27	1·24	1·22	1·20	1·18	1·15	1·14	1·12	1·10	1·08	1·06	1·04	1·01	0·99	0·97	0·95	0·93	0·91	0·90	0·87	0·85	0·84	0·82	0·80	0·78	0·75	0·73	0·71	0·69	0·67	0·66
12	1·31	1·29	1·26	1·24	1·21	1·19	1·17	1·15	1·13	1·11	1·09	1·07	1·06	1·04	1·01	0·99	0·96	0·95	0·93	0·91	0·89	0·87	0·85	0·84	0·81	0·79	0·78	0·75	0·73	0·71	0·69	0·67	0·65
13	1·31	1·28	1·26	1·23	1·21	1·19	1·17	1·15	1·13	1·11	1·09	1·07	1·05	1·04	1·00	0·98	0·96	0·95	0·93	0·91	0·89	0·86	0·85	0·83	0·81	0·79	0·77	0·74	0·73	0·71	0·69	0·67	0·65
14	1·30	1·28	1·25	1·23	1·20	1·18	1·16	1·14	1·12	1·10	1·08	1·07	1·05	1·03	1·00	0·98	0·96	0·94	0·92	0·90	0·88	0·86	0·84	0·83	0·81	0·79	0·77	0·74	0·72	0·70	0·68	0·66	0·65
15	1·30	1·27	1·25	1·22	1·20	1·18	1·16	1·14	1·12	1·10	1·08	1·06	1·04	1·03	1·00	0·97	0·95	0·94	0·92	0·90	0·88	0·86	0·84	0·83	0·80	0·79	0·77	0·74	0·72	0·70	0·68	0·66	0·64
16	1·29	1·26	1·24	1·22	1·19	1·17	1·15	1·13	1·11	1·09	1·08	1·06	1·04	1·02	0·99	0·97	0·95	0·93	0·92	0·90	0·88	0·85	0·84	0·82	0·80	0·78	0·76	0·73	0·72	0·70	0·68	0·66	0·64
17	1·29	1·26	1·24	1·21	1·19	1·17	1·15	1·13	1·11	1·09	1·07	1·05	1·04	1·02	0·99	0·97	0·94	0·93	0·91	0·89	0·87	0·85	0·83	0·82	0·80	0·78	0·76	0·73	0·71	0·69	0·68	0·66	0·64
18	1·28	1·25	1·23	1·21	1·19	1·16	1·14	1·12	1·10	1·08	1·07	1·05	1·03	1·02	0·98	0·96	0·94	0·93	0·91	0·89	0·87	0·85	0·83	0·82	0·79	0·78	0·76	0·73	0·71	0·69	0·67	0·65	0·64
19	1·27	1·25	1·23	1·20	1·18	1·16	1·14	1·12	1·10	1·08	1·06	1·04	1·03	1·01	0·98	0·96	0·94	0·92	0·90	0·89	0·87	0·84	0·83	0·81	0·79	0·77	0·75	0·72	0·71	0·69	0·67	0·65	0·63
20	1·27	1·24	1·22	1·20	1·18	1·15	1·13	1·11	1·09	1·08	1·06	1·04	1·02	1·01	0·98	0·95	0·93	0·92	0·90	0·88	0·86	0·84	0·82	0·81	0·79	0·77	0·75	0·72	0·71	0·69	0·67	0·65	0·63
21	1·26	1·24	1·22	1·19	1·17	1·15	1·13	1·11	1·09	1·07	1·05	1·04	1·02	1·00	0·97	0·95	0·93	0·92	0·90	0·88	0·86	0·84	0·82	0·81	0·79	0·77	0·75	0·72	0·70	0·68	0·67	0·64	0·63
22	1·26	1·23	1·21	1·19	1·17	1·14	1·12	1·10	1·09	1·07	1·05	1·03	1·02	1·00	0·97	0·95	0·93	0·91	0·89	0·87	0·86	0·83	0·82	0·80	0·78	0·76	0·74	0·72	0·70	0·68	0·66	0·64	0·63

If less than 10 c.c. are already sufficient to decolorize the Test Solution, the liquid used for the polarization is to be diluted ten times, and the figure yielded by the table to be multiplied by 2.

FORMULA: $x = \frac{110 \times 5 \times 0{\cdot}025}{a \times \text{sp. gravity}}$.

VI. SWEET-WATERS FROM THE FILTER-PRESSES.

In factories where the sweet-waters from the presses are used for the maceration of the bagasse, it is necessary to know their Brix and polarization, but if no such use is made, the determination of the Brix alone will do.

The samples are taken from each measuring tank and collected as has already been described. The Brix readings are noted every hour, and if the polarization is to be determined this is done once per shift in the collected subsample of the 8-hour samples.

VII. FILTER-PRESS CAKE.

Sampling.

The sample is taken with an iron sampler from the fresh cakes at various places in the heap, is kneaded well in a mortar and is then analysed.

Polarization.

Taking into account the insoluble matter of the sample, weigh 50 grms., triturate it in a mortar with a little water, dilute with more water, and transfer the thin pasty mass into a 200 c.c. flask. 5 c.c. of solution of basic lead acetate are added, and the contents made up to the mark, shaken, filtered, and polarized in the 200 mm. tube, which reading directly represents the polarization of the filter-press cake.

When analysing filter-press cake from the carbonatation process, about 15 grms. of crystallized ammonium nitrate are added to the mixture of mud and water in order to break up any trace of calcium saccharate that may possibly be present. This body may also be decomposed by the addition of acetic acid, using phenolphthalein as an indicator.

Dry Substance.

Weigh 20 grms. of the filter-press cake on a tared drying saucer as used in the determination of the dry substance of bagasse, spread it out in a thin layer, and dry at 102°—105° C. to constant weight.

VIII. SYRUP.

Sampling.

The sampling may be done as has been described under the heading "CLARIFIED JUICE," with a small cock in the cover of the pump, and a pail with a level mark.

A good alternative method is the following :—After subsiding the syrup, an equal portion is taken from every syrup settling tank and poured into a collecting bottle. Once per shift of six or eight hours the contents are shaken and analysed. If good care is taken to rinse the bottles with soda solution after emptying them, and to wash them thoroughly, it is quite unnecessary to use a disinfectant as a preservative of the syrup samples.

Brix, Polarization, Sucrose, Reducing Sugars, and Quotient of Purity.

In order to effect a good comparison of the quotients of purity of the juices, and the syrups and massecuites obtained from them, it is advisable to determine the Brix degrees in about the same concentration in the different cases. In so doing, the syrup is diluted with twice its weight of water, and the mixture thus obtained used for the determination of the Brix and the polarization, following the methods already described under the heading "RAW JUICE." It is evident that in this case the separation of foam and subsiding dirt is not necessary, as the syrup does not contain them.

The Brix degrees, the polarization, the sucrose, and the reducing sugars of the original syrup are found by multiplying the figures of the diluted syrup by 3. The Brix must be multiplied, after the correction for the temperature has been applied.

The alkalinity and the acidity of the syrup are determined in the syrup itself in exactly the same manner as has been described under the heading "CLARIFIED JUICE." As a rule, the change of colour of the indicator is not very visible in the mixture, and therefore it is advisable to determine the point of neutrality in this substance by placing drops of the liquid under examination on litmus paper or on a porcelain plate, and adding a small drop of the indicator with a glass rod.

IX. MASSECUITES.

Sampling.

Samples of first massecuite are taken continuously from every panful separately from the gutter under the pan during the strike; those of the second and later massecuites from the crystallizers immediately after striking. An equal portion is taken from every pan, and these are gathered in a collecting bottle to be mixed and analysed once a day.

Analysis.

The analysis is made just as has been described under the heading "Syrup," save that the massecuite is diluted with four times its weight of water, and accordingly the figures found are multiplied by 5.

The quantity of basic lead acetate to be added varies with the quotient of purity of the massecuite, and may be tabulated as follows:—

Quotient of purity of the massecuite.	Basic lead acetate solution, c.c.	Quotient of purity of the massecuite.	Basic lead acetate solution, c.c.
90	3	60	8
80	5	50	9
70	6	40	10

X. GREEN MOLASSES.

Sampling.

The samples of green molasses are taken from every massecuite separately out of the gutters of the centrifugals and analysed separately.

Analysis.

The green molasses is diluted with four times its weight of water just as with the massecuite, and the liquid is analysed in the same way as is a juice. In the case of molasses of 60° purity, 8 c.c. of basic lead acetate solution are added; while for those of 50° purity 9 c.c., and for those of 40°, 10 c.c. are required.

If the filtrate be too dark to be polarized in the 200 mm. tube, a 100 mm. one is used, the polarization being multiplied by 2; but if the liquid be still too cloudy for even that reading, the molasses should be polarized by the method described under the section "Final Molasses."

XI. FINAL MOLASSES.

Sampling.

The final molasses is sampled continuously during the process of emptying the tank in which it has been weighed. Approximately, the same weight of molasses is taken from each tankful and collected in a large sample tin. The contents are mixed and analysed once a day only as far as Brix and polarization are concerned. A small sub-sample of every daily sample is weighed out, *e.g.*, 100 grms. for every 10 tons of molasses, and transferred into a second collecting bottle. These sub-samples are mixed and serve for the total analysis which is made once a fortnight.

Analysis.

Brix and Polarization.—150 grms. of the final molasses are diluted with water to a weight of 1500 grms., and the diluted solution used for the determination of the Brix and polarization, using the methods described under the heading "Raw Juice." The figures obtained are multiplied by 10; this being done in the case of the Brix degree after the application of the correction for the temperature.

Sucrose.—One and a quarter times the "normal weight" of the polariscope (32·56 grms.) is transferred with water into a 250 c.c. flask, clarified with 40 c.c. of basic lead acetate solution and 2 c.c. of alumina cream, and made up with water to the mark, a pinch of powdered charcoal being added if necessary, the liquid filtered and polarized in the 200 mm. tube, and the reading multiplied by 2.

The real sucrose content is determined in the filtrate used for the polarization following one of the two methods described under the heading "Raw Juice," taking care to employ the constant value belonging to the method chosen.

Reducing Sugars.—The colour of the molasses solution is much too dark to allow of any reliable execution of the volumetric method in which the blue coloration of the supernatant liquid is the only criterion of an incomplete reaction and a yellow one that of an excess of juice to be tested. Therefore another method is resorted to which

TABLE SHOWING THE CONTENT OF REDUCING SUGARS IN MOLASSES PRECIPITATED AS Cu_2O FROM FEHLING'S TEST

Mgrms. Copper.	POLARIZATION.							
	10	20	30	40	50	60	70	80
100	8·70	8·60	8·57	8·55	8·55	8·53	8·51	8·47
102	8·87	8·77	8·74	8·72	8·72	8·70	8·68	8·64
104	9·05	8·94	8·91	8·89	8·88	8·87	8·85	8·81
106	9·22	9·11	9·08	9·06	9·06	9·05	9·03	9·00
108	9·40	9·29	9·26	9·23	9·23	9·22	9·20	9·17
110	9·57	9·48	9·44	9·41	9·41	9·40	9·38	9·35
112	9·74	9·65	9·61	9·58	9·58	9·57	9·55	9·52
114	9·91	9·82	9·78	9·75	9·75	9·74	9·72	9·70
116	10·08	10·00	9·96	9·92	9·92	9·92	9·90	9·88
118	10·26	10·18	10·14	10·10	10·10	10·10	10·08	10·06
120	10·44	10·36	10·32	10·28	10·28	10·28	10·26	10·24
122	10·61	10·53	10·49	10·45	10·45	10·45	10·43	10·41
124	10·78	10·70	10·66	10·62	10·62	10·62	10·60	10·58
126	10·95	10·87	10·84	10·80	10·80	10·80	10·78	10·76
128	11·13	11·04	11·02	10·98	10·98	10·98	10·96	10·94
130	11·31	11·22	11·20	11·16	11·16	11·16	11·14	11·12
132	11·48	11·39	11·37	11·34	11·33	11·33	11·32	11·31
134	11·66	11·57	11·55	11·52	11·50	11·50	11·49	11·48
136	11·84	11·75	11·73	11·70	11·68	11·68	11·67	11·66
138	12·02	11·93	11·91	11·88	11·86	11·86	11·85	11·84
140	12·20	12·11	12·09	12·06	12·04	12·04	12·03	12·02
142	12·38	12·29	12·26	12·24	12·21	12·21	12·20	
144	12·56	12·48	12·43	12·42	12·39	12·38	12·37	
146	12·74	12·67	12·61	12·60	12·57	12·57	12·56	
148	12·93	12·86	12·79	12·78	12·75	12·75	12·74	
150	13·12	13·05	12·97	12·97	12·93	12·93	12·92	
152	13·30	13·23	13·15	13·15	13·11	13·10	13·09	
154	13·48	13·41	13·33	13·33	13·29	13·27	13·26	
156	13·66	13·59	13·51	13·51	13·47	13·45	13·44	
158	13·84	13·77	13·70	13·69	13·65	13·63	13·62	
160	14·03	13·95	13·89	13·87	13·84	13·81	13·80	
162	14·21	14·13	14·07	14·05	14·01	13·98	13·97	
164	14·39	14·31	14·25	14·23	14·19	14·16	14·15	
166	14·57	14·49	14·43	14·41	14·37	14·34	14·33	
168	14·75	14·67	14·61	14·59	14·55	14·52	14·51	
170	14·93	14·85	14·79	14·76	14·73	14·70	14·69	
172	15·10	15·03	14·97	14·94	14·91	14·88	14·86	
174	15·28	15·21	15·15	15·12	15·09	15·06	15·05	
176	15·46	15·40	15·33	15·30	15·27	15·24	15·22	

FROM THE POLARIZATION, AND THE MILLIGRAMMES OF CU

SOLUTION BY 0·6 GRMS. OF THE MOLASSES.

Mgrms. Copper.	POLARIZATION.						
	10	20	30	40	50	60	70
178	15·65	15·59	15·51	15·48	15·45	15·42	15·40
180	15·84	15·78	15·69	15·66	15·63	15·60	15·58
182	16·03	15·96	15·87	15·84	15·81	15·78	15·76
184	16·22	16·14	16·05	16·02	15·99	15·96	15·94
186	16·41	16·32	16·23	16·21	16·17	16·14	16·12
188	16·60	16·50	16·41	16·40	16·35	16·32	16·30
190	16·80	16·69	16·59	16·59	16·53	16·50	16·48
192	16·98	16·87	16·77	16·77	16·71	16·68	16·66
194	17·16	17·06	16·96	16·95	16·90	16·86	16·86
196	17·34	17·25	17·15	17·13	17·09	17·05	17·03
198	17·52	17·44	17·34	17·31	17·28	17·24	17·22
200	17·70	17·63	17·53	17·50	17·47	17·43	17·41
202	17·88	17·82	17·72	17·68	17·65	17·61	17·61
204	18·06	18·01	17·92	17·86	17·83	17·78	17·76
206	18·24	18·20	18·12	18·04	18·01	17·96	17·94
208	18·43	18·39	18·32	18·22	18·19	18·15	18·13
210	18·62	18·58	18·52	18·41	18·38	18·34	18·32
212	18·80	18·76	18·70	18·60	18·56	18·52	18·50
214	18·98	18·94	18·88	18·79	18·74	18·70	18·68
216	19·16	19·12	19·06	18·98	18·92	18·88	18·86
218	19·35	19·31	19·25	19·17	19·10	19·06	19·04
220	19·54	19·50	19·44	19·36	19·28	19·25	19·22
222	19·72	19·68	19·62	19·54	19·47	19·44	19·41
224	19·90	19·86	19·80	19·72	19·66	19·63	19·60
226	20·08	20·05	19·98	19·90	19·85	19·82	19·79
228	20·27	20·24	20·16	20·09	20·04	20·01	19·98
230	20·46	20·43	20·35	20·28	20·24	20·20	20·17
232	20·64	20·61	20·53	20·46	20·42	20·38	20·35
234	20·83	20·79	20·71	20·64	20·60	20·56	20·53
236	21·02	20·98	20·90	20·82	20·78	20·74	20·71
238	21·21	21·17	21·09	21·01	20·97	20·93	20·90
240	21·40	21·36	21·28	21·20	21·16	21·12	21·09
242	21·58	21·54	21·46	21·38	21·34	21·30	21·27
244	21·77	21·72	21·64	21·66	21·52	21·48	21·45
246	21·96	21·91	21·83	21·75	21·70	21·66	21·63
248	22·15	22·10	22·02	21·94	21·89	21·85	21·81
250	22·34	22·29	22·21	22·13	22·08	22·04	22·00
252	22·52	22·47	22·39	22·31	22·26	22·22	22·18
254	22·70	22·65	22·57	22·49	22·44	22·40	22·36

TABLE SHOWING THE CONTENT OF REDUCING SUGARS IN MOLASSES PRECIPITATED AS Cu_2O FROM FEHLING'S TEST

Mgrms. Copper.	POLARIZATION.					
	10	20	30	40	50	60
256	22·89	22·84	22·75	22·67	22·63	22·59
258	23·08	23·03	22·94	22·86	22·82	22·78
260	23·27	23·22	23·13	23·05	23·01	22·97
262	23·45	23·40	23·31	23·23	23·19	23·15
264	23·64	23·59	23·50	23·41	23·37	23·33
266	23·83	23·78	23·69	23·60	23·55	23·51
268	24·02	23·97	23·88	23·79	23·74	23·70
270	24·21	24·16	24·07	23·98	23·93	23·89
272	24·40	24·35	24·26	24·16	24·11	24·07
274	24·59	24·54	24·45	24·34	24·30	24·26
276	24·78	24·73	24·64	24·53	24·49	24·45
278	24·97	24·92	24·83	24·72	24·68	24·64
280	25·16	25·12	25·02	24·91	24·87	24·83
282	25·35	25·30	25·20	25·10	25·05	25·02
284	25·54	25·49	25·39	25·29	25·24	25·21
286	25·73	25·68	25·58	25·48	25·43	25·41
288	25·92	25·87	25·77	25·67	25·62	25·61
290	26·11	26·06	25·96	25·86	25·81	25·81
292	26·29	26·24	26·15	26·06	26·01	26·00
294	26·48	26·43	26·35	26·27	26·22	26·20
296	26·67	26·62	26·55	26·48	26·43	26·40
298	26·86	26·81	26·75	26·69	26·64	26·60
300	27·05	27·00	26·95	26·90	26·85	26·80
302	27·25	27·20	27·15	27·10	27·05	27·00
304	27·45	27·40	27·35	27·30	27·25	27·20
306	27·65	27·60	27·55	27·50	27·45	27·40
308	27·85	27·80	27·75	27·70	27·65	27·60
310	28·06	28·00	27·95	27·90	27·85	27·80
312	28·26	28·20	28·15	28·10	28·05	28·00
314	28·46	28·40	28·35	28·30	28·25	28·20
316	28·66	28·60	28·55	28·50	28·45	28·40
318	28·86	28·80	28·75	28·70	28·65	28·60
320	29·07	29·01	28·95	28·90	28·85	28·80
322	29·27	29·21	29·15	29·10	29·04	28·99
324	29·47	29·41	29·35	29·30	29·23	29·18
326	29·67	29·61	29·55	29·50	29·42	29 37
328	29·87	29·81	29·75	29·70	29·62	29·56

FROM THE POLARIZATION, AND THE MILLIGRAMMES OF Cu SOLUTION BY 0·6 GRMS. OF THE MOLASSES (*Continued*).

Mgrms. Copper.	POLARIZATION.					
	10	20	30	40	50	60
330	30·08	30·02	29·96	29·90	29·82	29·75
332	30·28	30·22	30·16	30·10	30·02	29·95
334	30·48	30·42	30·36	30·30	30·22	30·15
336	30·69	30·63	30·56	30·50	30·42	30·35
338	30·90	30·84	30·77	30·70	30·63	30·56
340	31·11	31·05	30·98	30·91	30·84	30·77
342	31·31	31·25	31·18	31·11	31·04	30·97
344	31·51	31·45	31·39	31·31	31·24	31·17
346	31·72	31·66	31·60	31·51	31·44	31·38
348	31·93	31·87	31·81	31·71	31·65	31·59
350	32·14	32·08	32·02	31·92	31·86	31·80
352	32·34	32·28	32·22	32·12	32·06	32·00
354	32·55	32·48	32·42	32·33	32·26	32·20
356	32·76	32·69	32·62	32·54	32·47	32·40
358	32·97	32·90	32·83	32·75	32·68	32·61
360	33·18	33·11	33·04	32·96	32·89	32·82
362	33·39	33·30	33·24	33·16	33·09	33·02
364	33·60	33·50	33·44	33·36	33·29	33·23
366	33·81	33·70	33·64	33·56	33·50	33·44
368	34·02	33·90	33·84	33·77	33·71	33·65
370	34·23	34·10	34·04	33·98	33·92	33·86
372	34·44	34·31	34·24	34·18	34·12	34·06
374	34·65	34·52	34·45	34·38	34·32	34·26
376	34·86	34·73	34·66	34·59	34·53	34·47
378	35·07	34·94	34·87	34·80	34·74	34·68
380	35·28	35·15	35·08	35·01	34·95	34·89
382	35·49	35·36	35·29	35·22	35·16	35·10
384	35·70	35·57	35·50	35·43	35·37	35·31
386	35·91	35·78	35·71	35·64	35·58	35·52
388	36·12	35·99	35·92	35·85	35·79	35·73
390	36·33	36·20	36·13	36·06	36·00	35·94
392	36·54	36·41	36·34	36·27	36·21	36·15
394	36·75	36·62	36·55	36·48	36·42	36·36
396	36·96	36·83	36·76	36·69	36·63	36·57
398	37·18	37·05	36·98	36·91	36·84	36·78
400	37·40	37·27	37·20	37·13	37·06	37·00

takes more time and is consequently only employed in such cases where the rapid method is not applicable.

Weigh 6 grms. of the final molasses and transfer them with water into a flask of 250 c.c. capacity, dissolve, clarify with 15 c.c. of neutral lead acetate solution of 30 per cent., make up to the mark, and filter. Transfer 50 c.c. of the filtrate into a 100 c.c. flask, add about 4 c.c. of Striegler's reagent, make up to the mark with water, shake and filter.

50 c.c. of this filtrate, corresponding to 0·6 grm. of the molasses, are boiled for two minutes with 50 c.c. of freshly prepared Fehling's test solution, and cooled rapidly in order to stop the further action of the copper salt on the sucrose. The cuprous oxide precipitate is filtered through an asbestos filtering tube placed on a filtering flask evacuated by an air-pump, and washed with boiled and cooled water, doing this in such a way that during the whole period of filtering and washing the precipitate shall be continuously submerged under the liquid and not for one moment come into contact with the air.

After the cuprous oxide has been thoroughly washed, and is still submerged under water, the filtering tube is placed in a small filtering bottle and the oxide dissolved by being treated with about 30 c.c. of an acid solution of ferric ammonium sulphate,* with which it is stirred by means of a glass rod, which solution is sucked by the air-pump into the filtering bottle. The filtering tube is thoroughly washed with boiled and cooled water, and the pale yellow filtrate is titrated with a solution of potassium permanganate (containing 4·98 grms. of that substance per litre) till only the pink colour remains. Every c.c. of the permanganate solution corresponds to 10 mgrms. of copper (*Cu*).

In order to calculate the percentage of reducing sugars from the weight of copper precipitated in the shape of cuprous oxide, the foregoing Table is used which takes into account the cuprous oxide thrown down by the sucrose, so that the polarization of the molasses should also be noted.

Example.—A molasses polarizing 40 and precipitating 172 mgrms. of Cu in the shape of cuprous oxide, contains 14·94 per cent. of reducing sugars.

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* 35 grms. of ferric ammonium sulphate, and 12 c.c. of concentrated sulphuric acid dissolved and made up to 500 c.c.

XII. FIRST AND SECOND SUGARS. MOLASSES SUGAR.

Sampling.

A small quantity of sugar is taken out of every bag and collected in a large bottle, each of the various descriptions of sugar being done separately. The contents of each bottle are well mixed and the polarization ascertained once a day.

A quantity of the sugar in proportion to the quantities sampled is weighed daily, and the quantities thus obtained are collected in a second bottle to be analysed once a week.

Analysis.

Polarization.—In the case of light-coloured sugars the normal weight is taken, and of dark after-products the half-normal weight; this is transferred into a 100 c.c. flask, dissolved in water, clarified with as little basic lead acetate as will suffice, filled up to the mark, filtered and polarized. The polariscope reading of the determination in which half the normal weight had been dissolved to 100 c.c. has naturally to be multiplied by 2.

Brix.—250 grms. of the well-mixed collective sample are dissolved in 1 kg. of water and the Brix determined in the solution thus obtained. After having applied the correction for the temperature, the readings are multiplied by 5.

Sucrose.—It is not necessary to determine the real sucrose content of white plantation sugar or other sugars having a high polarization, as the content of reducing sugars in these sorts is so small that it does not exert any notable influence on the rotation. Yet it must not be assumed that in every case the polarization of such sugars is the expression of the real sucrose content, since at temperatures other than 20° C the polarization differs from the real sucrose figure by 0·03 per cent. for every degree C, so that a 100 per cent. sugar only polarizes 99·7 at 30° C.

The sucrose content of a white sugar is therefore equal to polarization + $(t - 20)$ 0·03, in which t is the temperature in degrees C at which the polarization took place.

For all other sugars 50 c.c. of the liquid that has served for the polarization, if necessary decolorized with powdered and washed charcoal, are inverted in exactly the same way as has been described under the heading "RAW JUICE," filled up to the mark and polarized either in a 200 or a 400 mm. tube provided with a water jacket.

In the former case, the polarization after inversion is multiplied by 2.

The sucrose is found by the formula: $\frac{100\ s}{c - \frac{1}{2} t}$, in which c is the constant given on page 29 or page 30, according to the method employed.

Reducing Sugars.—Of Plantation White and similar high grade sugars 33 grms. are transferred into a 150 c.c. flask and dissolved in about 125 c.c. of water. A few drops of a solution of neutral lead acetate are added, whereupon the liquid is made up to the mark, shaken, and filtered.

100 c.c. of the filtrate are placed in a 100/110 c.c. flask, treated with 4 c.c. of Striegler's reagent and filled up to the upper mark. The liquid is filtered, and 50 c.c. of the filtrate, equivalent to 10 grms. of the sugar to be analysed, are used for the determination of the reducing sugars, using the method described on page 37.

In the case of refining sugar, basis 96°, 22 grms. are weighed and dissolved in water in a 100 c.c. flask. After adding the necessary quantity of neutral lead acetate solution and filling up to the mark, the liquid is filtered; 50 c.c. of the filtrate are placed in a 50/55 c.c. flask, 4 c.c. of Striegler's reagent are added, and the liquid is made up to the upper mark and filtered. In 25 c.c. of the filtrate, equivalent to 5 grms. of the sugar to be analysed, the reducing sugar is ascertained by the method described on page 37.

In the case of molasses sugar, 11 grms. are weighed and dissolved in water in a 100 c.c. flask; neutral lead acetate solution is added, the liquid is filled up, shaken and filtered, and 50 c.c. of the filtrate are placed in a 50/55 c.c. flask. Next, 4 c.c. of Striegler's reagent are added, the contents are made up to the 55 c.c. mark, shaken, and filtered; 25 c.c. of this filtrate, equivalent to 2·5 grms. of the sugar to be analysed, are used for the determination of the reducing sugars by the method described on page 37.

In the first case, when 10 grms. of sugar had been dealt with, Herzfeld's Table (page 46) should be used; in the second case, in which 5 grms. of sugar were tested, that of Baumann is to be used (see page 46); while in the third case, the figures obtained by Baumann's Table should be doubled.

Ash.—A pair of watch-glasses with clips is tared, 5 grms. of sugar weighed in them, and then transferred carefully into a porcelain, silica, or platinum crucible, compressed gently with the fingers, and treated with 2 c.c. of pure concentrated sulphuric acid. On putting the crucible in a hot place, the sugar becomes black, swells and fills the crucible to the brim. It is heated in a muffle oven or over a Bunsen or spirit lamp in a gas cupboard till the ash is completely white or slightly pink, and all particles of carbonaceous matter are burnt.

The ash is allowed to cool in a desiccator and is then weighed. The crucible is cleansed with a fine brush without rubbing it too hard and weighed again; the difference is the weight of sulphated ash in 5 grms. of sugar, and is calculated on 100 parts of sugar by multiplying it by 20 and subtracting 10 per cent. as a correction for the difference in weight between the sulphates and the carbonates.

Moisture.—The same pair of watch-glasses that has served for weighing the sugar in the determination of the ash is used for that of the moisture too. Weigh again 5 grms. of sugar, put both glasses with the sugar open in a hot air-bath in which the temperature does not rise above 103° C nor fall below 100° C, and leave them there for three hours. After that interval, cover the sugar with the empty glass, close both with the clip, cool in the desiccator and weigh. The difference between this weight and the original one represents the moisture in 5 grms. of sugar, and is calculated on 100 parts of sugar by multiplying the figure by 20.

Undetermined Matter.—The balance of the sum of polarization, reducing sugars, ash, and moisture is reckoned as "UNDETERMINED MATTER."

Calculation of the Net Sugar Content.—Subtract five times the ash and once the reducing sugars content from the polarization.

Herzfeld's Table.[1]

Mgrms. Cu.	Per cent. Reducing Sugar.	Mgrms. Cu.	Per cent. Reducing Sugar.	Mgrms. Cu.	Per cent. Reducing Sugar.	Mgrms. Cu.	Per cent. Reducing Sugar.
50	0·05	125	0·43	200	0·85	275	1·27
55	0·07	130	0·45	205	0·88	280	1·30
60	0·09	135	0·48	210	0·90	285	1·33
65	0·11	140	0·51	215	0·93	290	1·36
70	0·14	145	0·53	220	0·96	300	1·38
75	0·16	150	0·56	225	0·99	305	1·41
80	0·19	155	0·59	230	1·02	310	1·44
85	0·21	160	0·62	235	1·05	315	1·47
90	0·24	165	0·65	240	1·07		
95	0·27	170	0·68	245	1·10		
100	0·30	175	0·71	250	1·13		
105	0·32	180	0·74	255	1·16		
110	0 35	185	0·76	260	1·19		
115	0·38	190	0·79	265	1·21		
120	0·40	195	0·82	270	1·24		

Baumann's Table.[2]

Mgrms. Cu.	Invert Sugar Per cent.	Mgrms. Cu.	Invert Sugar Per cent.	Mgrms. Cu.	Invert Sugar Per cent.	Mgrms. Cu.	Invert Sugar Per cent.
(35)	(0·04)	100	0·72	175	1·54	250	2·39
40	0·09	105	0·77	180	1·59	255	2·44
45	0·14	110	0·83	185	1·65	260	2·50
50	0·19	115	0·88	190	1·70	265	2·56
55	0·25	120	0·93	195	1·76	270	2·62
60	0·30	125	0·99	200	1·82	275	2·68
65	0·35	130	1·04	205	1·87	280	2·74
70	0·40	135	1·10	210	1·93	285	2·79
75	0·45	140	1·15	215	1·98	290	2·85
80	0·51	145	1·21	220	2·04	295	2·91
85	0·56	150	1·26	225	2·10	300	2·97
90	0·61	155	1·31	230	2·16	305	3·03
95	0·66	160	1·37	235	2·21	310	3·09
		165	1·42	240	2·27	315	3·15
		170	1·48	245	2·33	320	3·21

[1] Zeitsch. f. d. Rübenz. Ind., 1885, 1012. [2] *Ibid*, 1892, p. 826.

RECAPITULATION OF THE NECESSARY ANALYSES.

Bagasse from the Last Mill.

Polarization: 24 times a day.

Dry substance: 24 times a day.

Expressed Juice from Last Mill's Bagasse.

Brix and polarization: Once per shift.

Other Mill's Bagasse.

When required for investigation of the mill's work—

Brix in expressed juice: Once per day.

Mill Juices.

Brix: 24 times a day.

In the collective sample—

Brix and polarization: Once per shift.

Raw Juice.

Brix: 24 times per day.

In the collective sample—

Brix, polarization, sucrose: Once per shift.

Reducing sugars: Once per day.

Clarified Juice.

Brix: 24 times per day.

In the collective sample—

Brix, polarization, sucrose: Once per shift.

Reducing sugars: Once per day.

Syrup.

Brix: 24 times per day.

In the collective sample—

Brix, polarization, sucrose: Once per shift.

Filter-press Cake.

Polarization and dry substance: Once per shift.

First Massecuite.

Brix and polarization in every strike.

Second Boiling Massecuites.

Brix and polarization: Once per day.

Green Molasses.

Quotient of purity in every sample.

Final Molasses.

Quotient of purity in every sample.

In the collective sample—

Brix and polarization: Once per shift.

In the second collective sample—

Brix, polarization, sucrose, dry substance, and reducing sugars: Once every fortnight.

Sugar Delivered.

If the sugar is sold on the basis of simple polarization:

Polarization in a sample of every parcel sold.

If the sugar is sold on the basis of net sugar content:

Polarization, reducing sugars, ash, undetermined, and moisture in a sample of every parcel sold.

In the collective sample—

Brix, polarization, sucrose, reducing sugars, and moisture: Once every week.

PART II.

DETERMINATION OF QUANTITIES.

DETERMINATION OF QUANTITIES.

I. WEIGHTS THAT ARE DIRECTLY ASCERTAINED.

Cane.

The cane is weighed on its entry into the factory yard on the waggons, trucks or cars, by means of a weighbridge. The weight of the empty cars is, of course, established after their being unloaded and the tare subtracted from the gross weight.

The weight of the cane entered in the Chemical Control books is that of the cane in the condition in which it is received, i.e., with the adhering trash, bamboo rope, dirt, etc.

No correction is made for the drying up of the cane between the moment of its arrival and its being crushed, nor for trash, etc. The only correction which could be made is that for the earth removed from the factory floor on the occasion of a clean up, which might be weighed and subtracted from the weight of the cane, but in most instances this will be superfluous, because of the small amount of that accretion.

Liquids used for Maceration.

It is necessary to know the quantity of all the water, sweet-water, and dilute juices used for maceration. When Last Mill Juice is employed for that operation, all of it should be weighed or measured, even if it is not entirely sprinkled over the bagasse.

The best mode of determining the weight of these liquids is by directly weighing them, preferably on automatic scales.

When using cold maceration water, this may be measured in tanks which are filled and emptied alternately.

In order to avoid fermentation, the weighing of the mill juices used for maceration must be performed very rapidly and with the least delay possible.

Raw Juice.

The best and surest method of ascertaining the weight of raw juice expressed by the mills is by actual weighing. Although a number of entirely automatic juice-weighing machines have been put on the market, they have up to now failed to find general acceptance in cane sugar factories; but, on the other hand, semi-automatic weighers are being more generally adopted. They are simple and accurate, while the drawback of the totally non-automatic weighing apparatus, viz., the dependency on the men in charge is overcome by the automatic recording and weighing apparatus of semi-automatic type. Yet, simple measurement of the juice is still met with in most sugar-houses, by which method the weight of the juice is found from its volume and its specific gravity.

The juice measured or weighed always contains dirt in suspension which settles slowly, and also occluded air or sometimes carbonic acid, while the analysis is made with the subsided and air-free juice. In order to make the analysis of the juice have a bearing on the actual material of which the weight is ascertained, it is necessary to make a correction for the subsided dirt if the juice is weighed, and for subsided dirt and occluded gases if the juice is measured.

Correction for the Dirt.—A sample of the raw juice is taken from the supply pipe, just at the point of its entry into the measuring or weighing tank, after baffle-plates or sieves have ensured a thorough mixing of the juices from the different mills. In the case of weighing, 1 kg., or in that of measuring, 1 litre, of the juice is poured into a decanting cylinder, having an outlet cock at the bottom, or into a large separatory funnel, provided with a syphon. After standing it half-an-hour the dirt will have subsided, whereupon the supernatant juice is decanted or syphoned off.

The subsided dirt is shaken up with 1 litre of water, allowed to settle again for a quarter of an hour, and the clear liquid again decanted or syphoned off. This operation is repeated three times more. Finally, a paper filter is placed under the outlet cock of the cylinder, or under the stem of the separatory funnel, the dirt is collected thereon, and the water allowed to drain off, after which the filter with its contents is dried at 100°–110° C and weighed.

In the case of juice weighing, the paper filter should be tared beforehand, and the amount of dirt present in 1 kg. of juice found by the difference of weight. When measuring juices, the dry dirt is transferred to a 25 c.c. measuring cylinder, which has previously been filled to the 15 c.c. mark with alcohol. After the complete immersion of the dirt and the escape of the air bubbles, the level of the liquid is read, and the difference between that and 15 is the volume of the dirt. If the dirt does not sink at once it should be pressed down with a small glass rod, which is left in the measuring cylinder during the reading of the level; afterwards the volume of the immersed part of the rod is ascertained and taken into account.

Correction for Occluded Gases.—A measuring tank is well disinfected and filled with juice in the usual manner. The juice is allowed to stand till all the air has escaped, which will take about half an hour. The level of the juice will have sunk below the mark and must be filled up again with water added from a litre flask. The volume of water necessary for making up for the decrease in volume owing to the escaped gas represents the scum correction for the measuring tank.

Determination of the Weight by Actual Weighing.—The weight of juice ascertained by the weighing machines is decreased by the amount representing the correction for the dirt. This correction is checked and established a few times during the grinding season and applied to the figure of the weight once a day.

Determination of the Weight of the Juice by Measuring.—The correction for the dirt and for the occluded gases is applied once for all to the volume of the measuring tanks. These are controlled with water, as described on page 93, and the volume of dirt and gases ascertained now and then and accounted for at once, so that the volume of the measuring tanks is recorded as "net volume" with the two corrections already applied.

EXAMPLE:

Suppose the volume of the tank as ascertained with water to be 1006·7 litres, the volume of the dirt found on determination to be 9·4 c.c. per litre, and the amount of water to be added to the juice after the air bubbles have escaped to be 11·6 litres, the net content of the tank is 1006·7 — (9·4 + 11·6) = 985·7 litres.

From this net volume the weight of the juice is calculated as follows:—

Every hour the temperature and the Brix of the measured juice are ascertained and the latter corrected to the normal temperature of 17·5° C by the aid of Stammer's Tables (*see* pages 108–120). At the end of the day the average Brix and the average temperature are calculated by adding all the values of the 24 determinations for the Brix and also those for the temperature, and dividing the sum by 24 (or in case of fewer observations, by their actual lesser number). The average figure for the Brix degrees at 17·5° C is converted to the actual one at the average temperature determined, by application of the same correction from Stammer's Correction Tables (page 21); and from that figure the real specific gravity of the juice at the moment of its being measured is found from the Tables at pages 108–120. This represents the actual specific gravity of the juice at the temperature of its being measured but free from dirt and from air. When multiplying this value by that of the net volume in litres of the tanks filled, we obtain the real weight of the juice in kg., which may be converted into lbs., piculs, tons, or whatever standard of weight is desired.

Example :

Net Volume of Juice in 24 Hours: 751,482 Litres.

Readings of Brix Hydrometer.	Temperature °C.	Corrected degrees Brix.	Readings of Brix Hydrometer.	Temperature °C.	Corrected degrees Brix.
16·5	33	17·60	16·8	32	17·83
16·9	32	17·93	16·5	31	17·45
16·4	33	17·50	15·3	32	16·33
17·2	30	18·07	17·2	30	18·07
17·1	30	17·97	17·0	31	17·95
15·9	31	16·85	17·0	31	17·95
16·4	30	17·27	17·1	32	18·13
16·6	29	17·38	16·8	30	17·67
15·9	30	16·77	16·7	31	17·65
15·8	32	16·83	16·9	32	17·93
16·4	33	17·50	16·4	32	17·43
16·6	34	17·77			
17·0	33	18·10		754	421·93
		Average		**31·4**	**17·57**

Corrected to actual degrees Brix .. = 17·57 – 0·99 = **16·58**, corresponding to 1·06819 specific gravity.

751,482 litres of juice, specific gravity 1·06819 = **802,726 kg.**

Filter-press Cake.

The best method of weighing the filter-press cake is by means of a small weighbridge with a registering appliance. The cake is carried in cars, by which it is removed from the factory over the weighbridge, while the tare of the empty cars is recorded on their return. The difference between the two weighings represents the weight of the cake. If the filter-press cakes are not muddy, but hard, so that they do not adhere to the cars, the previously ascertained tare of the empty waggons may be subtracted from that of the filled ones, but in this operation the value must be controlled now and then by weighing.

Final Molasses.

The quantity of final molasses can only be ascertained in a reliable manner by direct weighing. Measuring gives rise to inaccurate figures, owing to the presence of occluded air or gas, and the difficulty of emptying the tanks completely after each filling.

The molasses is weighed on scales carrying an iron tank which is weighed when full of molasses, then drained through a hole at the bottom and weighed when empty again, so as to find the exact weight of the molasses discharged.

The scales on which the molasses is weighed should be of considerable capacity, in order to reduce the number of weighings as much as possible.

Sugar Produced.

The actual weight of the sugar produced should be entered in the books; but it is not always the same weight as that of the sugar delivered. The allowance of sugar consumed by the employees and workmen at the factory must be recorded just as well as the sugar sold, while the customary "overweight" accorded to purchasers needs also to be carried into account here. For these reasons the weight of sugar actually produced will be more than that on which payment is received. The sugars should be weighed with their packages on accurate scales, and the tare of the packages be subtracted from the gross weight.

II. WEIGHTS THAT ARE CALCULATED.

Cane.

Although the weight of the cane is ascertained on the weigh-bridge, we require to calculate the weight of the cane crushed in a certain period, because not all of the cane entering the factory yard is worked up by the end of a given time.

In some countries the cane is weighed again a moment previous to its being crushed, and in that case the weight of the cane crushed is recorded directly. In other places, however, the cane is weighed on arrival, and at the end of a period some of it is still lying in the yard. In order to find the weight of cane crushed during, say, a fortnight or a month, the weight of the cane entered into the factory yard during that time is augmented with the stock of cane present at the beginning of the period and diminished by the stock still lying there at the end. These stocks are taken at a guess and, as their quality is comparatively small when compared with the huge amount of cane worked up in that length of time, small discrepancies between the estimated weight and the actual one are of so little importance that they can be neglected.

But if it is desired to know the weight of cane crushed during 24 hours, this method is much too inaccurate, since here the disproportion between the weight of cane crushed and that in stock is not so great, and even small variations in our guesswork are much too serious to allow one to follow any such rough and ready method with accuracy.

The better way to find the approximate weight of cane crushed during one day is discussed on page 78.

Bagasse.

The weight of the bagasse is very seldom ascertained directly, although very convenient automatic weighing appliances are in existence.

As a rule, the weight of the bagasse is found by subtracting the weight of the raw juice from the sum of the weights of cane and maceration water.*

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* When sweet-waters are used for maceration the quantity of these must also be accounted for.

This method of reckoning implies the supposition that no notable amount of water is evaporated during the milling process; and for this reason, and also with a view to an exact weighing or measuring of the maceration water, the use of water at ordinary temperature is desirable.

Careful investigations* have shown that the extraction does not differ whether hot or cold maceration water is used in the milling work, and since the use of cold water helps towards the establishment of a reliable control, it is preferable to make use of water at ordinary temperature which does not evaporate perceptibly during the milling, the quantity of which can be carefully ascertained.

Polarization lost in the Bagasse.—The total amount of polarization lost in the bagasse is found by multiplying the weight of the bagasse by its percentage of polarization and dividing by 100.

Fibre in Bagasse.—The weight of the bagasse multiplied by the percentage of fibre ascertained in this product during the run and divided by 100 yields the total amount of fibre in the bagasse.

Raw Juice.

Dry Substance in Raw Juice.—The weight of the raw juice multiplied by the average degrees Brix, or dry substance content, of the raw juice during the run and divided by 100 constitutes the total amount of dry substance entered into the factory in the raw juice.

Polarization of Raw Juice.—The weight of the raw juice multiplied by the average polarization of the raw juice during the run and divided by 100 constitutes the total amount of polarization entered into the factory in the raw juice.

Sucrose in Raw Juice.—The weight of the raw juice multiplied by the average sucrose content of the raw juice during the run and divided by 100 constitutes the total amount of sucrose entered into the factory in the raw juice.

Available Sugar to be expected from the Raw Juice.—After a series of experiments made in well-equipped cane sugar factories, it has become evident that the raw sugar, basis 96° polarization, obtained in regular working can be represented by the formula:

$$\text{Available sugar} = \text{polarization in raw juice} \times 1{\cdot}4 \frac{40}{\text{Q. P. of Raw Juice}}$$

* See H. C. Prinsen Geerligs, "Cane Sugar and its Manufacture," page 103.

TABLE SHOWING THE VALUE OF THE FACTOR, $\left(1{\cdot}4 - \frac{40}{\text{Q.P.}}\right) \times 100$, FOR EVERY QUOTIENT OF PURITY OF THE RAW JUICE BETWEEN 77 AND 93.

	0	1	2	3	4	5	6	7	8	9
77	88·05	88·1	88·2	88·25	88·3	88·4	88·45	88·5	88·6	88·65
78	88·7	88·8	88·85	88·9	89·0	89·05	89·1	89·15	89·25	89·3
79	89·35	89·4	89·5	89·5	89·6	89·7	89·75	89·8	89·85	89·95
80	90·0	90·05	90·1	90·2	90·25	90·3	90·35	90·4	90·5	90·55
81	90·6	90·7	90·75	90·8	90·85	90·9	91·0	91·05	91·1	91·15
82	91·2	91·3	91·3	91·4	91·45	91·5	91·6	91·6	91·7	91·75
83	91·8	91·9	91·9	92·0	92·0	92·1	92·15	92·2	92·3	92·3
84	92·4	92·4	92·5	92·55	92·6	92·7	92·7	92·8	92·8	92·9
85	92·9	93·0	93·05	93·1	93·2	93·2	93·3	93·3	93·4	93·4
86	93·5	93·5	93·6	93·6	93·75	93·75	93·8	93·9	93·9	94·0
87	94·0	94·1	94·1	94·2	94·2	94·3	94·3	94·4	94·4	94·5
88	94·55	94·6	94·65	94·7	94·75	94·8	94·85	94·9	94·95	95·0
89	95·05	95·1	95·15	95·2	95·25	95·3	95·35	95·4	95·45	95·5
90	95·5	95·6	95·65	95·7	95·75	95·8	95·85	95·9	95·95	96·0
91	96·0	96·1	96·1	96·2	96·2	96·3	96·3	96·4	96·4	96·5
92	96·5	96·6	96·6	96·65	96·7	96·75	96·8	96·85	96·9	96·95
93	97·0	97·0	97·0	97·1	97·2	97·2	97·3	97·3	97·35	97·45

so that the total amount of raw sugar, basis 96°, to be expected in the run may be found by multiplying the polarization of the raw juice by the expression: $1{\cdot}4 - \frac{40}{\text{Quotient}}$, the values of which for every quotient of purity of the raw juice between 77 and 93 are to be found from the Table opposite.

These values are, of course, only approximate and may deviate from the real ones according to the degree of purity to which the molasses are worked down.

The author has however suggested* another method of calculating the highest value of sugar to be expected from the juice, in which reckoning no unaccountable loss is assumed, and the only loss taken into account is that in the filter-press cake and in the molasses. Further, he assumes that both in the filter-press cake and in the molasses the ratio of the sucrose and the non-sugar is as 1 : 2, which is not very far amiss. According to his calculations† the loss of sucrose in filter-press cake is about 0·10 per cent. of cane, and that of the non-sugar in the same material about 0·20, so that in this case the ratio is the desired one. The quotient of purity of the molasses is estimated at 33⅓, thus giving the same ratio, which releases us from the trouble of making a distinction between the two ways in which sucrose is accountably lost.

Suppose the quotient of purity of the commercial sugar expected to be p, that of the initial raw juice to be p_1, and that of the molasses and filter-press cake to be 33⅓, and suppose the percentage of dry commercial sugar to be obtained from 100 parts of dry substance in the raw juice to be x. Then we have the following equation:—

$$x \times p + (100 - x)\, 33\tfrac{1}{3} = 100 \times p_1$$

$$x = 100 \times \frac{p_1 - 33\frac{1}{3}}{p - 33\frac{1}{3}}$$

On 100 parts of sucrose in the raw juice the amount of dry sugar

$$x = 100\,\frac{p_1 - 33\frac{1}{3}}{p - 33\frac{1}{3}} \times \frac{100}{p_1}$$

and that of commercial sugar with its water content,

$$x = 100\,\frac{p_1 - 33\frac{1}{3}}{p - 33\frac{1}{3}} \times \frac{100}{p_1} \times \frac{100}{\text{dry solids in sugar}}.$$

* *International Sugar Journal*, 1912, 274.

† "Cane Sugar and its Manufacture," page 196.

To a commercial sugar of 96·5° polarization, 0·7 per cent. moisture, and 97·2 quotient of purity, the percentage of available sugar on 100 parts of sucrose in the raw juice is :—

$$100\,\frac{p_1 - 33\frac{1}{3}}{97{\cdot}2 - 33\frac{1}{3}} \times \frac{100}{p_1} \times \frac{100}{99{\cdot}3}.$$

In this way, for every degree of purity of the raw juice, the factor can be calculated by which the percentage of sucrose in the juice must be multiplied in order to give the figure for the available sugar of the given constitution.

In the following table the factors for the purity values between 77° and 93° are summarized for a sugar of the analysis given above :—

TABLE SHOWING AVAILABLE SUGAR OF 96·5° POLARIZATION, 95·1 PER CENT. CRYSTAL CONTENT, AND 99·3 PER CENT. TOTAL SOLIDS, FOR EVERY DEGREE OF PURITY OF THE RAW JUICE BETWEEN 77 AND 93.

	0·0	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
77	0·8942	0·8951	0·8960	0·8968	0·8976	0·8985	0·8994	0·9003	0·9012	0·9021
78	0·9030	0.9038	0·9047	0·9055	0·9064	0·9072	0·9081	0·9089	0·9098	0·9107
79	0·9115	0·9123	0·9131	0·9140	0·9148	0·9156	0·9165	0·9173	0·9182	0·9190
80	0·9198	0·9206	0·9214	0·9222	0·9231	0·9239	0·9247	0·9255	0·9263	0·9271
81	0·9279	0·9287	0·9295	0·9303	0·9311	0·9318	0·9326	0·9334	0·9342	0·9350
82	0·9358	0·9366	0·9374	0·9381	0·9389	0·9397	0·9405	0·9412	0·9420	0·9428
83	0·9435	0·9443	0·9450	0·9458	0·9465	0·9473	0·9481	0·9488	0·9496	0·9503
84	0·9511	0·9518	0·9526	0·9533	0·9540	0·9548	0·9555	0·9563	0·9570	0·9577
85	0·9584	0·9591	0·9598	0·9605	0·9613	0·9620	0·9627	0·9634	0·9641	0·9648
86	0·9655	0·9663	0·9670	0·9677	0·9684	0·9691	0·9699	0·9706	0·9713	0·9720
87	0·9727	0·9733	0·9740	0·9747	0·9754	0·9761	0·9767	0·9774	0·9781	0·9788
88	0·9795	0·9802	0·9808	0·9815	0·9822	0·9829	0·9835	0·9842	0·9849	0·9856
89	0·9862	0·9869	0·9875	0·9882	0·9888	0·9895	0·9902	0·9908	0·9915	0·9921
90	0·9928	0·9934	0·9941	0·9947	0·9953	0·9960	0·9966	0·9973	0·9979	0·9986
91	0·9992	0·9998	1·0005	1·0011	1·0017	1·0024	1·0030	1·0037	1·0041	1·0048
92	1·0055	1·0061	1·0067	1·0073	1·0080	1·0086	1·0092	1·0098	1·0104	1·0110
93	1·0116	1·0122	1·0128	1·0134	1·0140	1·0146	1·0152	1·0158	1·0164	1·0170

The values for the available commercial sugar, according to this table, represent the highest attainable *rendement* under the circumstances. There might, however, be slightly higher *rendements* if the filter-scum were sweetened off to a lower sucrose content than 0·10 on 100 parts of cane, or if the molasses were exhausted to a lower quotient of purity than 33⅓, or again if the sugar had a lower total solids content than 99·3. In any case, the difference that might hereby be caused would not be more than a few hundredths per cent.

The amount of available crystal in the raw juice can now be readily found by multiplying the above figures by the factor 0·951.

Still, for convenience' sake, the calculation has been made for each figure, and the results are summarized in the following table :—

TABLE GIVING THE FACTORS WITH WHICH THE SUCROSE PRESENT IN THE JUICE MUST BE MULTIPLIED IN ORDER TO GIVE THE AVAILABLE CRYSTAL SUGAR FOR EVERY DEGREE OF PURITY BETWEEN 77 AND 93, THE PURITY OF THE MOLASSES BEING 33⅓.

	0·0	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
77	0·8504	0·8512	0·8520	0·8529	0·8537	0·8546	0·8554	0·8562	0·8571	0·8579
78	0·8587	0·8595	0·8603	0·8611	0·8620	0·8628	0·8636	0·8644	0·8652	0·8660
79	0·8668	0·8676	0·8684	0·8692	0·8699	0·8707	0·8715	0·8723	0·8731	0·8739
80	0·8747	0·8754	0·8762	0·8770	0·8777	0·8785	0·8793	0·8800	0·8808	0·8816
81	0·8824	0·8831	0·8839	0·8847	0·8854	0·8662	0·8869	0·8877	0·8884	0·8892
82	0·8899	0·8907	0·8914	0·8922	0·8929	0·8936	0·8944	0·8951	0·8958	0·8965
83	0·8973	0·8980	0·8987	0·8995	0·9002	0·9009	0·9016	0·9024	0·9031	0·9038
84	0·9046	0·9053	0·9060	0·9067	0·9073	0·9080	0·9087	0·9093	0·9100	0·9107
85	0·9114	0·9121	0·9128	0·9134	0·9141	0·9148	0·9154	0·9169	0·9168	0·9175
86	0·9182	0·9189	0·9195	0·9202	0·9209	0·9215	0·9222	0·9229	0·9235	0·9242
87	0·9249	0·9256	0·9263	0·9270	0·9276	0·9282	0·9289	0·9295	0·9301	0·9308
88	0·9315	0·9321	0·9328	0·9334	0·9341	0·9347	0·9354	0·9360	0·9367	0·9374
89	0·9380	0·9386	0·9393	0·9399	0·9406	0·9412	0·9419	0·9426	0·9432	0·9438
90	0·9442	0·9448	0·9452	0·9458	0·9464	0·9472	0·9478	0·9484	0·9490	0·9496
91	0·9502	0·9508	0·9514	0·9520	0·9526	0·9532	0·9538	0·9544	0·9550	0·9556
92	0·9562	0·9568	0·9574	0·9579	0·9585	0·9591	0·9597	0·9602	0·9608	0·9614
93	0·9620	0·9626	0·9631	0·9637	0·9643	0·9648	0·9652	0·9658	0·9663	0·9669

Filter-press Cake.

Polarization Lost in Filter-press Cake.—The weight of the filter-press cake, multiplied by the average percentage of polarization during the run and divided by 100, represents the weight of polarization which, in this relatively small quantity, is considered to be the same as the real weight of sucrose lost in the filter-press cake.

Clarified Juice.

The weight of the clarified juice is never ascertained directly, and therefore we must calculate the total weight of dry substance and of polarization or sucrose indirectly.

In this case we can assume that no undeterminable loss has been sustained during clarification, and that the amount of sucrose in the clarified juice consists of the difference between that in the raw juice and that in the filter-press cakes.

Total Polarization of the Clarified Juice.—The total loss of polarization in the filter-press cake during the run under consideration is subtracted from the total weight of polarization of the raw juice during that same period.

Total Sucrose in the Clarified Juice.—The total loss of sucrose in the filter-press cake (which, in this case, is taken to be the same value as that of the polarization) during the run under consideration is subtracted from the total weight of sucrose in the raw juice of that period.

Total Dry Substance in the Clarified Juice.—The total amount of polarization of the clarified juice is divided by the figure representing the apparent quotient of purity of that same clarified juice and multiplied by 100.

Total Non-Sugar in the Clarified Juice.—By subtraction of the total sucrose from the total amount of dry substance, the total amount of non-sugar is found.

Calculated Maximum Yield of Crystallized Sucrose from the Clarified Juice.—To calculate the maximum yield to be obtained from a given quantity of clarified juice of a given constitution, we assume that no undetermined loss occurs between the stages of clarified juice and the finished product, so that the only loss sustained is that in the filter-press cake. We know the total amount of sucrose which has entered the raw juice during a given period, and also that of the total sucrose lost in the filter-press cake during that same run; by subtraction we find the weight of sucrose in the clarified juice. The quotient of purity of the clarified juice is also known, so that the total amount of dry substance in the clarified juice during the run may be found by dividing the sucrose by the quotient of purity and multiplying the quotient by 100. The total weight of dry substance being known and also that of the sucrose, it is easy to find the total amount of non-sugar in the clarified juice.

We assume further that, after the stage of clarified juice, no dry substance is lost unaccountably, and that all the dry substance from the clarified juice is recovered, either in the molasses or in the product.

If the quotient of purity of the exhausted molasses is known, we can find how much sucrose is being lost in the molasses on every part of non-sugar in the molasses, and therefore also on every part of the non-sugar in the clarified juice.

We know how much non-sugar exists in the clarified juice, and can therefore find how much sucrose ultimately will be immobilized in the molasses. The difference between the total sucrose and the part immobilized later on represents the amount of crystallizable sucrose, or the value to be found.

In a molasses having a purity p, the loss of sucrose will be p on $100 - p$ parts of non-sugar, or on 1 part: $\frac{p}{100 - p}$.

On the total amount of non-sugar in the clarified juice represented by the formula $B - S$, the loss of sucrose in molasses is $(B - S)\,\frac{p}{100 - p}$, and consequently the formula for the available crystallized sugar in clarified juice will be:

$$\text{Available crystallized sucrose} = S - (B - S) \times \frac{p}{100 - p},$$

in which S = sucrose in clarified juice; B = Brix in clarified juice; and p = purity of the final molasses.

The same result may be obtained by using the following formula:

$$\text{Available crystallizable sucrose} = \frac{\frac{P}{100 - P} - \frac{p}{100 - p}}{\frac{P}{100 - P}} \times s,$$ in which P represents the purity of the clarified juice.

The expression $\frac{P}{100 - P}$ represents the amount of sucrose present in the clarified juice on 1 part of non-sugar, and, as we have already said, the expression $\frac{p}{100 - p}$ represents the amount of sucrose present in the molasses on 1 part of non-sugar. As the total amount of that non-sugar is the same in both cases, the amount of sucrose capable of crystallizing out is found by subtraction of the two values, and by a simple calculation we find how much sucrose will crystallize out on a quantity of sucrose in clarified juice of s.

The Tables for the values $\frac{P}{100 - P}$ for every quotient of purity between 71° and 92°, and $\frac{p}{100 - p}$ for every quotient of purity between 26 and 50 are given here.

TABLE FOR THE VALUE, $\frac{P}{100 - P}$, FOR EVERY QUOTIENT OF PURITY OF CLARIFIED JUICES BETWEEN 71 AND 92.

Quotient of Purity.	0	1	2	3	4	5	6	7	8	9
71	2·448	2·460	2·472	2·485	2·497	2·509	2·521	2·534	2·546	2·559
72	2·571	2·584	2·597	2·610	2·623	2·636	2·650	2·663	2·676	2·690
73	2·704	2·717	2·731	2·745	2·760	2·774	2·788	2·802	2·817	2·831
74	2·846	2·861	2·876	2·891	2·906	2·922	2·937	2·953	2·968	2·984
75	3·000	3·016	3·032	3·049	3·065	3·082	3·098	3·115	3·132	3·149
76	3·167	3·184	3·202	3·219	3·237	3·255	3·274	3·292	3·310	3·329
77	3·348	3·367	3·386	3·406	3·425	3·445	3·464	3·484	3·505	3·525
78	3·545	3·566	3·587	3·608	3·630	3·651	3·673	3·695	3·717	3·739
79	3·762	3·785	3·808	3·831	3·855	3·878	3·902	3·926	3·950	3·975
80	4·000	4·025	4·051	4·076	4·102	4·128	4·155	4·181	4·208	4·236
81	4·263	4·291	4·319	4·347	4·376	4·405	4·435	4·465	4·495	4·525
82	4·556	4·587	4·618	4·650	4·682	4·714	4·747	4·780	4·814	4·848
83	4·882	4·917	4·952	4·988	5·024	5·061	5·098	5·135	5·173	5·211
84	5·250	5·289	5·329	5·369	5·410	5·452	5·494	5·536	5·579	5·623
85	5·667	5·711	5·757	5·803	5·849	5·897	5·945	5·993	6·042	6·092
86	6·143	6·194	6·246	6·299	6·353	6·408	6·463	6·519	6·576	6·634
87	6·692	6·752	6·813	6·874	6·936	7·000	7·064	7·130	7·197	7·264
88	7·333	7·403	7·475	7·547	7·621	7·696	7·772	7·850	7·928	8·009
89	8·091	8·174	8·259	8·346	8·434	8·524	8·615	8·709	8·804	8·901
90	9·000	9·101	9·204	9·309	9·417	9·526	9·638	9·753	9·870	9·989
91	10·111	10·236	10·364	10·494	10·628	10·765	10·905	11·048	11·195	11·346
92	11·500	11·658	11·821	11·987	12·158	12·333	12·514	12·700	12·889	13·085

TABLE FOR THE VALUE, $\frac{p}{100 - p}$, FOR EVERY QUOTIENT OF PURITY OF FINAL MOLASSES BETWEEN 26 AND 50.

Quotient of Purity.	0	1	2	3	4	5	6	7	8	9
26	0·351	0·353	0·355	0·357	0·359	0·361	0·362	0·364	0·366	0·368
27	370	372	374	376	377	379	381	383	385	387
28	389	391	393	395	397	399	401	403	405	407
29	408	410	412	414	416	418	421	423	425	427
30	429	431	433	435	437	439	441	443	445	447
31	449	451	453	456	458	460	462	464	466	468
32	471	473	475	477	479	482	484	486	488	490
33	493	495	497	499	502	504	506	508	511	513
34	515	517	520	522	524	527	529	531	534	536
35	538	541	543	546	548	550	553	555	558	560
36	563	565	567	570	572	575	577	580	582	585
37	587	590	592	595	597	600	603	605	608	610
38	613	616	618	621	623	626	629	631	634	637
39	639	642	645	647	650	653	656	658	661	664
40	667	669	672	675	678	681	684	686	689	692
41	695	698	701	704	707	709	712	715	718	721
42	724	727	730	733	736	739	742	745	748	751
43	754	757	761	764	767	770	773	776	779	783
44	786	789	792	795	799	802	805	808	812	815
45	818	821	825	828	832	835	838	842	845	848
46	852	855	859	862	866	869	873	876	880	883
47	887	890	894	898	901	905	908	912	916	919
48	923	927	931	934	938	942	946	949	953	957
49	961	965	969	972	976	980	984	988	992	996
50	1·000	—	—	—	—	—	—	—	—	—

Sugar Delivered.

Amount of Sucrose.—The weight of sucrose in the sugars delivered is found by multiplying the weight of the sugar of every shipment by the average polarization or the average sucrose content and dividing by 100.

Amount of Crystallizable Sucrose in the Sugars.—By the phrase CRYSTALLIZABLE SUCROSE IN THE SUGARS we do not understand that portion of the sucrose which is really crystallized out, but that portion which can crystallize out when the molasses surrounding the crystals is exhausted to a quotient of purity of $33\frac{1}{3}$.

The calculation is very easy, the purity being taken at the convenient figure of $33\frac{1}{3}$, which indicates that for every 2 parts of water-free non-sugar there goes to the molasses 1 part of sucrose, which must be subtracted from the polarization to give the crystal figure.

Thus, for example, if we have a sugar of 99·5 per cent. of total solids, 97·4° polarization, and consequently 2·1 per cent. of non-sugar, then the sucrose going to the molasses is $\frac{2{\cdot}1}{2} = 1{\cdot}05$ and that belonging to the crystal is $97{\cdot}4 - 1{\cdot}05 = 96{\cdot}35$ per cent.

An after-product sugar of 95 per cent. total solids, and 75 polarization will thus have 20 per cent. dry non-sugar, or 10 per cent. of sucrose, passing into the molasses. The crystal content is then $75 - \frac{20}{2} = 65$ per cent. The Table on pages 68 and 69 shows the crystal content, according to the meaning just expressed of sugars of every polarization, between 96 and 100, and every water content between 0·1 and 2·0 per cent.

Thus, for example, if we have produced 9·89 per cent. of white sugar of 99·59 polarization and 100 per cent. of total solids, and 1·8 per cent. of white second sugar of 98·9 polarization and 0·2 per cent. water content, then, according to the Table, the crystal contents of the sugars are respectively 99·4 and 98·45 per cent., the calculation being as follows :—

	Per cent.
9·89 per cent. of first sugar at 99·4 per cent. of crystal ..	9·83
1·80 per cent. of second sugar at 98·45 per cent. of crystal	1·77
11·69 per cent. of product with	**11·60**

per cent. of crystal on cane.

Molasses.

Weight of Sucrose lost in Molasses.—The weight of the molasses multiplied by the percentage of sucrose in the molasses and divided by 100 represents the total loss of sucrose in the molasses during the run.

TABLE FOR CONTENT OF CRYSTALLIZABLE SUCROSE IN COMMERCIAL

Polarization.	Moisture.										
	0·0	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1·0
99·9	99·85	99·90	..	..	..	.	..	..	..	..	.
99·8	99·70	99·75	99·80	..	..	..	..	..	..	..	..
99·7	99·55	99·60	99·65	99·70	..	..	.	..	..	.	..
99·6	99·40	99·45	99·50	99·55	99·60	..	..	..	..	..	..
99·5	99·25	99·30	99·35	99·40	99·45	99·50	..	..	.	..	..
99·4	99·10	99·15	99·20	99·25	99·30	99·35	99·40	..	..	..	..
99·3	98·95	99·00	99·05	99·10	99·15	99·20	99·25	99·30	..	..	..
99·2	98·80	98·85	98·90	98·95	99·00	99·05	99·10	99·15	99·20	..	..
99·1	98·65	98·70	98·75	98·80	98·85	98·90	98·95	99·00	99·05	99·10	..
99·0	98·50	98·55	98·60	98·65	98·70	98·75	98·80	98·85	98·90	98·95	99·00
98·9	98·35	98·40	98·45	98·50	98·55	98·60	98·65	98·70	98·75	98·80	98·85
98·8	98·20	98·25	98·30	98·35	98·40	98·45	98·50	98·55	98·60	98·65	98·70
98·7	98·05	98·10	98·15	98·20	98·25	98·30	98·35	98·40	98·45	98·50	98·55
98·6	97·90	97·95	98·00	98·05	98·10	98·15	98·20	98·25	98·30	98·35	98·40
98·5	97·75	97·80	97·85	97·90	97·95	98·00	98·05	98·10	98·15	98·20	98·25
98·4	97·60	97·65	97·70	97·75	97·80	97·85	97·90	97·95	98·00	98·05	98·10
98·3	97·45	97·50	97·55	97·60	97·65	97·70	97·75	97·80	97·85	97·90	97·95
98·2	97·30	97·35	97·40	97·45	97·50	97·55	97·60	97·65	97·70	97·75	97·80
98·1	97·15	97·20	97·25	97·30	97·35	97·40	97·45	97·50	97·55	97·60	97·65
98·0	97·00	97·05	97·10	97·15	97·20	97·25	97·30	97·35	97·40	97·45	97·50
97·9	96·85	96·90	96·95	97·00	97·05	97·10	97·15	97·20	97·25	97·30	97·35
97·8	96·70	96·75	96·80	96·85	96·90	96·95	97·00	97·05	97·10	97·15	97·20
97·7	96·55	96·60	96·65	96·70	96·75	96·80	96·85	96·90	96·95	97·00	97·05
97·6	96·40	96·45	96·50	96·55	96·60	96·65	96·70	96·75	96·80	96·85	96·90
97·5	96·25	96·30	96·35	96·40	96·45	96·50	96·55	96·60	96·65	96·70	96·75
97·4	96·10	96·15	96·20	96·25	96·30	96·35	96·40	96·45	96·50	96·55	96·60
97·3	95·95	96·00	96·05	96·10	96·15	96·20	96·25	96·30	96·35	96·40	96·45
97·2	95·80	95·85	95·90	95·95	96·00	96·05	96·10	96·15	96·20	96·25	96·30
97·1	95·65	95·70	95·75	95·80	95·85	95·90	95·95	96·00	96·05	96·10	96·15
97·0	95·50	95·55	95·60	95·65	95·70	95·75	95·80	95·85	95·90	95·95	96·00
96·9	95·35	95·40	95·45	95·50	95·55	95·60	95·65	95·70	95·75	95·80	95·85
96·8	95·20	95·25	95·30	95·35	95·40	95·45	95·50	95·55	95·60	95·65	95·70
96·7	95·05	95·10	95·15	95·20	95·25	95·30	95·35	95·40	95·45	95·50	95·55
96·6	..	..	95·00	95·05	95·10	95·15	95·20	95·25	95·30	95·35	95·40
96·5	..	..	..	..	..	95·00	95·05	95·10	95·15	95·20	95·25
96·4	..	..	..	..	..	94·85	94·90	94·95	95·00	95·05	95·10
96·3	..	..	..	..	..	94·70	94·75	94·80	94·85	94·90	94·95
96·2	..	..	..	..	..	94·55	94·60	94·65	94·70	94·75	94·80
96·1	..	..	..	..	..	94·40	94·45	94·50	94·55	94·60	94·65
96·0	..	..	..	..	..	..	94·30	94·35	94·40	94·45	94·50

Sugar from its Polarization and Moisture Content.

Polarization.	Moisture.									
	1·1	1·2	1·3	1·4	1·5	1·6	1·7	1·8	1·9	2·0
99·9	..	..	..	..	..	..	..	..	..	..
99·8	..	..	..	..	..	..	..	..	..	..
99·7	..	..	..	..	..	..	..	..	..	..
99·6	..	..	..	..	..	..	..	..	..	..
99·5	..	..	..	..	..	..	..	..	..	..
99·4	..	..	..	..	..	..	..	..	..	..
99·3	..	..	..	..	..	..	..	..	..	..
99·2	..	..	..	..	..	..	..	..	..	..
99·1	..	..	..	..	..	..	..	..	..	..
99·0	..	..	..	..	..	..	..	..	..	..
98·9	98·90	..	..	..	..	..	..	..	..	..
98·8	98·75	98·80	..	..	..	..	..	..	..	..
98·7	98·60	98·65	98·70	..	..	..	..	..	..	..
98·6	98·45	98·50	98·55	98·60	..	..	..	..	..	..
98·5	98·30	98·35	98·40	98·45	98·50	..	..	..	..	..
98·4	98·15	98·20	98·25	98·30	98·35	98·40	..	..	..	..
98·3	98·00	98·05	98·10	98·15	98·20	98·25	98·30	..	..	..
98·2	97·85	97·90	97·95	98·00	98·05	98·10	98·15	98·20	..	..
98·1	97·70	97·75	97·80	97·85	97·90	97·95	98·00	98·05	98·10	..
98·0	97·55	97·60	97·65	97·70	97·75	97·80	97·85	97·90	97·95	98·00
97·9	97·40	97·45	97·50	97·55	97·60	97·65	97·70	97·75	97·80	97·85
97·8	97·25	97·30	97·35	97·40	97·45	97·50	97·55	97·60	97·65	97·70
97·7	97·10	97·15	97·20	97·25	97·30	97·35	97·40	97·45	97·50	97·55
97·6	96·95	97·00	97·05	97·10	97·15	97·20	97·25	97·30	97·35	97·40
97·5	96·80	96·85	96·90	96·95	97·00	97·05	97·10	97·15	97·20	97·25
97·4	96·65	96·70	96·75	96·80	96·85	96·90	96·95	97·00	97·05	97·10
97·3	96·50	96·55	96·60	96·65	96·70	96·75	96·80	96·85	96·90	96·95
97·2	96·35	96·40	96·45	96·50	96·55	96·60	96·65	96·70	96·75	96·80
97·1	96·20	96·25	96·30	96·35	96·40	96·45	96·50	96·55	96·60	96·65
97·0	96·05	96·10	96·15	96·20	96·25	96·30	96·35	96·40	96·45	96·50
96·9	95·90	95·95	96·00	96·05	96·10	96·15	96·20	96·25	96·30	96·35
96·8	95·75	95·80	95·85	95·90	95·95	96·00	96·05	96·10	96·15	96·20
96·7	95·60	95·65	95·70	95·75	95·80	95·85	95·90	95·95	96·00	96·05
96·6	95·45	95·50	95·55	95·60	95·65	95·70	95·75	95·80	95·85	95·90
96·5	95·30	95·35	95·40	95·45	95·50	95·55	95·60	95·65	95·70	95·75
96·4	95·15	95·20	95·25	95·30	95·35	95·40	95·45	95·50	95·55	95·60
96·3	95·00	95·05	95·10	95·15	95·20	95·25	95·30	95·35	94·40	95·45
96·2	94·85	94·90	94·95	95·00	95·05	95·10	95·15	95·20	95·25	95·30
96·1	94·70	94·75	94·80	94·85	94·90	94·95	95·00	95·05	95·10	95·15
96·0	94·55	94·60	94·65	94·70	94·75	94·80	94·85	94·90	94·95	95·00

PART III.

STOCK-TAKING.

CALCULATED PERCENTAGES.

STOCK-TAKING.

At the end of the half-monthly or monthly period, at which time the work in the factory is usually interrupted for a while in order to give the machinery a general clean-up, and during which interval the cane carried into the factory yard will be crushed, it is a rule to take stock of the sugar still to be obtained from the syrups, massecuites, molasses, etc. This is done with a view to stating how much sugar will probably be forthcoming from the amount of cane worked up plus the portion already bagged, and to comparing that total with the figure for the calculated available sugar.

With this end in view, the total amounts of juice, syrup, massecuite, molasses, etc., still present in the sugar-house, are measured and their analysis recorded in the books. The total amount of solids in all the products is found by multiplying the weight of each of these products by their percentage of solids or their degrees Brix. The product is divided by 100 and the total amount of solids found by addition of all the items. In the same way, the total amount of sucrose or the polarization is ascertained, and, by subtraction of these two, also the amount of non-sugar.

We assume again that in the final molasses the relation between sucrose and non-sugar is as 1 : 2, equivalent to a purity of $33\frac{1}{3}$. The total amount of sucrose immobilized in the molasses is therefore equal to half that of the non-sugar. If therefore we subtract from the weight of the total sucrose half that of the non-sugar we find the amount of crystallizable sucrose present in the juices, etc., in the sugar-house.

If we want to know to how much raw sugar of 96° polarization and 1 per cent. moisture this figure corresponds, we find in the Table on page 68 that 94·50 parts of crystallized sucrose are equivalent to 100 parts of sugar of that description, so that the amount of raw sugar to be recovered from the stock in the sugar-house is found from the formula:

$$\text{Raw sugar in stock} = \frac{\text{Total sucrose} - \frac{1}{2}\text{ total non-sugar}}{94{\cdot}5} \times 100.$$

CALCULATED PERCENTAGES.

From the total figures we may calculate the percentages of the various materials of the different constituents.

Composition of the Cane.

Sugar cane is much too troublesome a material to be sampled and analysed directly. The sugar and fibre content of the individual stalks differ so widely that every effort to obtain a reliable sample of just a day's supply has failed, and we are compelled to find the composition of the cane indirectly.

This may be calculated in either of two ways, depending on whether the weight of the cane is ascertained in a direct manner by weighing or indirectly by calculation from analytical data. In the former case the weight of the cane is a known value, and as the weight of the raw juice and that of the maceration water are also known, that of the bagasse is very easily calculated.

Sucrose.—The total sucrose entering into the raw juice during the run, added to the total sucrose lost in bagasse during that period, together constitutes the total sucrose in the cane. By dividing that figure by the weight of the cane crushed, and multiplying by 100, the percentage of sucrose in the cane is found.

This calculation implies that no sucrose is lost unaccountably between the moment of milling and that of the measuring or weighing of the juice. This hypothesis is not improbable, since the time elapsing between these two stages is a very short one, and if good care is bestowed on the cleansing and disinfecting of gutters, stone-catchers, tanks, and pipes, there will not be any notable loss of sugar by inversion, fermentation, or souring. Further, the loss of sugar by the spilling of juice or by its leaking away is nowadays no longer likely, since the underground conduits of former times have been removed and all the juice is conducted through gutters and pipes above the floor level.

Fibre.—The total fibre in the bagasse obtained during the run is divided by the weight of the cane, and that quotient multiplied by 100 to find the fibre content of the cane.

This procedure implies that all the fibre of the cane is recovered in the bagasse, and that none of it passes away with the juice. We are justified in using this hypothesis also since the juice is strained through a series of sieves having gradually narrowing meshes, and the fibre collected thereon is sent back to the carrier. The small amount of "cush-cush" passing along with the juice is not worth mentioning, hence we may safely assume that all the fibre of the cane is found in the bagasse. The figures obtained by means of the actual weight of the cane crushed are quite reliable, and serve as a basis for the further control, but they are only to be collected at the end of a period of some duration. They fail, however, to give exact data for any short period, at the end of which uncrushed portions of the cane weighed are still lying in the factory yard. That is to say, one cannot in this manner possess quite reliable figures either as regards the weight of cane crushed in a single day or that of the bagasse obtained. In order to use figures which, even though not quite accurate, permit a review of the day's work, the daily figures are calculated indirectly, but are only intended to give an approximate insight into the daily work. They are intended for the daily reports, and are not to be carried over into the periodical surveys, where, as we mentioned before, the real figures obtained by actual weighing are to be recorded. The figures from the daily reports which have to go over in the periodical surveys must be corrected by using the actual weights at the end of the period, when all the cane weighed has actually been crushed, or at least when the small balance of still uncrushed cane has been taken into account.

Attempts have been repeatedly made to find a relation between the sucrose content of the cane and that of the juice, by which it would be feasible to find the former by multiplying the latter by a certain factor. If the cane consisted of one uniform juice and dry fibre, so that juice of the same constitution was expressed by the mill independent of the amount of pressure exercised, the matter would be easy enough. In that case the sucrose content of the juice has only to be multiplied by the factor $\frac{100 - \text{fibre}}{100}$ to find the sucrose content of the cane.

This is, however, not the case, for the cane consists of fibre having a water content of its own ; and, further, the juice is stored in a great many cells and bundles which have walls of unequal firmness and contain juices of an ever varying sucrose content. The softer cells give way more easily to pressure than do the harder ones, and so a juice of unequal constitution is squeezed out if the pressure changes. As the first juice is always richest, the sugar content of the cane would be found too high, if use was made of the factor $\frac{100 - \text{fibre}}{100}$ for multiplication by the excessive figure of the undiluted juice.

The mixed juice from the different mills, which might be considered as the real juice in the cane so far as it concerns us, is always diluted by the maceration water, and moreover its constitution changes with the degree of pressure, so that even if the calculations to work it out were not so tedious and inaccurate, this juice could not serve as a basis for our calculation.

Quite a number of factors have been suggested in the course of time, dependent on the fibre content and a certain allowance for sugar-free water which that constituent is considered to contain, but they are none of them accurate, and therefore it is better to take the simplest one, well convinced that its value is not absolute. The real sucrose content of the first mill juice during the former period is divided by the real sucrose content of the cane determined in the way mentioned on page 74, and the quotient obtained in this manner is used to multiply the figure for the sucrose content of the first mill juice during the days in the running period, to find approximately the sucrose content of the cane.

For the first period, in which there is no existing factor to guide us, one of 0·85 is used for soft and one of 0·80 for hard cane. The sucrose content to be used in the Daily Reports is therefore found by multiplying the average sucrose content of the first mill juice by a factor *f*, which is assumed for the first period and calculated from the real data for the following ones.

The fibre content of the cane cannot either be determined in a direct way, first because of the great difficulty in sampling such an unwieldy material as sugar cane; and in the second place because, if it were possible to sample the cane, this sample would consist of clean stalks without adhering leaf-sheaths or trash. The cane crushed contains much of that rubbish, and as these impurities have, as a rule, a much larger fibre content than the cane, even a small admixture of trash to the cane is apt to raise unduly the fibre content. The sample cane will therefore, being clean, produce a much smaller fibre content than that of the cane really crushed, and as the fibre content of the bagasse is reckoned to be exclusively derived from that of the cane, it is admissible only if the fibre content of the cane be that of this material in the same form as it is milled, i.e., together with the adhering trash.

It is therefore not allowable to state the fibre content of the clean cane and reckon it to be that of the dirty material, all the more as these admixtures have so great an influence on the results.

It has been suggested to state every day the percentage of dirt in a few cartloads of cane, to mix a sample of cane with trash in the same proportion as indicated, and to determine the fibre content in that mixture. The amount of trouble involved in having the exact tare stated, and the most difficult estimation of the fibre content, together with the difficulties encountered in preparing a good representative sample of the cane, explain why this method has never come in general use. And even if all that trouble were taken, the figure would only be used for the calculations of the Daily Report, and could not be made use of in periodical reviews. So the fibre of the cane is never determined in a direct manner, but only indirectly.

In the case of these periodical reviews, in which the weight of the cane crushed is known, the following method is resorted to:—

The weight of the cane is known, and also that of the raw juice and that of the maceration water. We assume that nothing is lost by spilling nor by evaporation, and calculate the weight of the bagasse by subtracting the weight of the raw juice from the sum of the weights of cane and maceration water.

We have already seen that the loss of juice or water by spilling, leaking, or overflowing might be neglected and, provided the maceration is performed with the aid of water at ordinary temperature, we may also neglect the loss by evaporation. When using hot water for maceration, as is the rule in many cases, the large surface of fibre offers so much opportunity for evaporation that the milling plant is often enveloped in a cloud of vapour, and in such a case there is a considerable loss of water, so that the weight of bagasse could not be calculated thus. Further, the amount of hot water used is difficult to measure by means of water meters, especially if the water stands at high pressure, as is the case when the boiler feed-pump is used also for the supply of maceration water.

That is why in many factories cold water is used for maceration, and is measured or weighed, so that the exact weight applied to the bagasse is perfectly well known every day and, if necessary, every hour. The loss of water by evaporation is, in such a case, so trifling that it may be entirely neglected.

We are able to find by the simple calculation mentioned above the weight of the bagasse; the fibre content is also known, and therefore the total weight of fibre in the bagasse for the run is found by multiplying that weight by the fibre percentage of the bagasse and dividing the product by 100.

The weight of cane is known, so that the percentage of fibre on 100 cane can easily be found.

In the case, however, of the Daily Reports, where the weight of the cane is not ascertained, a rather intricate means of calculating the fibre in cane is used, of which calculation the factors are:—

(1) The weight of sucrose (polarization) in the raw juice of the day;

(2) The weight of the maceration water applied;

(3) The factor by which to multiply the sucrose content of the first mill juice to find that of the cane;

(4) The sucrose content of the first mill juice; and

(5) The polarization of the bagasse.

All these figures are the values and averages of the day under consideration.

Here we base our calculations again on the three suppositions, viz., that no juice nor sucrose, nor maceration water, nor fibre have been lost unaccountably, and then put forward these formulæ:—

Weight of cane — weight of bagasse = weight of raw juice — weight of maceration water. (1)

$$\text{Weight of bagasse} = \text{weight of cane} \times \frac{\text{fibre on 100 cane}}{\text{fibre on 100 bagasse}}. \quad (2)$$

Weight of raw juice × sucrose on 100 raw juice + weight of bagasse × sucrose on 100 bagasse = weight of cane × sucrose on 100 cane. (3)

By substituting the value of the weight of bagasse of (2) and (1), we find:

$$\text{Weight of cane} - \text{weight of cane} \times \frac{\text{fibre cane}}{\text{fibre bagasse}} = \text{weight raw juice} - \text{weight maceration water; or}$$

$$\text{Weight of cane} = (\text{weight of raw juice} - \text{weight of maceration water}) \times \frac{\text{fibre bagasse}}{\text{fibre bagasse} - \text{fibre cane}}. \qquad (4)$$

Applying the same substitution of the value for the weight of the bagasse of (2) in (3), we find:

$$\text{Weight raw juice} \times \text{sucrose raw juice} + \text{weight cane} \times \frac{\text{fibre cane}}{\text{fibre bagasse}} \times \text{sucrose bagasse} = \text{weight cane} \times \text{sucrose cane}.$$

Now substitute the value for the weight of cane of (4) in this formula:

$$\text{Weight raw juice} \times \text{sucrose raw juice} + (\text{weight raw juice} - \text{weight maceration water}) \times \frac{\text{fibre bagasse}}{\text{fibre bagasse} - \text{fibre cane}} \times \text{sucrose bagasse} = (\text{weight raw juice} - \text{weight maceration water}) \times \frac{\text{fibre bagasse}}{\text{fibre bagasse} - \text{juice cane}} \times \text{sucrose cane}.$$

$$\text{Weight raw juice} \times \text{sucrose raw juice} (\text{fibre bagasse} - \text{fibre cane}) + (\text{weight raw juice} - \text{weight maceration water}) \times \text{fibre cane} \times \text{sucrose bagasse} = (\text{weight raw juice} - \text{weight maceration water}) \times \text{fibre bagasse} \times \text{sucrose cane}.$$

$$\text{Fibre cane} \{\text{weight raw juice} \times \text{sucrose raw juice} \times \text{fibre bagasse} - (\text{weight raw juice} - \text{weight maceration water}) \times \text{sucrose bagasse}\} = \text{weight raw juice} \times \text{sucrose raw juice} \times \text{fibre bagasse} - (\text{weight raw juice} - \text{weight maceration water}) \times \text{fibre bagasse} \times \text{sucrose cane}.$$

$$\text{Fibre cane} = \frac{\text{w. raw j.} \times \text{sucr. raw j.} - (\text{w. raw j.} - \text{w. mac. water}) \times}{\text{w. raw j.} \times \text{sucr. raw j,} - (\text{w. raw j.} - \text{w. mac. water}) \times} \frac{\text{sucrose cane}}{\text{sucrose bagasse}} \times \text{fibre bagasse}.$$

And as in the Daily Report, sucrose of cane is found by multiplying the sucrose in first mill juice by the factor, the fibre content of the cane finds ultimately its expression in the formula of which all the components are daily ascertained.

$$\text{Fibre cane} = \frac{\text{w. raw j.} \times \text{sucr. raw j.} - (\text{w. raw j.} - \text{w. mac. water}) \times}{\text{w. raw j.} \times \text{sucr. raw j.} - (\text{w. raw j.} - \text{w. mac. water}) \times} \frac{\text{factor} \times \text{sucrose first mill juice}}{\text{sucrose bagasse}} \times \text{fibre bagasse.}$$

Starting from the same hypothesis as before, we find the weight of the cane by the formula first formed :

$$\text{Weight of cane} = (\text{w. raw j.} - \text{w. mac. water}) \times \frac{\text{fibre bagasse}}{\text{fibre bagasse} - \text{fibre cane.}}$$

We saw that the value for the fibre of the cane was determined with the aid of the factor for the multiplication which is not accurate, and for this reason the weight of the cane crushed is also not quite true. The values derived therefrom are only admitted in the Daily Report and require correction before being allowed to be used for further reviews.

Bagasse.

The average figures for the polarization, fibre, and moisture of the bagasse are found by dividing the sum of the percentages of each of the constituents by the number of observations.

The total weight of sucrose and of fibre in the bagasse is found daily by multiplying the average percentage for the day by the weight of bagasse for that same day and dividing the product by 100. Since the weight for the bagasse in the Daily Report is the calculated one, and differs slightly from the actual weight which may only be found at the end of the period, the real figure for the total weight of sucrose in the bagasse obtained by addition of the daily values requires a correction. To this end, the sum of the daily quantities is multiplied by the total amount of weighed cane crushed, and divided by the total quantity of cane calculated for the run.

The percentage of fibre is found in the way mentioned on pages 5 and 18, from the average during the run for the dry substance and polarization of the bagasse and the average quotient of purity of the expressed juice.

The figure for sucrose lost in bagasse on 100 cane is found by dividing the total sucrose lost in bagasse by the weight of the cane and multiplying by 100.

Mill Juices.

The sum of the percentages of Brix degrees and polarization is divided by the number of observations, while the quotient of purity is calculated by dividing the figures for the polarization by the degrees Brix ascertained in this way, and multiplying the result by 100.

Raw Juice.

The figure showing the quantity of sucrose entered into the factory in the raw juice is ascertained with the greatest care every day, as it constitutes the basis of the whole chemical control both ways, up to the milling and down to the sugar-house work. It is found by multiplying the weight of the raw juice by the sucrose content and dividing the result by 100.

This same holds good too for the polarization and the Brix. The quotient of purity is calculated from the figures for the total sucrose or polarization, and the solids after the degrees Brix.

At the end of the run the quantities of sucrose, polarization, solids, and available sugar, calculated by one or other of the methods on page 57, for every day are added up, and the sum of the totals of each of the various constituents calculated to 100 parts of raw juice to find the average percentage, or calculated to 100 parts of cane to find the amount of them entered into the juice on 100 cane.

Clarified Juice.

The average constitution of the clarified juice is found with satisfactory accuracy by dividing the sum of the percentage of degrees Brix and sucrose by the number of observations, and calculating the average quotient of purity from these figures.

The total amount of available crystallizable sucrose in the clarified juice calculated daily is added for all the days of the run and divided by the weight of the cane. The quotient multiplied by 100 constitutes the calculated crystallizable sucrose in clarified juice on 100 parts of cane.

Filter-press Cake.

The daily figures for the percentages are obtained by addition of the percentages for every constituent, and by dividing that sum by the number of observations. By multiplying that average percentage by the weight of the cake and dividing by 100, the amount of dry substance and solids lost in filter-press cake during the day is found. The sum of these daily quantities constitutes their total loss during the run, which may be calculated to 100 parts of cane by dividing the total figure by the weight of the cane and multiplying by 100.

Syrup, Massecuites, and First Molasses.

The average constitution of all these materials may be found by the addition of the percentages of Brix and polarization for the various analyses and dividing the sum by the number of observations, while the quotient of purity is calculated from these results.

Sugar Delivered.

The total weight of solids, sucrose, polarization, net analysis, crystal, etc., of the total amount of sugar obtained during the run is found by multiplying these several values by the weight of the parcel of sugar to which they belong and finding the total by addition, after which that sum is divided by 100.

These quantities may be calculated to 100 parts of sugar, or to 100 parts of cane in the way already repeatedly indicated.

Final Molasses.

In this case again the total weights of solids, sucrose, polarization, etc., are found by multiplying the percentages of each constituent by the weight of that portion of molasses to which it belongs.

The quotient of purity is found from the figures for the degrees Brix and the polarization or from the sucrose figures.

These amounts are added and the percentages of the constituents are calculated back to 100 parts of final molasses or to 100 parts of cane after the manner already indicated.

PART IV.

VARIOUS CALCULATIONS.

FINAL ACCOUNT OF SUCROSE EXTRACTED AND LOST.

NATIVE ASSISTANCE.

VARIOUS CALCULATIONS.

Milling Figures.

Percentage of Sucrose Extracted in Juice on 100 Sucrose in Cane.—The figure for the sucrose in the raw juice on 100 parts of cane is divided by that of the sucrose in 100 cane and multiplied by 100.

Extraction.—By *Extraction* we understand the amount of cane juice calculated in an undiluted state extracted on 100 parts of cane.

This figure is strongly influenced by the fibre content of the cane in a two-fold degree, both effects being in the same direction. To begin with, a high fibre content means a low juice content, and, further, a high fibre content implies a large amount of bagasse and a considerable loss of juice therein.

A second difficulty in the mutual comparison of the figures for extraction is that the quality of the juice, expressed by the mills without dilution, is greatly dependent on the pressure of the mill, so that with a heavy pressure, juice of an inferior quality is expressed than with a light one.

In former years the term NORMAL JUICE was used, thereby meaning a hypothetical juice having the density of the first mill juice and the quotient of the purity of the raw juice. The sucrose content of that juice could be easily found, and for a long while it was assumed that the juice in the cane had the constitution of that normal juice.

Great difficulties arose however, because when crushers came into use nobody knew if the undiluted juice was the juice expressed by the crusher, or by the first mill or the mixture of both, every one of them having a separate constitution and giving different figures for extraction in case either of them was used as a basis. Further, the quotient of purity of the raw juice differs also if the total pressure increases, so that the sucrose content of the normal juice was dependent to some extent on the pressure of the milling plant.

So the expression NORMAL JUICE was abandoned and that of CANE JUICE was adopted instead.

Under CANE JUICE, we no longer imply the juice expressed by one mill or by all of them, but the juice actually present in the cane and which is represented by the undiluted juice supposed to be in the raw juice and the residual juice supposed to be in an undiluted state in the bagasse. As both of these constituents, in practical working, are diluted with the maceration water, they cannot be ascertained by a direct determination, but have to be calculated in an indirect manner. We cannot suppose the cane to consist of anhydrous fibre imbibed with a juice of uniform constitution; we must take into consideration the circumstance that the cane is a living organism, containing a multitude of juices of varying constitution, while the fibre itself contains a sugar-free juice of its own. During the milling process all these juices are rubbed together, and will certainly become mixed to some extent with the constitution water of the fibre, so that we can never tell for certain how the state of affairs has been in the original cane at the moment of its being milled.

This is not necessary in our case, as we only want to know the quantity of water free from sucrose still present in the bagasse at the moment when it leaves the milling plant, and to calculate that on 100 parts of dry fibre. This same proportion of sugar-free water and fibre is reckoned to exist also in the cane, and in this way we are able to find how much fibre with its natural water content is presumably present in the cane, while the balance from 100 is represented by the real cane juice.

The first thing to be done is to determine the amount of the constitution water of the fibre.

Representing this amount on 100 parts of dry fibre by w, the amount of that water on 100 parts of bagasse is $\frac{\text{fibre in bagasse}}{100} \times w$, leaving for the residual juice:

$$100 - \text{fibre in bagasse} - \frac{\text{fibre in bagasse}}{100} \times w.$$

The sucrose content of the residual juice is known, and as the amount of residual juice on 100 bagasse is expressed by the formula above, we may express the sucrose content of the bagasse by the following formula:

$$\left(100 - \text{fibre in bagasse} - \frac{\text{fibre in bagasse}}{100} \times w\right) \times \frac{\text{sucr. residual juice}}{100}.$$

The sucrose content of the bagasse is also known by direct analysis, so that we get this equation:

$$\left(100 - \text{fibre in bag.} - \frac{\text{fibre in bag.}}{100} \times w\right) \times \frac{\text{sucr. residual juice}}{100} = \text{sucr. bagasse},$$

from which

$$w = 100\ \frac{(100 - \text{fibre in bagasse}) \times \text{sucr. residual juice} - 100 \text{ sucr. bagasse}}{\text{fibre in bagasse} \times \text{sucrose residual juice.}}.$$

Weight of Cane Juice on 100 Parts of Cane.—On 100 parts of dry fibre we have found w parts of constitution water, or when expressing the fibre content of the cane on f parts of fibre, $f \times \frac{w}{100}$, owing to which the percentage of dry fibre in the cane, f, becomes $\frac{w + 100}{100} \times f$ as the expression of the real fibre with its normal water content in the cane.

The amount of cane juice on 100 parts of cane is therefore $100 - \frac{w + 100}{100} \times f$, and the total amount of cane juice during the period under review is found by multiplying the weight of cane crushed by the percentage just found and dividing by 100.

Constitution of the Cane Juice.

Sucrose.—The sucrose in the cane juice consists of both the sucrose in the raw juice and that in the residual juice. We know how much sucrose has been extracted in the raw juice during the period under consideration, and also how much sucrose has been lost in the bagasse during that period. By addition of these two values, we find the total amount of sucrose entering by the cane into the factory, and as we know the total amount of cane juice in that period, we can easily calculate the sucrose content of the juice present in the cane.

Degrees Brix.—The solids (degrees Brix) in the soluble part of the cane are composed of those of the raw juice plus those of the residual juice. We know how much solids have been extracted in the raw juice during the period under review, and we know also how much sucrose has been lost in the bagasse in that time. Further, the quotient of purity of the residual juice, in which that latter portion of sucrose is dissolved, is likewise known, so that the total amount of solids in the residual juice is easily calculated. Adding the weight of solids in the raw juice to that of those present in the residual juice, we find the total amount of solids in the total cane juice, and as the weight of that juice is known, the percentage of solids is easily calculated.

Quotient of Purity.—The quotient of purity of the cane juice is calculated from the figures of the degrees Brix and the sucrose content.

Calculation of the Extraction.

The percentage of sucrose extracted in raw juice on 100 cane is known, and also that of the percentage of sucrose in the cane juice, so that we can ascertain to how many parts of that cane juice the sucrose extracted in raw juice on 100 cane is equivalent.

$$\text{Extraction} = \frac{\text{sucrose extracted in juice on 100 cane}}{\text{sucrose on 100 cane juice}} \times 100.$$

Maceration Figures.

The total percentage of maceration water applied on 100 parts of cane is found by dividing the total weight of maceration water used during the run by the weight of cane crushed and multiplying the quotient by 100.

The quantity of maceration water in the raw juice is found by comparison of the degrees Brix of the raw juice with that of the cane juice. The difference between these two is only due to the maceration water, and therefore the solids in the raw juice come exclusively from the cane juice. Now we must calculate how many parts of raw juice of a given Brix are required to contain as much solids as 100 parts of cane juice of a certain Brix degree.

Brix.—Suppose the quantity of maceration water in the juice on 100 parts of cane juice to be x, the Brix of the cane juice to be B, and that of the raw juice to be B_1, then

$$100\,B = (100 + x)\,B_1$$

$$x = 100\,\frac{B - B_1}{B_1}.$$

FINAL ACCOUNT OF SUCROSE EXTRACTED AND LOST.

At the conclusion of the grinding season, and also occasionally after a stoppage which allows the stock of cane to be worked off, the final account can be made of the profit and loss of the sucrose from the cane. The total weights of sucrose in cane, in bagasse, in raw juice, in filter-press cake, in molasses, and in the products, are all entered in the form as given on page 137.

By multiplying by 100, and dividing by the weight of the cane crushed, these are calculated on 100 parts of cane, and finally the remaining blanks may be filled in for the different products.

The figure for "Unaccounted for" is found by subtracting the determined losses from the total loss.

Finally, calculate all weights by multiplying by 100 and dividing the figure for sucrose indicated in the cane into the value for the sucrose lost and gained on 100 parts of sugar in the cane, and placing the results in the proper column.

In case the unaccountable losses are too great to be neglected, a record is made in the same way for the solids in order to obtain a good insight into the character of the loss. Chemical losses, occasioned by inversion, souring, superheating, etc., are found in the sucrose account, but not in that of the solids; while mechanical losses, such as spilling, boiling over, etc., are also recorded in both sucrose and solids accounts.

NATIVE ASSISTANCE.

The exact execution of the analyses and calculations enumerated in the foregoing pages requires the assistance of a well trained staff of native helpers.

Two shifts, each consisting of:—One assistant analysing the bagasse; one assistant analysing the juices; and one analysing the samples of sugar, massecuites, molasses, etc.; with boys for chopping up bagasse samples, cleaning the glass ware, etc., should prove sufficient for the work day and night.

Further, a seventh assistant is employed working only during the day-time to examine the field and factory samples of the cane, and the fibre contents of the bagasse, and to enter the data in the books.

The execution of the analyses and determinations in this treatise has been rendered so simple that the European chemist need not occupy himself with them and need only exercise a general supervision of the work of the native assistants.

An important factor is the strict rule that the juices in which the degrees Brix have been determined and the tubes which have served for the polarizations remain untouched for a certain time, in order to enable the chemist to verify at any unexpected moment the results entered in the books by his own observation of the same sample.

Only the most important determinations, such as the analysis of the sugar delivered, etc., need be entrusted to the personal care of the European chemist instead of to his native assistants.

PART V.

FACTORY AND LABORATORY INSTRUMENTS.

VERIFICATION OF WEIGHBRIDGES, MEASURING TANKS, AND INSTRUMENTS.

Weighbridges.

Every factory ought to be in possession of a set of well-controlled weights running from 1 to 100 lbs.

A lot of old iron, such as rails, wheels, etc., should be carefully weighed on a sensitive scale with the aid of these weights, and the weight of each piece be recorded.

These pieces of iron can then be placed on the weighbridges to make up a weight equivalent to that which is placed on the bridge in practical working, and the apparatus is, if necessary, adjusted so as to show the real weight.

Measuring Tanks.

The measuring tanks may be verified in three ways, viz. :—

1. By measuring the quantity of water which fills the tank by means of a 50-gallon measure ;

2. By weighing the quantity of water which fills the tank ; or

3. By weighing the quantity of water which flows out from the filled tank.

If local circumstances allow, the last-mentioned method is to be preferred, because it is just in accordance with what happens in practical working.

The execution of the method is as follows :—The measuring tank is filled with water, which is left standing therein for some minutes, in order to let the air bubbles escape. Next it is carefully filled with water till the contents overflow. Finally, a tank with outflow at the bottom, provided with a cock, is placed on a sensitive scale under the outflow of the measuring tank. The tank is tared, then filled with water from the measuring tank, weighed again, and the operation is repeated till the measuring tank is empty. The sum of the quantities of water weighed constitutes the weight of the contents of the measuring tank expressed in water of the temperature which is ascertained.

This weight is calculated to a volume in litres by multiplying with the following factors for the different temperatures coming into account.

Temp.		Factor.	Temp.		Factor.
25° C.	....	1·0016	29° C.	....	1·0027
26° C.	....	1·0019	30° C.	....	1·0030
27° C.	....	1·0021	31° C.	....	1·0033
28° C.	....	1·0024			

Where the local situation forbids the weighing of the juice under the outflow of the measuring tank, the water may be weighed before filling it.

To this end the measuring tank is first filled with water and then emptied, in order to have its surfaces moistened just as under the conditions of actual working. A tank on an accurate scale is placed over the measuring tank, filled with water, weighed, emptied into the measuring tank and weighed empty again, so as to ascertain the actual weight of water poured into the measuring tank. This is continued till the tank is almost full, and finally water from the weighed tank is let off into a large beaker with which the measuring tank is filled to the mark. The rest of the water in the beaker is poured back into the weighed tank and the last tare is weighed. The total weight in kg. or lbs. is known, and is transposed into litres or gallons, as described above.

Measuring Flasks for Polarizations.

The generally-used Schmidt and Haensch polariscopes are so constructed that they show the 100 point when 26·048 grms. of dry and perfectly pure sucrose, weighed in the air with brass weights and dissolved at 17·5° C in water to a volume of 100 Mohr c.c., are polarized at that same temperature in a 200 mm. tube.

The flasks used for dissolving sugar solutions for the polariscopic test must therefore be verified and graduated at the temperature of 17·5° C and must be based on the specific gravity of pure water of 17·5° C = 1, as the Mohr c.c. means the volume of 1 grm. of water at 17·5° C weighed in the air with brass weights.

When verifying a 100 c.c. flask we therefore weigh in the dry flask in the air with brass weights at the temperature of 17·5° C exactly 100 grms. of water of that temperature, and mark on the neck the place where the level of that water stands.

As, however, the temperature in the tropics renders this operation at 17·5° C impossible, or at least troublesome, a table of the weights of water of different temperatures, also weighed in the air with brass weights, is given below in order to allow the verification of the flasks at temperatures deviating from 17·5° C.

Temperature in °C.		Weight of 50 c.c. after Mohr: 17° C. = 1.		Weight of 100 c.c. after Mohr: 17° C. = 1.
25	....	49·916	....	99·833
25·5	....	49·910	....	99·820
26	....	49·903	....	99·807
26·5	....	49·896	....	99·793
27	....	49·890	....	99·780
27·5	....	49·883	....	99·767
28	....	49·877	....	99·754
28·5	....	49·870	....	99·740
29	....	49·863	....	99·727
29·5	....	49·857	....	99·714
30	....	49·850	....	99·701

Of late years the real c.c. has been adopted again for the measuring flasks. It contains 1 grm. of water at 4° C weighed *in vacuo* and is thus smaller than the Mohr c.c.

The standard weight of sucrose for such flasks is accordingly smaller, and amounts to 26·0 grms. of pure and dried sucrose weighed in the air with brass weights.

The weight of water at different temperatures of 50 and 100 real c.c. is given in the table underneath :

Temperature in °C.		Weight of 50 real c.c. 4° C. = 1.		Weight of 100 real c.c. 4° C. = 1.
25	....	49·802	....	99·604
25·5	....	49·796	....	99·591
26	....	49·789	....	99·578
26·5	....	49·783	....	99·565
27	....	49·776	....	99·551
27·5	....	49·769	....	99·537
28	....	49·762	....	99·523
28·5	....	49·754	....	99·509
29	....	49·747	....	99·494
29·5	....	49·740	....	99·480
30	....	49·733	....	99·465

Flasks of 50/55 and 100/110 used for juice after addition of basic lead acetate need not exactly contain 50 or 100 c.c.; the only thing required is that the volume between the two marks be exactly one-tenth of the volume under the lowest mark.

Pipettes.

The best are those with two marks, and they are verified by the direct weighing of their contents between the two marks.

For pipettes of 100 and 50 c.c., a difference of 0·1 per cent. is tolerated; for smaller ones, one of 0·25 per cent.

Brix Hydrometers.

Brix hydrometers are based on the specific gravity of water at 17·5° C. Every factory should be equipped with one set of well-controlled hydrometers used as standards only, in order to verify those in practical use in the laboratory. If, perchance, hydrometers of 17·5° C are not at hand, those of another standard temperature may equally be used, provided a correction be applied.

Suppose we test a sample of juice with two hydrometers *A* and *B*, of which *A* is based on the temperature 17·5° C and *B* on that of 27·5° C. The temperature of the juice is supposed to be 30° C, then if the reading on *A* is 14·52°, the real Brix is 14·62° + 0·87° = 15·49° and *B* will show 15·3° or a real Brix of 15·3° + 0·19° = 15·49° or the same figure. Both hydrometers give after their proper correction is applied the same Brix, which only in this case is equivalent to the percentage of dry substance and may be used for the calculation of the quotient of purity.

Polariscopes.

The polariscope should be verified daily with the tube filled with water and with the control quartz plates, which latter ought to be submitted every four or five years to a technical institute for examination.

INSTRUMENTS AND UTENSILS REQUIRED FOR THE EXECUTION OF THE ANALYSES MENTIONED IN THIS TREATISE.

A laboratory 3-roller test-mill of strong construction.

A bagasse-chopping machine.

Sieves of different mesh, for sieving the bagasse.

A strong hand press, for expressing the residual juice.

A polariscope with single quartz-edge compensation for tubes up to 400 mm. with a scale of — 20° to 100° Ventzke.

A polariscope lamp for electric or gas light, kerosene oil, or spirit.

Quartz control plates of about — 10°, + 50°, and + 85° Ventzke.

Observation tubes for the polariscope of 100, 200, and 400 mm., with a good supply of rubber ringlets and glass cover circles.

Water-jacketed observation tubes of 200 mm.

A thermometer between 15° and 35° C divided into tenths of a degree.

A water-bath of large dimensions.

A hot-air bath, heated by a lamp or by steam, for drying various products at temperatures up to 110° C.

Tared shallow dishes for the determination of moisture in bagasse and filter-press cake.

German silver dishes with lids for the determination of moisture in juices, syrups, etc.

Watch glasses for drying sugar, in pairs, with clamps.

Pycnometers.

Brix hydrometers with cylinders to sink them in, tested at 17·5° C, provided with a thermometer of 0—11°, 10—21°, 20—30°, 40—60° Brix.

A refractometer with thermometer.

Copper or tin cylinders with sieves and discharge tube.

An analytical balance with 200 grms. capacity on either side.

A technical balance, capacity 500 grms. on either side.

A laboratory scale, capacity 5 kg. on either side.

A laboratory scale, capacity 50 kg.

Sets of weights for the different scales and balances.

Normal Weights of 0·5, 1 and 2 times the Normal Weight.

A double cooker for bagasse investigation.

Brass or tin cookers for sucrose estimation in bagasse.

Weighing dishes for sugar with their tare.

A German silver funnel.

Volumetric flasks of 50, 50/55, 100, 100/110, 250, 500, and 1000 c.c. tested at 17·5° C.

Measures of 10, 25, 50, 100, 500, and 1000 c.c., subdivided into parts, tested at 17·5° C.

Pipettes.

Burettes.

A platinum dish or crucible.

Quartz crucibles.

Water-air pump, with filtering bottle, and a few yards of thick rubber tube, with the necessary asbestos filtering tubes.

Funnels.

Filtering cylinders.

Further, a well-equipped laboratory should possess :—

A set of bottles for test solutions with enamelled labels, wood supports for test tubes and pipettes, dropping bottles, washing flasks, clamps, tweezers, spatulae and spoons, files, cork borers, cork squeezers, scissors, test tubes, flasks, beakers, crucibles, stirring rods, saucers, coolers, rubber tubes and stoppers of different sizes, lamps, tripods, copper wire gauze, asbestos plates with and without aperture, clay triangles, crucible tongs, test-tube holders, mortars, weighing flasks, iron supports with their clamps and rings, filter supports, etc., etc., and a well assorted stock of chemicals.

PART VI.

TABLES.

TABLE FOR FINDING THE SUCROSE CONTENT OF JUICES, CLARIFIED WITH THE ORIGINAL JUICE, AND THE READINGS IN A SCHMIDT AND

Degrees Brix from 0·5 to 12·0.		Readings on the Polari-scope.	DEGREES BRIX AND								
Degrees.	Per cent. Sucrose.		0·5 1·0019	1·0 1·0039	1·5 1·0058	2·0 1·0078	2·5 1·0098	3·0 1·0117	3·5 1·0137	4·0 1·0157	4·5 1·0177
0·1°	0·03	1°	0·29	0·29	0·29	0·28	0·28	0·28	0·28	0·28	0·28
0·2	0·06	2		0·57	0·57	0·57	0·57	0·56	0·56	0·56	0·56
0·3	0·08	3		0·85	0·85	0·85	0·85	0·85	0·85	0 84	0·84
0·4	0·11	4			1·14	1·13	1·13	1·13	1 13	1·13	1·12
0·5	0·14	5			1·42	1·42	1·41	1·41	1·41	1·41	1·40
0·6	0·17	6				1·70	1·70	1·69	1·69	1·69	1·68
0·7	0·19	7				1·98	1·98	1·98	1·97	1·97	1·96
0·8	0·22	8					2·26	2 26	2·26	2·25	2·25
0·9	0·25	9						2·54	2·54	2·53	2·53
		10						2·82	2·82	2·81	2·81
		11							3·10	3·09	3·09
		12							3·38	3·38	3·37
		13								3·66	3·65
		14								3·94	3·93
		15									4·21
		16									4·49
		17									
		18									
		19									
		20									
		21									
		22									
		23									
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		31									
		32									
		33									
		34									
		35									
		36									
		37									
		38									
		39									

10 per cent. of Basic Lead Acetate, from the Specific Gravity of Haensch Polariscope, when observed in a 200 mm. Tube.

Corresponding Specific Gravity.											Readings on the Polariscope.
5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10·0	
1·0197	1·0217	1·0237	1·0258	1·0278	1·0298	1·0319	1·0339	1·0360	1·0381	1·0401	
0·28	0·28	0·28	0·28	0·28	0·28	0·28	0·28	0·28	0·28	0·28	1°
0·56	0·56	0·56	0·56	0·56	0·55	0·55	0·55	0·55	0·55	0·55	2
0·84	0·84	0·84	0·84	0·83	0·83	0·83	0·83	0·83	0·83	0·83	3
1·12	1·12	1·12	1·11	1·11	1·11	1·11	1·11	1·10	1·10	1·10	4
1·40	1·40	1·40	1·39	1·39	1·39	1·38	1·38	1·38	1·38	1·37	5
1·68	1·68	1·67	1·67	1·67	1·66	1·66	1·66	1·66	1·65	1·65	6
1·96	1·96	1·95	1·95	1·95	1·94	1·94	1·93	1·93	1·93	1·92	7
2·24	2·24	2·23	2·23	2·22	2·22	2·22	2·21	2·21	2·20	2·20	8
2·52	2·52	2·51	2·51	2·50	2·50	2·49	2·49	2·48	2·48	2·47	9
2·80	2·80	2·79	2·79	2·78	2·78	2·77	2·76	2·76	2·75	2·75	10
3·08	3·08	3·07	3·06	3·06	3·05	3·05	3·04	3·03	3·03	3·02	11
3·36	3·36	3·35	3·34	3·34	3·33	3·32	3·32	3·31	3·30	3·30	12
3·64	3·64	3·63	3·62	3·61	3·61	3·60	3·59	3·59	3·58	3·57	13
3·92	3·92	3·91	3·90	3·89	3·88	3·88	3·87	3·86	3·85	3·85	14
4·20	4·19	4·19	4·18	4·17	4·16	4·15	4·15	4·14	4·13	4·12	15
4·48	4·47	4·47	4·46	4·45	4·44	4·43	4·42	4·41	4·40	4·40	16
4·77	4·76	4·75	4·74	4·73	4·72	4·71	4·70	4·69	4·68	4·67	17
	5·03	5·02	5·01	5·00	4·99	4·99	4·97	4·97	4·96	4·95	18
	5·32	5·31	5·29	5·28	5·27	5·26	5·25	5·24	5·23	5·22	19
		5·58	5·57	5·56	5·55	5·54	5·53	5·52	5·51	5·50	20
		5·86	5·85	5·84	5·83	5·82	5·81	5.79	5·78	5·77	21
			6·13	6·12	6·11	6·09	6·08	6·07	6·06	6·05	22
			6·41	6·40	6·38	6·37	6·36	6·35	6·33	6·32	23
				6·67	6·66	6·65	6·64	6·62	6·61	6·60	24
					6·94	6·93	6·91	6·90	6·89	6·87	25
					7·22	7·20	7·19	7·17	7·16	7·15	26
						7·48	7·46	7·45	7·44	7·42	27
						7·76	7·74	7·73	7·71	7·70	28
							8·02	8·00	7·99	7·97	29
								8·28	8·26	8·25	30
								8·55	8·54	8·52	31
								8·83	8·81	8·80	32
									9·09	9·07	33
										9·35	34
										9·62	35
											36
											37
											38
											39

TABLE FOR FINDING THE SUCROSE CONTENT OF JUICES, CLARIFIED WITH THE ORIGINAL JUICE, AND THE READINGS IN A SCHMIDT AND

Readings on the Polariscope.	DEGREES BRIX AND										
	10·5	11·0	11·5	12·0	12·5	13·0	13·5	14·0	14·5	15·0	15·5
	1·0422	1·0443	1·0464	1·0485	1·0506	1·0528	1·0549	1·0570	1·0592	1·0613	1·0635
1°	0·28	0·27	0·27	0·27	0·27	0·27	0·27	0·27	0·27	0·27	0·27
2	0·55	0·55	0·55	0·55	0·54	0·54	0·54	0·54	0·54	0·54	0·54
3	0·82	0·82	0·82	0·82	0·82	0·81	0·81	0·81	0·81	0·81	0·81
4	1·10	1·10	1·09	1·09	1·09	1·09	1·09	1·08	1·08	1·08	1·08
5	1·37	1·37	1·36	1·36	1·36	1·36	1·35	1·35	1·35	1·35	1·34
6	1·64	1·64	1·64	1·64	1·63	1·63	1·62	1·62	1·62	1·62	1·61
7	1·92	1·91	1·91	1·91	1·90	1·90	1·89	1·89	1·89	1·88	1·88
8	2·19	2·19	2·18	2·18	2·18	2·17	2·17	2·16	2·16	2·15	2·15
9	2·47	2·46	2·46	2·45	2·45	2·44	2·44	2·43	2·43	2·42	2·42
10	2·74	2·74	2·73	2·73	2·72	2·71	2·71	2·70	2·70	2·69	2·68
11	3·02	3·01	3·00	3·00	2·99	2·99	2·98	2·97	2·97	2·96	2·95
12	3·29	3·28	3·28	3·27	3·26	3·26	3·25	3·24	3·24	3·23	3·22
13	3·56	3·56	3·55	3·54	3·54	3·53	3·52	3·51	3·51	3·50	3·49
14	3·84	3·83	3·82	3·82	3·81	3·80	3·79	3·78	3·78	3·77	3·76
15	4·11	4·11	4·10	4·09	4·08	4·07	4·06	4·06	4·05	4·04	4·03
16	4·39	4·38	4·37	4·36	4·35	4·34	4·33	4·33	4·32	4·31	4·30
17	4·66	4·65	4·64	4·63	4·62	4·62	4·61	4·60	4·59	4·58	4·57
18	4·93	4·93	4·91	4·91	4·90	4·89	4·88	4·87	4·86	4·85	4·84
19	5·21	5·20	5·19	5·18	5·17	5·16	5·15	5·14	5·13	5·12	5·11
20	5·49	5·47	5·46	5·45	5·44	5·43	5·42	5·41	5·40	5·39	5·38
21	5·76	5·75	5·74	5·73	5·71	5·70	5·69	5·68	5·67	5·66	5·65
22	6·03	6·02	6·01	6·00	5·99	5·97	5·96	5·95	5·94	5·93	5·91
23	6·31	6·30	6·28	6·27	6·26	6·24	6·23	6·22	6·21	6·20	6·18
24	6·58	6·57	6·56	6·54	6·53	6·52	6·50	6·49	6·48	6·46	6·45
25	6·86	6·84	6·83	6·82	6·80	6·79	6·78	6·76	6·75	6·73	6·72
26	7·13	7·12	7·10	7·09	7·07	7·06	7·05	7·03	7·02	7·00	6·99
27	7·41	7·39	7·38	7·36	7·35	7 33	7·32	7·30	7·29	7·27	7·26
28	7·68	7·66	7·65	7·63	7·62	7·60	7·59	7·57	7·56	7·54	7·53
29	7·96	7·94	7·92	7·91	7·89	7·87	7·86	7·84	7·83	7·81	7·80
30	8·23	8·21	8·20	8·18	8·16	8·15	8·13	8·11	8·10	8·08	8·06
31	8·50	8·49	8·47	8·45	8·44	8·42	8·40	8·39	8·37	8·35	8·33
32	8·78	8·76	8·74	8·73	8·71	8·69	8·67	8·66	8·64	8·62	8·60
33	9·05	9·03	9·02	9·00	8·98	8·96	8·94	8·93	8·91	8·89	8·87
34	9·33	9·31	9·29	9·27	9·25	9·23	9·22	9·20	9·18	9·16	9·14
35	9·60	9·58	9·56	9·54	9·53	9·51	9·49	9·47	9·45	9·43	9·41
36	9·88	9·86	9·84	9·82	9·80	9·78	9·76	9·74	9·72	9·70	9·68
37	10·15	10·13	10·11	10·09	10·07	10·05	10·03	10·01	9·99	9·97	9·95
38		10·40	10·38	10·36	10·34	10·32	10·30	10·28	10·26	10·24	10·22
39		10·68	10·66	10·64	10·61	10·59	10·57	10·55	10·53	10·51	10·49

10 per cent. of Basic Lead Acetate, from the Specific Gravity of Haensch Polariscope, when observed in a 200 mm. Tube.

Corresponding Specific Gravity.									Readings on the Polari-scope.	Degrees Brix from 0·5 to 12.	
16·0 1·0657	16·5 1·0678	17·0 1·0700	17·5 1·0722	18·0 1·0744	18·5 1·0766	19·0 1·0788	19·5 1·0811	20·0 1·0833		Degrees.	Per cent. Sucrose.
0·27	0·27	0·27	0·27	0·27	0·27	0·27	0·27	0·26	1°	0·1°	0·03
0·54	0·54	0·53	0·53	0·53	0·53	0·53	0·53	0·53	2	0·2	0·06
0·80	0·80	0·80	0·80	0·80	0·80	0·79	0·79	0·79	3	0·3	0·08
1·07	1·07	1·07	1·07	1·06	1·06	1·06	1·06	1·06	4	0·4	0·11
1·34	1·34	1·34	1·33	1·33	1·33	1·32	1·32	1·32	5	0·5	0·14
1·61	1·61	1·60	1·60	1·60	1·59	1·59	1·59	1·58	6	0·6	0·17
1·88	1·87	1·87	1·86	1·86	1·86	1·85	1·85	1·85	7	0·7	0·19
2·15	2·14	2·14	2·13	2·13	2·12	2·12	2·12	2·11	8	0·8	0·22
2·41	2·41	2·40	2·40	2·39	2·39	2·38	2·38	2·37	9	0·9	0·25
2·68	2·68	2·67	2·67	2·66	2·65	2·65	2·64	2·64	10		
2·95	2·94	2·94	2·93	2·92	2·92	2·91	2·91	2·90	11		
3·22	3·21	3·20	3·20	3·19	3·18	3·18	3·17	3·17	12		
3·49	3·48	3·47	3·46	3·46	3·45	3·44	3·44	3·43	13		
3·75	3·75	3·74	3·73	3·72	3·72	3·71	3·70	3·69	14		
4·02	4·02	4·01	4·00	3·99	3·98	3·97	3·97	3·96	15		
4·29	4·28	4·27	4·26	4·26	4·25	4·24	4·23	4·22	16		
4·56	4·55	4·54	4·53	4·52	4·51	4·50	4·49	4·48	17		
4·83	4·82	4·81	4·80	4·79	4·78	4·77	4·76	4·75	18		
5·10	5·09	5·08	5·06	5·05	5·04	5·03	5·02	5·01	19		
5·36	5·35	5·34	5·33	5·32	5·31	5·30	5·29	5·28	20		
5·63	5·62	5·61	5·60	5·59	5·58	5·56	5·55	5·54	21		
5·90	5·89	5·88	5·87	5·85	5·84	5·83	5·82	5·80	22		
6·17	6·16	6·14	6·13	6·12	6·11	6·09	6·08	6·07	23		
6·44	6·43	6·41	6·40	6·39	6·37	6·36	6·35	6·33	24		
6·71	6·69	6·68	6·67	6·65	6·64	6·63	6·61	6·60	25		
6·97	6·96	6·95	6·93	6·92	6·90	6·89	6·88	6·86	26		
7·24	7·23	7·21	7·20	7·18	7·17	7·15	7·14	7·13	27		
7·51	7·50	7·48	7·47	7·45	7·44	7·42	7·40	7·39	28		
7·78	7·77	7·75	7·73	7·72	7·70	7·68	7·67	7·65	29		
8·05	8·03	8·02	8·00	7·98	7·97	7·95	7·93	7·92	30		
8·32	8·30	8·28	8·27	8·25	8·23	8·21	8·20	8·18	31		
8·58	8·57	8·55	8·53	8·51	8·50	8·48	8·46	8·45	32		
8·85	8·84	8·82	8·80	8·78	8·76	8·75	8·73	8·71	33		
9·12	9·10	9·09	9·07	9·05	9·03	9·01	8·99	8·97	34		
9·39	9·37	9·35	9·34	9·31	9·30	9·28	9·26	9·24	35		
9·66	9·64	9·62	9·60	9·58	9·56	9·54	9·52	9·50	36		
9·93	9·91	9·89	9·87	9·85	9·83	9·81	9·79	9·77	37		
10·20	10·18	10·15	10·13	10·11	10·09	10·07	10·05	10·03	38		
10·46	10·44	10·42	10·40	10·38	10·36	10·34	10·32	10·29	39		

Degrees Brix from 12·5 to 20.	
Degrees.	Per cent. Sucrose.
0·1°	0·03
0·2	0·05
0·3	0·08
0·4	0·11
0·5	0·13
0·6	0·16
0·7	0·18
0·8	0·21
0·9	0·23

TABLE FOR FINDING THE SUCROSE CONTENT OF JUICES, CLARIFIED WITH THE ORIGINAL JUICE, AND THE READINGS IN A SCHMIDT AND

Degrees Brix from 11·5 to 22·5. Degrees.	Per cent. Sucrose.	Readings on the Polariscope.	DEGREES BRIX AND 11·5 1·0464	12·0 1·0485	12·5 1·0506	13·0 1·0528	13·5 1·0549	14·0 1·0570
		40°	10·93	10·91	10·89	10·86	10·84	10·82
0·1°	0·03	41		11·18	11·16	11·14	11·12	11·09
0·2	0·05	42		11·46	11·43	11·41	11·39	11·36
0·3	0·08	43			11·71	11·68	11·66	11·64
0·4	0·11	44			11·98	11·95	11·93	11·91
0·5	0·13	45			12·25	12·23	12·20	12·18
0·6	0·16	46				12·50	12·47	12·45
0·7	0·19	47					12·74	12·72
0·8	0·21	48					13·02	12·99
0·9	0·24	49						13·26
		50						
		51						
		52						
		53						
		54						
		55						
		56						
		57						
		58						
		59						
		60						
		61						
		62						
		63						
		64						
		65						
		66						
		67						
		68						
		69						
		70						
		71						
		72						
		73						
		74						
		75						
		76						
		77						
		78						
		79						
		80						

10 per cent. of Basic Lead Acetate, from the Specific Gravity of Haensch Polariscope, when observed in a 200 mm. Tube.

Corresponding Specific Gravity.							Readings on the Polariscope.
14·5 1·0592	15·0 1·0613	15·5 1·0635	16·0 1·0657	16·5 1·0678	17·0 1·0700	17·5 1·0722	
10·80	10·78	10·76	10·73	10·71	10·69	10·67	40°
11·07	11·05	11·03	11·00	10·98	10·96	10·94	41
11·34	11·32	11·29	11·27	11·25	11·23	11·20	42
11·61	11·59	11·56	11·45	11·52	11·49	11·47	43
11·88	11·86	11·83	11·81	11·79	11·76	11·74	44
12·15	12·13	12·10	12·08	12·05	12·03	12·01	45
12·42	12·40	12·37	12·35	12·32	12·30	12·27	46
12·69	12·67	12·64	12·61	12·59	12·56	12·54	47
12·97	12·94	12·91	12·88	12·86	12·83	12·81	48
13·23	13·21	13·18	13·15	13·13	13·10	13·07	49
13·50	13·48	13·45	13·42	13·40	13·37	13·34	50
13·78	13·75	13·72	13·69	13·66	13·64	13·61	51
	14·02	13·99	13·96	13·93	13·90	13·88	52
	14·29	14·26	14·23	14·20	14·17	14·14	53
		14·53	14·50	14·47	14·44	14·41	54
		14·80	14·77	14·74	14·71	14·68	55
			15·03	15·00	14·97	14·94	56
			15·30	15·27	15·24	15·21	57
			15·57	15·54	15·51	15·48	58
				15·81	15·78	15·75	59
					16·05	16·01	60
					16·31	16·28	61
						16·55	62
						16·82	63
							64
							65
							66
							67
							68
							69
							70
							71
							72
							73
							74
							75
							76
							77
							78
							79
							80

TABLE FOR FINDING THE SUCROSE CONTENT OF JUICES, CLARIFIED WITH THE ORIGINAL JUICE, AND THE READINGS IN A SCHMIDT AND

Readings on the Polariscope.	Degrees Brix and						
	18·0	18·5	19·0	19·5	20·0	20·5	21·0
	1·0744	1·0766	1·0788	1·0811	1·0833	1·0855	1·0878
40°	10·64	10·62	10·60	10·58	10·56	10·54	10·52
41	10·91	10.89	10·87	10·85	10·82	10·80	10·78
42	11·18	11·16	11·13	11·11	11·09	11·07	11·04
43	11·45	11·42	11·40	11·38	11·35	11·33	11·31
44	11·71	11·69	11·66	11·64	11·62	11·59	11·57
45	11·98	11·96	11·93	11·91	11·88	11·86	11·83
46	12·25	12·22	12·20	12·17	12·15	12·12	12·09
47	12·51	12·49	12·46	12·44	12·41	12·39	12·36
48	12·78	12·75	12·73	12·70	12·67	12·65	12·62
49	13·05	13·02	12·99	12·97	12·94	12·91	12·88
50	13·31	13·29	13·26	13·23	13·20	13·18	13·15
51	13·58	13·55	13·52	13·50	13·47	13·14	13·41
52	13·85	13·82	13·79	13·76	13·73	13·70	13·68
53	14·11	14·08	14·05	14·03	14·00	13·97	13·94
54	14·38	14·35	14·32	14·29	14·26	14·23	14·20
55	14·65	14·62	14·59	14·56	14·53	14·50	14·47
56	14·91	14·88	14·85	14·82	14·79	14·76	14·73
57	15·18	15·15	15·12	15·09	15·06	15·02	14·99
58	15·45	15·42	15·38	15·35	15·32	15·29	15·26
59	15·71	15·68	15·65	15·62	15·58	15·55	15·52
60	15·98	15·95	15·92	15·88	15·85	15·82	15·78
61	16·25	16·21	16·18	16·15	16·11	16·08	16·05
62	16·52	16·48	16·45	16·41	16·38	16·35	16·31
63	16·78	16·75	16·71	16·68	16·64	16·61	16·57
64	17·05	17·01	16·98	16·94	16·91	16·87	16·84
65	17·32	17·28	17·24	17·21	17·17	17·14	17·10
66		17·55	17·51	17·47	17·44	17·40	17·37
67		17·81	17·78	17·74	17·70	17·67	17·63
68			18·04	18·00	17·97	17·93	17·89
69			18·31	18·27	18·23	18·19	18·16
70				18·53	18·50	18·46	18·42
71					18·76	18·72	18·68
72					19·03	18·99	18·95
73						19·25	19·21
74						19·52	19·48
75						19·78	19·74
76							20·00
77							20·27
78							
79							
80							

10 PER CENT. OF BASIC LEAD ACETATE, FROM THE SPECIFIC GRAVITY OF HAENSCH POLARISCOPE, WHEN OBSERVED IN A 200 MM. TUBE.

Corresponding Specific Gravity.						Readings on the Polariscope.	Degrees Brix from 11·5 to 22·5.	
21·5	22·0	22·5	23·0	23·5	24.0		Degrees.	Per cent. Sucrose.
1·0900	1·0923	1·0946	1·0969	1·0992	1·1015			
10·49	10·47	10·45	10·43	10·41	10·38	40°		
10·76	10·74	10·71	10·69	10·67	10·65	41	0·1°	0·03
11·02	11·00	10·97	10·95	10·93	10·90	42	0·2	0·05
11·28	11·26	11·24	11·21	11·19	11·17	43	0·3	0·08
11·55	11·52	11·50	11·47	11·45	11·42	44	0·4	0·11
11·81	11·78	11·76	11·73	11·71	11·69	45	0·5	0·13
12·07	12·05	12·02	12·00	11·97	11·94	46	0·6	0·16
12·33	12·31	12·28	12·26	12·23	12·21	47	0·7	0·19
12·60	12·57	12·54	12·52	12·49	12·47	48	0·8	0·21
12·86	12·83	12·81	12·78	12·75	12·73	49	0·9	0·24
13·12	13·09	13·07	13·04	13·01	12·99	50		
13·39	13·36	13·33	13·30	13·27	13·25	51		
13·65	13·62	13·59	13·56	13·53	13·51	52		
13·91	13·88	13·85	13·82	13·79	13·77	53		
14·17	14·14	14·11	14·08	14·06	14·02	54		
14·44	14·41	14·38	14·35	14·32	14·29	55	Degrees Brix from 23·0 to 24·0.	
14·70	14·67	14·64	14·61	14·58	14·55	56		
14·96	14·93	14·90	14·87	14·84	14·81	57		
15·23	15·19	15·16	15·13	15·10	15·07	58	Degrees.	Per cent. Sucrose.
15·49	15·46	15·42	15·39	15·36	15·33	59		
15·75	15·72	15·69	15·65	15 62	15·59	60		
16·01	15·98	15·95	15·91	15·88	15·85	61	0·1°	0·03
16·28	16·24	16·21	16·18	16·14	16·11	62	0·2	0·05
16·54	16·51	16·47	16·44	16·40	16·37	63	0·3	0·08
16·80	16·77	16·73	16·70	16·66	16·63	64	0·4	0·10
17·07	17·03	17·00	16·96	16·92	16·89	65	0·5	o·13
17·33	17·29	17·26	17·22	17·19	17·15	66	0·6	0·16
17·59	17·56	17·52	17·48	17·45	17·41	67	0·7	0·18
17·86	17·82	17·78	17 74	17·71	17·67	68	0·8	0·21
18·12	18·08	18·04	18·00	17·97	17·93	69	0·9	0·23
18·38	18·35	18·31	18·27	18·23	18·19	70		
18·65	18·61	18·57	18·53	18·49	18·45	71		
18·91	18·87	18·83	18·79	18·75	18·71	72		
19·17	19·13	19·09	19·05	19·01	18·97	73		
19·44	19·40	19·35	19·31	19·27	19·23	74		
19·70	19·66	19·62	19·57	19·53	19·49	75		
19·96	19·92	19·88	19·84	19·80	19·75	76		
10·22	20·18	20·14	20·10	20·06	20·01	77		
10·49	20·45	20·40	20·36	20·32	20·27	78		
10·75	20·71	20·66	20·62	20·58	20·54	79		
	20·93	20·93	20·88	20·84	20·80	80		

TABLE FOR THE COMPARISON OF THE DEGREES BRIX OR PER CENT. FOR SOLUTIONS OF PURE SUCROSE FROM

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
0·0	1·00000	0·00	4·0	1·01570	2·27
0·1	1·00038	0·06	4·1	1·01610	2·33
0·2	1·00077	0·11	4·2	1·01650	2·38
0·3	1·00116	0·17	4·3	1·01690	2·44
0·4	1·00155	0·23	4·4	1·01730	2·50
0·5	1·00193	0·28	4·5	1·01770	2·55
0·6	1·00232	0·34	4·6	1·01810	2·61
0·7	1·00271	0·40	4·7	1·01850	2·67
0·8	1·00310	0·45	4·8	1·01890	2·72
0·9	1·00349	0·51	4·9	1·01930	2·78
1·0	1·00388	0·57	5·0	1·01970	2·84
1·1	1·00447	0·63	5·1	1·02010	2·89
1·2	1·00466	0·68	5·2	1·02051	2·95
1·3	1·00505	0·74	5·3	1·02091	3·01
1·4	1·00544	0·80	5·4	1·02131	3·06
1·5	1·00583	0·85	5·5	1·02171	3·12
1·6	1·00622	0·91	5·6	1·02211	3·18
1·7	1·00662	0·97	5·7	1·02252	3·23
1·8	1·00701	1·02	5·8	1·02292	3·29
1·9	1·00740	1·08	5·9	1·02333	3·35
2·0	1·00779	1·14	6·0	1·02373	3·40
2·1	1·00818	1·19	6·1	1·02413	3·46
2·2	1·00858	1·25	6·2	1·02454	3·52
2·3	1·00897	1·31	6·3	1·02494	3·57
2·4	1·00936	1·36	6·4	1·02535	3·63
2·5	1·00976	1·42	6·5	1·02575	3·69
2·6	1·01015	1·48	6·6	1·02616	3·74
2·7	1·01055	1·53	6·7	1·02657	3·80
2·8	1·01094	1·59	6·8	1·02697	3·86
2 9	1·01134	1·65	6·9	1·02738	3·91
3·0	1·01173	1·70	7·0	1·02779	3·97
3·1	1·01213	1·76	7·1	1·02819	4·03
3·2	1·01252	1·82	7·2	1·02860	4·08
3·3	1·01292	1·87	7·3	1.02901	4·14
3·4	1·01332	1·93	7·4	1·02942	4·20
3·5	1·01371	1·99	7·5	1·02983	4·25
3·6	1·01411	2·04	7·6	1·03024	4·31
3·7	1·01451	2·10	7·7	1·03064	4·37
3·8	1·01491	2·16	7·8	1·03105	4·42
3·9	1·01531	2·21	7·9	1·03146	4·48

Solids, with the Specific Gravity and the Degrees Beaumé 0 to 100 per cent. at 17·5° C.

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
8·0	1·03187	4·53	12·0	1·04852	6·79
8·1	1·03228	4·59	12·1	1·04894	6·85
8·2	1·03270	4·65	12·2	1·04937	6·91
8·3	1·03311	4·70	12·3	1·04979	6·96
8·4	1·03352	4·76	12·4	1·05021	7·02
8·5	1·03393	4·82	12·5	1·05064	7·08
8·6	1·03434	4·87	12·6	1·05106	7·13
8·7	1·03475	4·93	12·7	1·05149	7·19
8·8	1·03517	4·99	12·8	1·05191	7·24
8·9	1·03558	5·04	12·9	1·05233	7·30
9·0	1·03599	5·10	13·0	1·05276	7·36
9·1	1·03640	5·16	13·1	1·05318	7·41
9·2	1·03682	5·21	13·2	1·05361	7·47
9·3	1·03723	5·27	13·3	1·05404	7·53
9·4	1·03765	5·33	13·4	1·05446	7·58
9·5	1·03806	5·38	13·5	1·05489	7·64
9·6	1·03848	5·44	13·6	1·05532	7·69
9·7	1·03889	5·50	13·7	1·05574	7·75
9·8	1·03931	5·55	13·8	1·05617	7·81
9·9	1·03972	5·61	13·9	1·05660	7·86
10·0	1·04014	5·67	14·0	1·05703	7·92
10·1	1·04055	5·72	14·1	1·05746	7·98
10·2	1·04097	5·78	14·2	1·05789	8·03
10·3	1·04139	5·83	14·3	1·05831	8·09
10·4	1·04180	5·89	14·4	1·05874	8·14
10·5	1·04222	5·95	14·5	1·05917	8·22
10·6	1·04264	6·00	14·6	1·05960	8·26
10·7	1·04306	6·06	14·7	1·06003	8·31
10·8	1·04348	6·12	14·8	1·06047	8·37
10·9	1·04390	6·17	14·9	1·06090	8·43
11·0	1·04431	6·23	15·0	1·06133	8·48
11·1	1·04473	6·29	15·1	1·06176	8·54
11·2	1·04515	6·34	15·2	1·06219	8·59
11·3	1·04557	6·40	15·3	1·06262	8·65
11·4	1·04599	6·46	15·4	1·06306	8·71
11·5	1·04641	6·51	15·5	1·06349	8·76
11·6	1·04683	6·57	15·6	1·06392	8·82
11·7	1·04726	6·62	15·7	1·06436	8·88
11·8	1·04768	6·68	15·8	1·06479	8·93
11·9	1·04810	6·74	15·9	1·06522	8·99

TABLE FOR THE COMPARISON OF THE DEGREES BRIX OR PER CENT. FOR SOLUTIONS OF PURE SUCROSE FROM

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
16·0	1·06566	9·04	20·0	1·08329	11·29
16·1	1·06609	9·10	20·1	1·08374	11·34
16·2	1·06653	9·16	20·2	1·08419	11·40
16·3	1·06696	9·21	20·3	1·08464	11·45
16·4	1·06740	9·27	20·4	1·08509	11·51
16·5	1·06783	9·33	20·5	1·08553	11·57
16·6	1·06827	9·38	20·6	1·08599	11·62
16·7	1·06871	9·44	20·7	1·08643	11·67
16·8	1·06914	9·49	20·8	1·08688	11·73
16·9	1·06958	9·55	20·9	1·08733	11·79
17·0	1·07002	9·61	21·0	1·08778	11·85
17·1	1·07046	9·66	21·1	1·08824	11·90
17·2	1·07090	9·72	21·2	1·08869	11·96
17·3	1·07133	9·77	21·3	1·08914	12·01
17·4	1·07177	9·83	21·4	1·08959	12·07
17·5	1·07221	9·89	21·5	1·09004	12·13
17·6	1·07265	9·94	21·6	1·09049	12·18
17·7	1·07309	10·00	21·7	1·09095	12·24
17·8	1·07358	10·06	21·8	1·09140	12·29
17·9	1·07397	10·11	21·9	1·09185	12·35
18·0	1·07441	10·17	22·0	1·09231	12·40
18·1	1·07485	10·22	22·1	1·09276	12·46
18·2	1·07530	10·28	22·2	1·09321	12·52
18·3	1·07574	10·33	22·3	1·09367	12·57
18·4	1·07618	10·39	22·4	1·09412	12·63
18·5	1·07662	10·45	22·5	1·09458	12·68
18·6	1·07706	10·50	22·6	1·09503	12·74
18·7	1·07751	10·56	22·7	1·09549	12·80
18·8	1·07795	10·62	22·8	1·09595	12·85
18·9	1·07839	10·67	22·9	1·09640	12·91
19·0	1·07884	10·73	23·0	1·09686	12·96
19·1	1·07928	10·78	23·1	1·09732	13·02
19.2	1·07973	10·84	23·2	1·09777	13·07
19·3	1·08017	10·90	23·3	1·09823	13·13
19·4	1·08062	10·95	23·4	1·09869	13·19
19·5	1·08106	11·01	23·5	1·09915	13·24
19·6	1·08151	11·06	23·6	1·09961	13·30
19·7	1·08196	11·12	23·7	1·10007	13·35
19·8	1·08240	11·18	23·8	1·10053	13·41
19·9	1·08285	11·23	23·9	1·10099	13·46

SOLIDS, WITH THE SPECIFIC GRAVITY AND THE DEGREES BEAUMÉ 0 TO 100 PER CENT. AT 17·5° C. (*Continued*).

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
24·0	1·10145	13·52	28·0	1·12013	15·74
24·1	1·10191	13·58	28·1	1·12060	15·80
24·2	1·10237	13·63	28·2	1·12107	15·85
24·3	1·10283	13·69	28·3	1·12155	15·91
24·4	1·10329	13·74	28·4	1·12202	15·96
24·5	1·10375	13·80	28·5	1·12250	16·02
24·6	1·10421	13·85	28·6	1·12297	16·07
24·7	1·10468	13·91	28·7	1·12345	16·13
24·8	1·10514	13·96	28·8	1·12393	16·18
24·9	1·10560	14·02	28·9	1·12440	16·24
25·0	1·10607	14·08	29·0	1·12488	16·30
25·1	1·10653	14·13	29·1	1·12536	16·35
25·2	1·10700	14·19	29·2	1·12583	16·41
25·3	1·10746	14·24	29·3	1·12631	16·46
25·4	1·10793	14·30	29·4	1·12679	16·52
25·5	1·10839	14·35	29·5	1·12727	16·57
25·6	1·10886	14·41	29·6	1·12775	16·63
25·7	1·10932	14·47	29·7	1·12823	16·68
25·8	1·10979	14·52	29·8	1·12871	16·74
25·9	1·11026	14·58	29·9	1·12919	16·79
26·0	1·11072	14·63	30·0	1·12967	16·85
26·1	1·11119	14·69	30·1	1·13015	16·90
26·2	1·11166	14·74	30·2	1·13063	16·96
26·3	1·11213	14·80	30·3	1·13111	17·01
26·4	1·11259	14·85	30·4	1·13159	17·07
26·5	1·11306	14·91	30·5	1·13207	17·12
26·6	1·11353	14·97	30·6	1·13255	17·18
26·7	1·11400	15·02	30·7	1·13304	17·23
26·8	1·11447	15·08	30·8	1·13352	17·29
26·9	1·11494	15·13	30·9	1·13400	17·35
27·0	1·11541	15·19	31·0	1·13449	17·40
27·1	1·11588	15·24	31·1	1·13497	17·46
27·2	1·11635	15·30	31·2	1·13545	17·51
27·3	1·11682	15·35	31·3	1·13594	17·57
27·4	1·11729	15·41	31·4	1·13642	17·62
27·5	1·11776	15·46	31·5	1·13691	17·68
27·6	1·11824	15·52	31·6	1·13740	17·73
27·7	1·11871	15·58	31·7	1·13788	17·79
27·8	1·11918	15·63	31·8	1·13837	17·84
27·9	1·11965	15·69	31·9	1·13885	17·90

TABLE FOR THE COMPARISON OF THE DEGREES BRIX OR PER CENT.
FOR SOLUTIONS OF PURE SUCROSE FROM

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
32·0	1·13934	17·95	36·0	1·15911	20·15
32·1	1·13983	18·01	36·1	1·15961	20·20
32·2	1·14032	18·06	36·2	1·16011	20·26
32·3	1·14081	18·12	36·3	1·16061	20·31
32·4	1·14129	18·17	36·4	1·16111	20·37
32·5	1·14178	18·23	36·5	1·16162	20·42
32·6	1·14227	18·28	36·6	1·16212	20·48
32·7	1·14276	18·34	36·7	1·16262	20·53
32·8	1·14325	18·39	36·8	1·16313	20·59
32·9	1·14374	18·45	36·9	1·16363	20·64
33·0	1·14423	18·50	37·0	1·16413	20·70
33·1	1·14472	18·56	37·1	1·16464	20·75
33·2	1·14521	18·61	37·2	1·16514	20·80
33·3	1·14570	18·67	37·3	1·16565	20·86
33·4	1·14620	18·72	37·4	1·16616	20·91
33·5	1·14669	18·78	37·5	1·16666	20·97
33·6	1·14718	18·83	37·6	1·16717	21·02
33·7	1·14767	18·89	37·7	1·16768	21·08
33·8	1·14817	18·94	37·8	1·16818	21·13
33·9	1·14866	19·00	37·9	1·16869	21·19
34·0	1·14915	19·05	38·0	1·16920	21·24
34·1	1·14965	19·11	38·1	1·16971	21·30
34·2	1·15014	19·16	38·2	1·17022	21·35
34·3	1·15064	19·22	38·3	1·17072	21·40
34·4	1·15113	19·27	38·4	1·17132	21·46
34·5	1·15163	19·33	38·5	1·17174	21·51
34·6	1·15213	19·38	38·6	1·17225	21·57
34·7	1·15262	19·44	38·7	1·17276	21·62
34·8	1·15312	19·49	38·8	1·17327	21·68
34·9	1·15362	19·55	38·9	1·17379	21·73
35·0	1·15411	19·60	39·0	1·17430	21·79
35·1	1·15461	19·66	39·1	1·17481	21·84
35·2	1·15511	19·71	39·2	1·17532	21·90
35·3	1·15561	19·76	39·3	1·17583	21·95
35·4	1·15611	19·82	39·4	1·17635	22·00
35·5	1·15661	19·87	39·5	1·17686	22·06
35·6	1·15710	19·93	39·6	1·17737	22·11
35·7	1·15760	19 98	39·7	1 17789	22·17
35·8	1·15810	20·04	39·8	1·17840	22·22
35·9	1·15861	20·09	39·9	1·17892	22·28

SOLIDS, WITH THE SPECIFIC GRAVITY AND THE DEGREES BEAUMÉ 0 TO 100 PER CENT. AT 17·5° C. (*Continued*).

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
40·0	1·17934	22·33	44·0	1·20033	24·50
40·1	1·17995	22·38	44·1	1·20086	24·55
40·2	1·18046	22·44	44·2	1·20139	24·61
40·3	1·18098	22·49	44·3	1·20192	24·66
40·4	1·18150	22·55	44·4	1·20245	24·71
40·5	1·18201	22·60	44·5	1·20299	24·77
40·6	1·18253	22·66	44·6	1·20352	24·82
40·7	1·18305	22·71	44·7	1·20405	24·88
40·8	1·18357	22·77	44·8	1·20458	24·93
40·9	1·18408	22·82	44·9	1·20512	24·98
41·0	1·18460	22·87	45·0	1·20565	25·04
41·1	1·18512	22·93	45·1	1·20618	25·09
41·2	1·18564	22·98	45·2	1·20672	25·14
41·3	1·18616	23·04	45·3	1·20725	25·20
41·4	1·18668	23·09	45·4	1·20779	25·25
41·5	1·18720	23·15	45·5	1·20832	25·31
41·6	1·18772	23·20	45·6	1·20886	25·36
41·7	1·18824	23·25	45·7	1·20939	25·41
41·8	1·18877	23·31	45·8	1·20993	25·47
41·9	1·18929	23·36	45·9	1·21046	25·52
42·0	1·18981	23·42	46·0	1·21100	25·57
42·1	1·19033	23·47	46·1	1·21154	25·63
42·2	1·19086	23·52	46·2	1·21208	25·68
42·3	1·19138	23·58	46·3	1·21261	25·74
42·4	1·19190	23·63	46·4	1·21315	25·79
42·5	1·19243	23·69	46·5	1·21369	25·84
42·6	1·19295	23·74	46·6	1·21423	25·90
42·7	1·19348	23·79	46·7	1·21477	25·95
42·8	1·19400	23·85	46·8	1·21531	26·00
42·9	1·19453	23·90	46·9	1·21585	26·06
43·0	1·19505	23·96	47·0	1·21639	26·11
43·1	1·19558	24·01	47·1	1·21693	26·17
43·2	1·19611	24·07	47·2	1·21747	26·22
43·3	1·19663	24·12	47·3	1·21802	26·27
43·4	1·19716	24·17	47·4	1·21856	26·33
43·5	1·19769	24·23	47·5	1·21910	26·38
43·6	1·19822	24·28	47·6	1·21964	26·43
43·7	1·19875	24·34	47·7	1·22019	26·49
43·8	1·19927	24·39	47·8	1·22073	26·54
43·9	1·19980	24·44	47·9	1·22127	26·59

Table for the Comparison of the Degrees Brix or Per cent. for Solutions of Pure Sucrose from

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
48·0	1·22182	26·65	52·0	1·24390	28·78
48·1	1·22236	26·70	52·1	1·24446	28·83
48·2	1·22291	26·75	52·2	1·24502	28·89
48·3	1·22345	26·81	52·3	1·24558	28·94
48·4	1·22400	26·86	52·4	1·24614	28·99
48·5	1·22455	26·92	52·5	1·24670	29·05
48·6	1·22509	26·97	52·6	1·24726	29·10
48·7	1·22564	27·02	52·7	1·24782	29·15
48·8	1·22619	27·08	52·8	1·24839	29·20
48·9	1·22673	27·13	52·9	1·24895	29·26
49·0	1·22728	27·18	53·0	1·24951	29·31
49·1	1·22783	27·24	53·1	1·25008	29·36
49·2	1·22838	27·29	53·2	1·25064	29·42
49·3	1·22893	27·34	53·3	1·25120	29·47
49·4	1·22948	27·40	53·4	1·25177	29·52
49·5	1·23003	27·45	53·5	1·25233	29·57
49·6	1·23058	27·50	53·6	1·25290	29·63
49·7	1·23113	27·56	53·7	1·25347	29·68
49·8	1·23168	27·61	53·8	1·25403	29·73
49·9	1·23223	27·66	53·9	1·25460	29·79
50·0	1·23278	27·72	54·0	1·25517	29·84
50·1	1·23334	27·77	54·1	1·25573	29·89
50·2	1·23389	27·82	54·2	1·25630	29·94
50·3	1·23444	27·88	54·3	1·25687	30·00
50·4	1·23499	27·93	54·4	1·25744	30·05
50·5	1·23555	27·98	54·5	1·25801	30·10
50·6	1·23610	28·04	54·6	1·25857	30·16
50·7	1·23666	28·09	54·7	1·25914	30·21
50·8	1·23721	28·14	54·8	1·25971	30·26
50·9	1·23777	28·20	54·9	1·26028	30·31
51·0	1·23832	28·25	55·0	1·26086	30·37
51·1	1·23888	28·30	55·1	1·26143	30·42
51·2	1·23943	28·36	55·2	1·26200	30·47
51·3	1·23999	28·41	55·3	1·26257	30·53
51·4	1·24055	28·46	55·4	1·26314	80·58
51·5	1·24111	28·51	55·5	1·26372	30·63
51·6	1·24166	28·57	55·6	1·26429	30·68
51·7	1·24222	28·62	55·7	1·26486	30·74
51·8	1·24278	28·67	55·8	1·26544	30·79
51·9	1·24334	28·73	55·9	1·26601	30·84

Solids, with the Specific Gravity and the Degrees Beaumé 0 to 100 per cent. at 17·5° C. (*Continued*).

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
56·0	1·26658	30·89	60·0	1·28989	32·99
56·1	1·26716	30·95	60·1	1·29048	33·04
56·2	1·26773	31·00	60·2	1·29107	33·09
56·3	1·26831	31·05	60·3	1·29166	33·14
56·4	1·26889	31·10	60·4	1·29225	33·20
56·5	1·26946	31·16	60·5	1·29284	33·25
56·6	1·27004	31·21	60·6	1·29343	33·30
56·7	1·27062	31·26	60·7	1·29403	33·35
56·8	1·27120	31·31	60·8	1·29462	33·40
56·9	1·27177	31·37	60·9	1·29521	33·46
57·0	1·27235	31·42	61·0	1·29581	33·51
57·1	1·27293	31·47	61·1	1·29640	33·56
57·2	1·27351	31·52	61·2	1·29700	33·61
57·3	1·27409	31·58	61·3	1·29759	33·66
57·4	1·27467	31·63	61·4	1·29819	33·71
57·5	1·27525	31·68	61·5	1·29878	33·77
57·6	1·27583	31·73	61·6	1·29938	33·82
57·7	1·27641	31·79	61·7	1·29998	33·87
57·8	1·27669	31·84	61·8	1·30057	33·92
57·9	1·27758	31·89	61·9	1·30117	33·97
58·0	1·27816	31·94	62·0	1·30177	34·03
58·1	1·27874	32·00	62·1	1·30237	34·08
58·2	1·27932	32·05	62·2	1·30297	34·13
58·3	1·27991	32·10	62·3	1·30356	34·18
58·4	1·28049	32·15	62·4	1·30461	34·23
58·5	1·28107	32·20	62·5	1·30476	34·28
58·6	1·28166	32·26	62·6	1·30536	34·34
58·7	1·28224	32·31	62·7	1·30596	34·39
58·8	1·28283	32·36	62·8	1·30657	34·44
58·9	1·28342	32·41	62·9	1·30717	34·49
59·0	1·28400	32·47	63·0	1·30777	34·54
59·1	1·28459	32·52	63·1	1·30837	34·59
59·2	1·28518	32·57	63·2	1·30897	34·65
59·3	1·28576	32·62	63·3	1·30958	34·70
59·4	1·28635	32·67	63·4	1·31018	34·75
59·5	1·28694	32·73	63·5	1·31078	34·80
59·6	1·28753	32·78	63·6	1·31139	34·85
59·7	1·28812	32·83	63·7	1·31199	34·90
59·8	1·28871	32·88	63·8	1·31260	34·96
59·9	1·28930	32·93	63·9	1·31320	35·01

TABLE FOR THE COMPARISON OF THE DEGREES BRIX OR PER CENT. FOR SOLUTIONS OF PURE SUCROSE FROM

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
64·0	1·31381	35·06	68·0	1·33836	37·11
64·1	1·31442	35·11	68·1	1·33899	37·16
64·2	1·31502	35·16	68·2	1·33961	37·21
64·3	1·31563	35·21	68·3	1·34023	37·26
64·4	1·31624	35·27	68·4	1·34085	37·31
64·5	1·31684	35·32	68·5	1·34148	37·36
64·6	1·31745	35·37	68·6	1·34210	37·41
64·7	1·31806	35·42	68·7	1·34273	37·47
64·8	1·31867	35·47	68·8	1·34335	37·52
64·9	1·31928	35·52	68·9	1·34398	37·57
65·0	1·31989	35·57	69·0	1·34460	37·62
65·1	1·32050	35·63	69·1	1·34523	37·67
65·2	1·32111	35·68	69·2	1·34585	37·72
65·3	1·32172	35·73	69·3	1·34648	37·77
65·4	1·32233	35·78	69·4	1·34711	37·82
65·5	1·32294	35·83	69·5	1·34774	37·87
65·6	1·32355	35·88	69·6	1·34836	37·92
65·7	1·32417	35·93	69·7	1·34899	37·97
65·8	1·32478	35·98	69·8	1·34962	38·02
65·9	1·32539	36·04	69·9	1·35025	38·07
66·0	1·32601	36·09	70·0	1·35088	38·12
66·1	1·32662	36·14	70·1	1·35151	38·18
66·2	1·32724	36·19	70·2	1·35214	38·23
66·3	1·32785	36·24	70·3	1·35277	38·28
66·4	1·32847	36·29	70·4	1·35340	38·33
66·5	1·32908	36·34	70·5	1·35403	38·38
66·6	1·32970	36·39	70·6	1·35466	38·43
66·7	1·33031	36·45	70·7	1·35530	38·48
66·8	1·33093	36·50	70·8	1·35593	38·53
66·9	1·33155	36·55	70·9	1·35656	38·58
67·0	1·33217	36·60	71·0	1·35720	38·63
67·1	1·33278	36·65	71·1	1·35783	38·68
67·2	1·33340	36·70	71·2	1·35847	38·73
67·3	1·33402	36·75	71·3	1·35910	38·78
67·4	1·33464	36·80	71·4	1·35974	38·83
67·5	1·33526	36·85	71·5	1·36037	38·88
67·6	1·33588	36·90	71·6	1·36101	38·93
67·7	1·33650	36·96	71·7	1·36164	39·98
67·8	1·33712	37·01	71·8	1·36228	39·03
67·9	1·33774	37·06	71·9	1·36292	39·08

SOLIDS, WITH THE SPECIFIC GRAVITY AND THE DEGREES BEAUMÉ 0 TO 100 PER CENT. AT 17·5° C. (*Continued*).

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
72·0	1·36355	39·13	76·0	1·38939	41·14
72·1	1·36419	39·19	76·1	1·39004	41·18
72·2	1·36483	39·24	76·2	1·39070	41·24
72·3	1·36547	39·29	76·3	1·39135	41·29
72·4	1·36611	39·34	76·4	1·39201	41·33
72·5	1·36675	39·39	76·5	1·39266	41·38
72·6	1·36739	39·44	76·6	1·39332	41·43
72·7	1·36803	39·49	76·7	1·39397	41·48
72·8	1·36867	39·54	76·8	1·39463	41·53
72·9	1·36931	39·59	76·9	1·39529	41·58
73·0	1·36995	39·64	77·0	1·39595	41·63
73·1	1·37059	39·69	77·1	1·39660	41·68
73·2	1·37124	39·74	77·2	1·39726	41·73
73·3	1·37188	39·79	77·3	1·39792	41·78
73·4	1·37252	39·84	77·4	1·39858	41·83
73·5	1·37317	39·89	77·5	1·39924	41·88
73·6	1·37381	39·94	77·6	1·39990	41·93
73·7	1·37446	39·99	77·7	1·40056	41·98
73·8	1·37510	40·04	77·8	1·40122	42·03
73·9	1·37575	40·09	77·9	1·40188	42·08
74·0	1·37639	40·14	78·0	1·40254	42·13
74·1	1·37704	40·19	78·1	1·40321	42·18
74·2	1·37768	40·24	78·2	1·40387	42·23
74·3	1·37833	40·29	78·3	1·40453	42·28
74·4	1·37898	40·34	78·4	1·40520	42·32
74·5	1·37962	40·39	78·5	1·40586	42·37
74·6	1·38027	40·44	78 6	1·40652	42·42
74·7	1·38092	40·49	78·7	1·40719	42·47
74·8	1·38157	40·54	78·8	1·40785	42·52
74·9	1·38222	40·59	78·9	1·40852	42·57
75·0	1·38287	40·64	79·0	1·40918	42·62
75·1	1·38352	40·69	79·1	1·40985	42·67
75·2	1·38417	40·74	79·2	1·41052	42·72
75·3	1·38482	40·79	79·3	1·41118	42·77
75·4	1·38547	40·84	79·4	1·41185	42·82
75·5	1·38612	40 89	79·5	1·41252	42·87
75·6	1·38677	40·94	79·6	1·41318	42·92
75·7	1·38743	40·99	79·7	1·41385	42·96
75·8	1·38808	41·04	79·8	1·41452	43·41
75·9	1·38873	41·09	79·9	1·41519	43·06

TABLE FOR THE COMPARISON OF THE DEGREES BRIX OR PER CENT. FOR SOLUTIONS OF PURE SUCROSE FROM

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
80·0	1·41586	43·11	84·0	1·44298	45·06
80·1	1·41653	43·16	84·1	1·44367	45·11
80·2	1 41720	43·21	84·2	1·44435	45·16
80·3	1·41787	43·26	84·3	1·44504	45·21
80·4	1·41854	43·31	84·4	1·44573	45·25
80·5	1·41921	43·36	84·5	1·44641	45·30
80·6	1·41989	43·41	84·6	1·44710	45·35
80·7	1·42056	43·45	84·7	1·44779	45·40
80·8	1·42123	43·50	84·8	1·44841	45·45
80·9	1·42190	43·55	84·9	1·44917	45·49
81·0	1·42258	43·60	85·0	1·44986	45·54
81·1	1·42325	43·65	85·1	1·45055	45·59
81·2	1·42393	43·70	85·2	1·45124	45·64
81·3	1·42460	43·75	85·3	1·45193	45·69
81·4	1·42528	43·80	85·4	1·45262	45·74
81·5	1·42595	43·85	85·5	1·45331	45·78
81·6	1·42663	43·89	85·6	1·45401	45·83
81·7	1·42731	43·94	85·7	1·45470	45·88
81·8	1·42798	43·99	85·8	1·45539	45·93
81·9	1·42866	44·04	85·9	1·45609	45·98
82·0	1·42934	44·09	86·0	1·45678	46·02
82·1	1·43002	44·14	86·1	1·45748	46·07
82·2	1·43070	44·19	86·2	1·45817	46·12
82·3	1·43137	44·24	86·3	1·45887	46·17
82·4	1·43205	44·28	86·4	1·45956	46·22
82·5	1·43273	44·33	86·5	1·46026	46·26
82·6	1·43341	44·38	86·6	1·46095	46·31
82·7	1·43409	44·43	86·7	1·46165	46·36
82·8	1·43478	44·48	86·8	1·46235	46·41
82·9	1·43546	44·53	86·9	1·46304	46·46
83·0	1·43614	44·58	87·0	1·46374	46·50
83·1	1·43682	44·62	87·1	1·46444	46·55
83·2	1·43750	44·67	87·2	1·46514	46 60
83·3	1·43819	44·72	87·3	1·46584	46·65
83·4	1·43887	44·77	87·4	1·46654	46·69
83·5	1·43955	44·82	87·5	1·46724	46·74
83·6	1·44024	44·87	87·6	1·46794	46·79
83·7	1·44092	44·91	87·7	1·46864	46·84
83·8	1·44161	44·96	87·8	1·46934	46·88
83·9	1·44229	45·01	87·9	1·47004	46·93

SOLIDS, WITH THE SPECIFIC GRAVITY AND THE DEGREES BEAUMÉ 0 TO 100 PER CENT. AT 17·5° C. (*Continued*).

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
88·0	1 47074	46·98	92·0	1·49915	48·87
88·1	1 47145	47·03	92·1	1·49987	48·92
88·2	1·47215	47·08	92·2	1·50058	48·96
88·3	1·47285	47·12	92·3	1·50130	49·01
88·4	1·47356	47·17	92·4	1·50202	49·06
88·5	1·47426	47·22	92·5	1·50274	49·11
88·6	1·47496	47·27	92·6	1·50346	49·15
88·7	1·47567	47·31	92·7	1·50419	49·20
88·8	1·47637	47·36	92·8	1·50491	49·25
88·9	1·47708	47·41	92·9	1·50563	49·29
89·0	1·47778	47·46	93·0	1·50635	49·34
89·1	1·47849	47·50	93·1	1·50707	49·39
89·2	1·47920	47·55	93·2	1·50779	49·43
89·3	1·47991	47·60	93·3	1·50852	49·48
89·4	1·48061	47·65	93·4	1·50924	49·53
89·5	1·48132	47·69	93·5	1·50996	49·57
89·6	1·48203	47·74	93·6	1·51069	49·62
89·7	1·48274	47·79	93·7	1·51141	49·67
89·8	1·48345	47·83	93·8	1·51214	49·71
89 9	1·48416	47·88	93·9	1·51286	49·76
90·0	1·48486	47·93	94·0	1·51359	49·81
90·1	1·48558	47·98	94·1	1·51431	49·85
90·2	1·48629	48·02	94·2	1·51504	49·90
90·3	1·48700	48·07	94·3	1·51577	49·94
90·4	1·48771	48·12	94·4	1·51640	49·99
90·5	1·48842	48·17	94·5	1·51722	50·04
90·6	1·48813	48·21	94·6	1·51795	50·08
90·7	1·48985	48·26	94·7	1·51868	50·13
90·8	1·49056	48·31	94·8	1·51941	50·18
90·9	1·49127	48·35	94·9	1·52014	50·22
91·0	1·49199	48·40	95·0	1·52087	50·27
91·1	1·49270	48·45	95·1	1·52159	50·32
91·2	1·49342	48·50	95·2	1·52232	50·36
91·3	1·49413	48·54	95·3	1·52304	50·41
91·4	1·49485	48·59	95·4	1·52376	50·45
91·5	1·49556	48·64	95·5	1·52449	50·50
91·6	1·49628	48·68	95·6	1·52521	50·55
91·7	1·49700	48·73	95·7	1·52593	50·59
91·8	1·49771	48·78	95·8	1·52665	50·64
91·9	1·49843	48 82	95·9	1·52738	50·69

TABLE FOR THE COMPARISON OF THE DEGREES BRIX OR PER CENT. SOLIDS, WITH THE SPECIFIC GRAVITY AND THE DEGREES BEAUMÉ, FOR SOLUTIONS OF PURE SUCROSE FROM 0 TO 100 PER CENT AT 17·5° C. (*Concluded*).

Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.	Degrees Brix, or Per cent. Solids.	Specific gravity.	Degrees Beaumé.
96·0	1·52810	50·73	98·0	1·54290	51·65
96·1	1·52884	50·78	98·1	1·54365	51·70
96·2	1·52958	50·82	98·2	1·54440	51·74
96·3	1·53032	50·87	98·3	1·54515	51·79
96·4	1·53106	50·92	98·4	1·54590	51·83
96·5	1·53180	50·96	98·5	1·54665	51·88
96·6	1·53254	51·01	98·6	1·54740	51·92
96·7	1·53328	51·05	98·7	1·54815	51·97
96·8	1·53402	51·10	98·8	1·54890	52·01
96·9	1·53476	51·15	98·9	1·54965	52·06
97·0	1·53550	51·19	99·0	1·55040	52·11
97·1	1·53624	51·24	99·1	1·55115	52·15
97·2	1·53698	51·28	99·2	1·55189	52·20
97·3	1·53772	51·33	99·3	1·55264	52·24
97·4	1·53846	51·38	99·4	1·55338	52·29
97·5	1·53920	51·42	99·5	1·55413	52·33
97·6	1·53994	51·47	99·6	1·55487	52·38
97·7	1·54068	51·51	99·7	1·55562	52·42
97·8	1·54142	51·56	99·8	1·55636	52·47
97·9	1·54216	51·60	99·9	1·55711	52·51
			100·0	1·55785	52·56

PART VII.

MODELS OF BOOKS.

RECORD OF

FACTORY ....TH OF ....

Hour.		First Mill and Crusher.		Second Mill.		Third Mill.		Fourth Mill.		Residual Juice.	
		Brix.	Temp.	Brix.	Temp.	Brix.	Temp.	Brix.	Temp.	Brix.	Temp.
5											
6											
7											
8											
9											
10											
11											
12											
Total number of analyses											
Average											
Stated by analysis of the collective samples	Brix										
	Temp. ..										
	Corrected Brix										
	Sucrose..										
	Quotient.										

N.B.—Three sheets per day, each one covering

(This period may be changed if

JUICES. No..................

YEAR....................

Raw Juice.		Clarified Juice.		Scum Juice.		Syrup.		Sweet-Waters.		Bagasse.		Press Cake.
Brix.	Temp.	Brix.	Temp.	Brix.	Temp.	Brix.	Temp.	Brix.	Temp.	Dry Subst.	Sucrose	Sucrose

the period of one shift of eight hours.

preferred to 12 hours, etc.)

SHIFT

FACTORY.. ....TH OF..........................

HOUR.	Measuring Tanks, Raw Juice.	Temperature, Raw Juice.	Gallons Lime-milk, per 1000.	Measuring Tanks, Maceration Water.	Tanks, Clarified Juice.	Number of Presses Emptied.
5-6						
6-7						
7-8						
8-9						
9-10						
10-11						
11-12						
12-1						
1-2						
2-3						
3-4						
4-5						
5-6						
6-7						
7-8						
8-9						
9-10						
10-11						
11-12						
12-1						
1-2						
2-3						
3-4						
4-5						
Total						

RECORD. No.................

..................TONS OF CANE RECEIVED. YEAR......................

Weight of Press Cake.	Tanks, Syrup.	Degrees Bé., Syrup.	Strikes of Vacuum Pan.	Coolers Cured.	Sugar Cured.	Hours Stopped.

AVERAGES PER

FACTORY ....TH OF ....

Juice of First Mill and Crusher.				Juice of Second Mill.				Juice of Third Mill.			
No. of Shift.	Brix.	Su-crose.	Quo-tient.	No. of Shift.	Brix.	Su-crose.	Quo-tient.	No. of Shift.	Brix.	Su-crose.	Quo-tient.
Average				Average				Average			

Clarifed Juice.				Scum Juice.				Syrup.			
No. of Shift.	Brix.	Su-crose.	Quo-tient.	No. of Shift.	Brix.	Su-crose.	Quo-tient.	No. of Shift.	Brix.	Su-crose.	Quo-tient.
Average				Average				Average			

DAILY

Analysis.	First Massecuite.	Second Massecuite.	Third Massecuite.	Last Massecuite.	First Molasses.	Second Molasses.
Brix						
Sucrose						
Quotient ..						

SHIFT AND PER DAY. No. ....

YEAR ....

Juice of Fourth Mill.				Residual Juice.				Raw Juice.			
No. of Shift.	Brix.	Sucrose.	Quotient.	No. of Shift.	Brix.	Sucrose.	Quotient.	No. of Shift.	Brix.	Sucrose.	Quotient.
Average				Average				Average			

Sweet-Waters.				Bagasse.			Press Cake.	
No. of Shift.	Brix.	Sucrose.	Quotient.	No. of Shift.	Dry Substance.	Sucrose.	No. of Shift.	Sucrose.
Average				Average				

SAMPLES.

Third Molasses.	Last Molasses.	Analysis.	White Sugar.	First Raw Sugar.	Second Boilings.	Molasses Sugar.
		Polarization				
		Glucose....				
		Ash				
		Moisture ..				
		Nett				

FACTORY ....   YEAR

DAILY REPORT OF

ANALYSIS OF	LABORATORY FIGURES.					
	Dry Substance.	Sucrose.	Quotient.	Glucose.	Glucose Ratio.	Fibre.
Cane						
Cane juice..						
Juice, first mill and crusher.						
Juice, second mill						
Juice, third mill						
Juice, fourth mill						
Bagasse						
Residual juice						
Raw juice......°C.						
Clarified juice						
Filterpress cake						
Syrup..						
First massecuite						
First molasses						
Second massecuite						
Second molasses						
Third massecuite						
Third molasses						
Last massecuite						
Waste molasses..						

DELIVERED.	Bags or Puncheons.	Weight.	Brix.	Polarization.	Glucose.	Ash.	Nett.
White sugar							
First raw sugar..							
Second boilings							
Molasses sugar..							
Molascuit							
Molasses							
Waste molasses							

19...........

THE.........................TH OF...

	Weight.	Per cent.	Cane: Factory Samples.				
			No. of Field.	Brix.	Su-crose.	Quo-tient.	Calculated available on 100 cane.
Sucrose on 100 cane							
Sucrose lost in bagasse on 100 cane..							
Sucrose extracted in juice on 100 cane							
Sucrose extracted in juice on 100 sucrose in cane ..							
Mill extraction, less dilution on 100 cane							
Dilution on 100 cane							
Saturation on 100 cane ..							
Sucrose in filterpress cake..							
Sucrose in returned sugar ..							
Sucrose in sugar delivered..							
Sucrose in molasses delivered							
Calculated available sugar..							
Calculated weight of cane crushed							

Factory Figures.			Cane: Field Samples.				
			No. of Field.	Date of Planting.	Brix.	Su-crose.	Quo-tient.
Cane delivered		Tons					
Raw juice..		Gallons					
Number of measuring tanks		Tanks					
Maceration water		Gallons					
Number of measuring tanks		Tanks					
Galls. milk-of-lime of .. °Bé		Gallons					
Sugar returned in juice....		Weight					
Filterpress cake		Weight					
Number of strikes of the pan							
Sugar cured		Weight					
Sugar ready for delivery ..		Bags					
Sugar delivered		Bags					
Sugar on hand		Bags					
Coal..		Weight					
Firewood		Weight					
Stoppages		Hours					

DAILY QUANTITIES.

FACTORY.................................... MONTH.................................... YEAR.................. NO.

Date.	Cane.		Raw Juice.					Bagasse.	Press Cakes.		Sugar Delivered.					Molasses.		Sugar Returned.	
	Weighed.	Crushed.	Gallons.	Weight.	Weight of Dry Substance.	Weight of Sucrose.	Weight of available Sugar.	Weight of Sucrose lost in.	Weight.	Weight of Sucrose in.	Weight of White Sugar.	Weight of Raw Sugar.	Weight of Second Sugar.	Weight of Molasses Sugar.	Weight of Sucrose in Sugars.	Weight of Molasses.	Weight of Sucrose in Molasses.	Weight.	Weight of Sucrose in.
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29																			
30																			
31																			
Total																			
Carried forward from previous Month																			
GRAND TOTAL																			

DAILY PERCENTAGES.

FACTORY .... MONTH .... YEAR .... NO. ....

Date.	Cane.		Bagasse.				Juice First Mill and Crusher.			Juice Second Mill.			Juice Third Mill.			Juice Fourth Mill.			Residual Juice.			Raw Juice.						Clarified Juice.			Press Cake.	
	Sucrose.	Fibre.	Dry Substance	Sucrose.	Sucrose on 100 cane.	Fibre.	Brix.	Sucrose	Quotient.	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Calculated avail'ble Sugar	Glucose.	Glucose ratio.	Brix.	Sucrose.	Quotient.	Sucrose.	Sucrose on 100 cane.
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Total																																
Carried forward from previous Month																																
GRAND TOTAL																																

DAILY PERCENTAGES (*Continued*).

FACTORY.................................... MONTH............................ YEAR................ No...............

Date.	Syrup.			First Masse-cuite.			Second Masse-cuite.			Third Masse-cuite.			Last Masse-cuite.			First Mo-lasses.	Second Mo-lasses.	Third Mo-lasses.	Waste Molasses.			White Sugar.		First Raw Sugar.		Second Boil-ings.		Mo-lasses Sugar.		Total Sugar Del'vd	Total M'lasses Deliv'd.
	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Brix.	Sucrose.	Quotient.	Quotient.	Quotient.	Quotient.	Brix.	Sucrose.	Quotient.	Polarization.	Nett.	Polarization.	Nett.	Polarization.	Nett.	Polarization.	Nett.	Sucrose.	Sucrose.
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Total																															
Carried forw'd from previous Month . ..																															
Grand Total..																															

STOCK-TAKING.

Estimation of the sugar obtainable from the juices, syrups, and massecuites in the factory :—

	Gallons.	Specific Gravity.	Weight.	Dry Substance. Per cent.	Sucrose. Per cent.	Weight, Dry Substance.	Weight, Sucrose.
Raw juice							
Clarified juice							
Scum juice.. .. .							
Evaporators							
Syrup							
Vacuum pan, No. 1..							
,, ,, No. 2..							
,, ,, No. 3..							
,, ,, No. 4..							
Coolers							
,, ...							
,, ...							
Molasses tanks							
,, ,, ...							
,, ,, ...							
Total							

The quantity of sugar obtainable is found by assuming the non-sugar to immobilize from crystallization half its weight of sucrose. Subtract the total weight of sucrose from the total weight of dry substance in the above list and find the total weight of non-sugar. Half of this weight subtracted from the total weight of sucrose yields the weight of crystallizable sugar, which weight, divided by 0·945, represents the weight of sugar of 96° polarization to be expected.

	Tons.
Example.—Total dry substance in estimation	75
Total sucrose in estimation	45
Total non-sugar	30

Immobilizing $\frac{30}{2} = 15$ tons of sucrose—

Total sucrose	45
Immobilized sucrose	15
Crystallizable sucrose..	30

equivalent to $\frac{30}{0·945} = 31·75$ tons sugar 96° test.

FACTORY .... YEAR

MONTHLY REPORT FOR

	This month.	To date.	Corresponding date last year.
FIELD RETURNS.			
Acres under cane (total)			
Acres harvested			
Tons of cane received			
Tons of cane per acre			
MILL WORK.			
Separate days			
Days grinding			
Hours stoppage			
Time lost on 100 total time			
Tons of cane crushed			
Cane crushed per hour, including stoppages.			
,, ,, ,, ,, excluding ,, ..			
,, ,, ,, day, including ,, ..			
,, ,, ,, ,, excluding ,, ..			
Sucrose in bagasse on 100 cane			
Sucrose extracted on 100 sucrose in cane ..			
Saturation on 100 cane			
Dilution on 100 cane			
Mill extraction, less dilution on 100 cane ..			
RENDEMENT.			
First sugar made and estimated, tons			
Second ,, ,, ,, ,, ...			
Third ,, ,, ,, ,, ...			
Total ,, ,, ,, ,, ...			
Total ,, ,, ,, ,, calculated to 96 per cent. test on 100 cane ..			
Available sugar, calculated to 96 per cent. test on 100 cane			
Sugar calculated to 96 per cent. test per acre			
Molasses per ton cane, gallons			
Molasses per cent. cane			
Molasses sucrose per 100 cane			
Sucrose in sugar on 100 sucrose in juice ..			

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THE MONTH ....

	This month.	To date.	Corresponding date last year.
Raw Juice.			
Gallons, sp. gr. ...... , .. °C. .. .			
Gallons per ton of cane			
Total weight			
Weight per 100 cane			
Gallons milk-of-lime per 1000			
Clarification.			
Weight of press cake			
Press cake on 100 cane			
Sucrose in press cake on 100 cane			
Sucrose Account.			
Sucrose on 100 juice			
Sugars: sucrose per cent. sucrose in juice			
Molasses: sucrose per cent. sucrose in juice			
Press cake: sucrose per cent. sucrose in juice			
Unknown loss on 100 sucrose in juice ..			
Total loss of sucrose in 100 juice			
Fuel.			
Coal on 100 cane			
Firewood on 100 cane			
Stoppages.			
Rain			
Lack of cane			
Cleaning up			
Low pressure of steam			
Repairs			
....			
....			
....			

MONTHLY REPORT.—*Continued.*

Analysis.	This Month.					To Date.				
	Dry Substance.	Sucrose.	Quotient.	Glucose.	Glucose ratio.	Dry Substance.	Sucrose.	Quotient.	Glucose.	Glucose ratio.
Cane			Fibre					Fibre		
Cane juice										
Juice, first mill and crusher										
Juice, second mill....										
Juice, third mill.. ..										
Juice, fourth mill....										
Bagasse			Fibre					Fibre		
Residual juice ..										
Raw juice										
Clarified juice										
Press cake										
Syrup										
First massecuite.. ..										
First molasses										
Second massecuite ..										
Second molasses										
Third massecuite ..										
Third molasses										
Last massecuite.. ..										
Waste molasses										

Delivered.	This Month.					To Date.				
	Bags or Puncheons.	Weight	Dry Substance.	Polarization.	Nett.	Bags or Puncheons.	Weight	Dry Substance.	Polarization.	Nett.
White sugar .. .										
First raw sugar										
Second boilings.. ..										
Molasses sugar										
Molascuit										
Molasses..										
Waste molasses.. ..										

ACCOUNT OF RECOVERY AND LOSS OF SUCROSE DURING ....

FACTORY .... YEAR ....

	Weight.	On 100 cane.	Weight of Sucrose.	Sucrose on 100 cane.	Sucrose on 100 Sucrose in cane.	Weight of Sucrose.	Sucrose on 100 cane.	Sucrose on 100 Sucrose in cane.
RECOVERY.								
In raw juice	....	....				....	....	....
In first sugar	....	....	....	....	....			
In second sugar	....	....	....	....	....			
In third sugar	....	....	....	....	....			
In molasses sugar	....	....	....	....	....			
Sugar estimated in the syrups, etc.	....	....	....	....	....			
Total sugar			....	....	....	....	....	....
Loss of sugar except in bagasse..						....	....	....
LOSS.								
In press cakes..	....	....				....	....	....
In molasses	....	....				....	....	....
Unaccounted for						....	....	....
In bagasse						....	....	....
Total loss of sucrose						....	....	....

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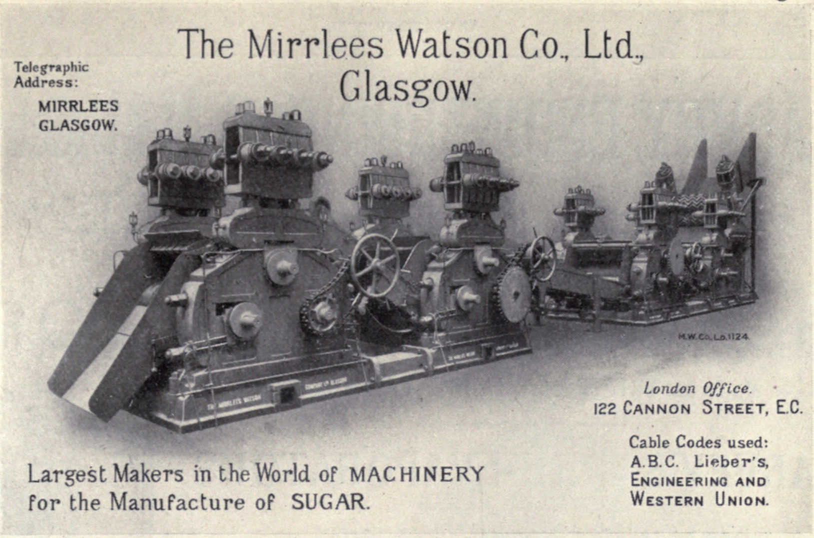
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M.W.Co.Ld.1124.
London Office.
122 CANNON STREET, E.C.
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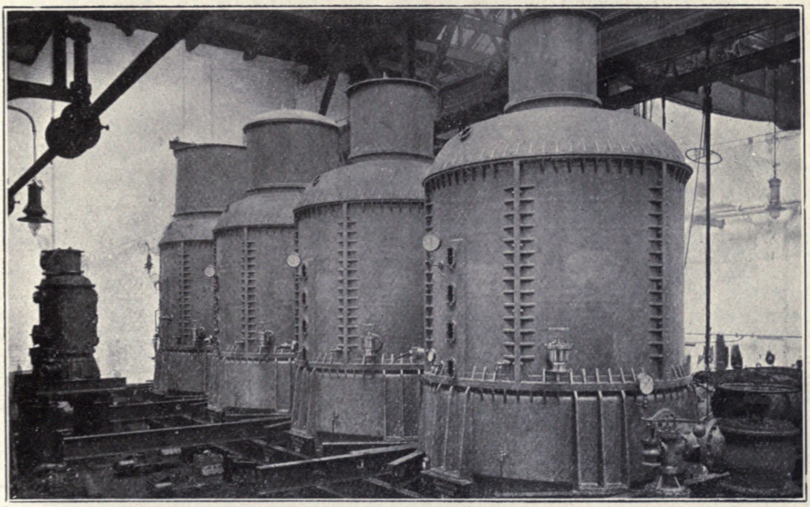

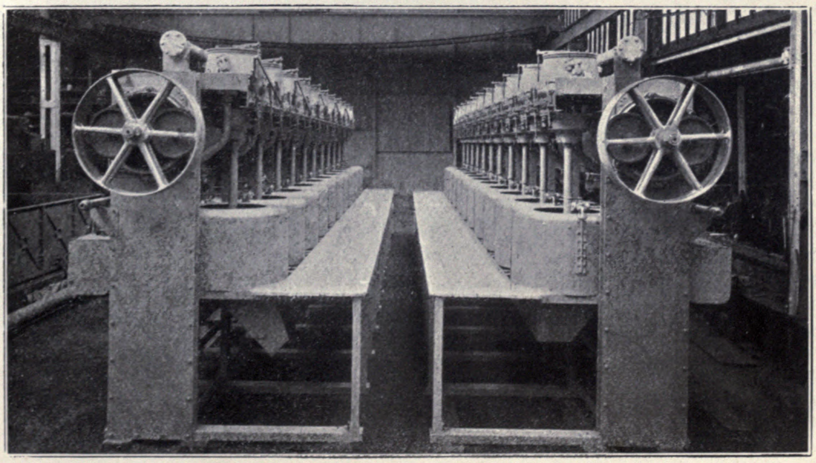

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SUGAR MACHINERY SPECIALISTS.

SOLE MAKERS OF THE WELL-KNOWN

HARVEY EVAPORATOR.

Made as TRIPLE or QUADRUPLE EFFETS.

HARVEY'S PRE-EVAPORATORS.

The Advantages of HARVEY'S EVAPORATING APPARATUS are:—

COMPLETE & RAPID CIRCULATION. | AUTOMATIC IN ITS ACTION.
SIMPLE IN DESIGN. | MODERATE IN PRICE.
REDUCES THE COST OF LABOUR, AND EFFECTS A VERY GREAT SAVING IN FUEL.

On several of our Evaporators, including "Soledad" Estate, Cuba, and "Sena" Sugar Factory, Mozambique, the results obtained have been fully 10 lbs. of water evaporated per square foot of heating surface per hour.

We have now constructed Evaporators for over ONE HUNDRED AND FORTY SUGAR ESTATES in the following countries, namely:—

Demerara, Berbice, Surinam, Trinidad, Jamaica, Porto Rico, Cuba, Brazil, Chile, Peru, Ecuador, Colombia, Mexico, Guatemala, Japan, Formosa, Fiji, Philippine Islands, Straits Settlements, Queensland, Java, British India, Mauritius, Mozambique, and South Africa, all of which are giving entire satisfaction.

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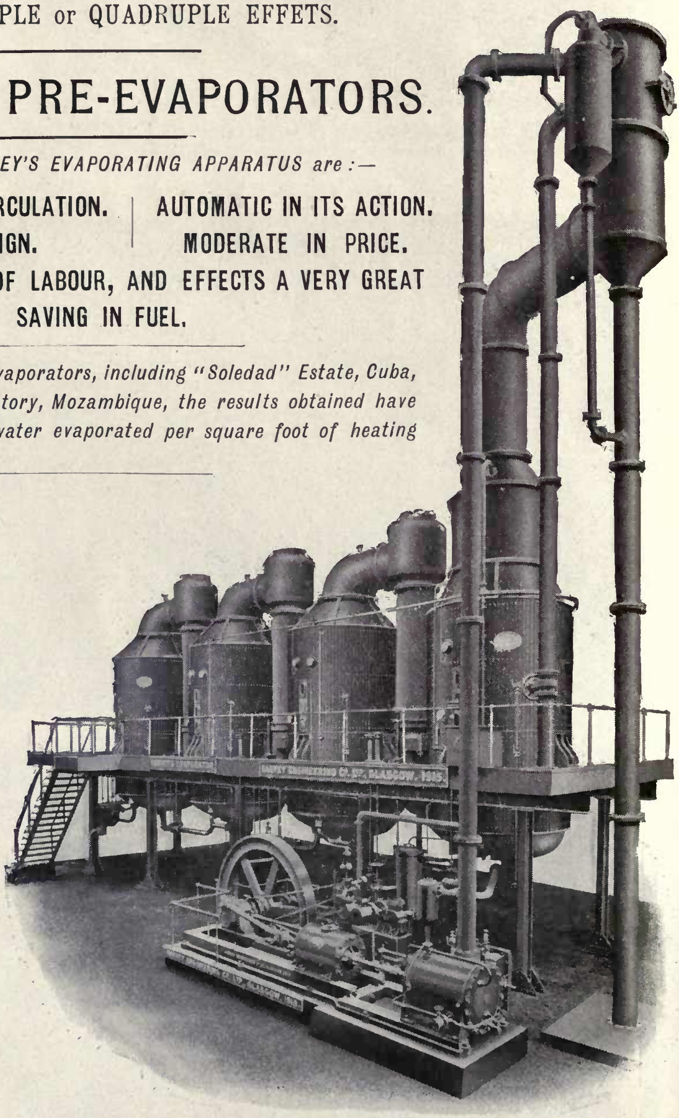

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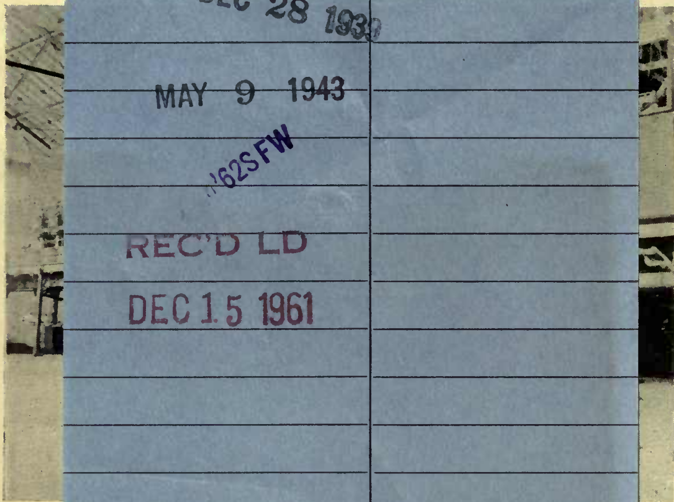
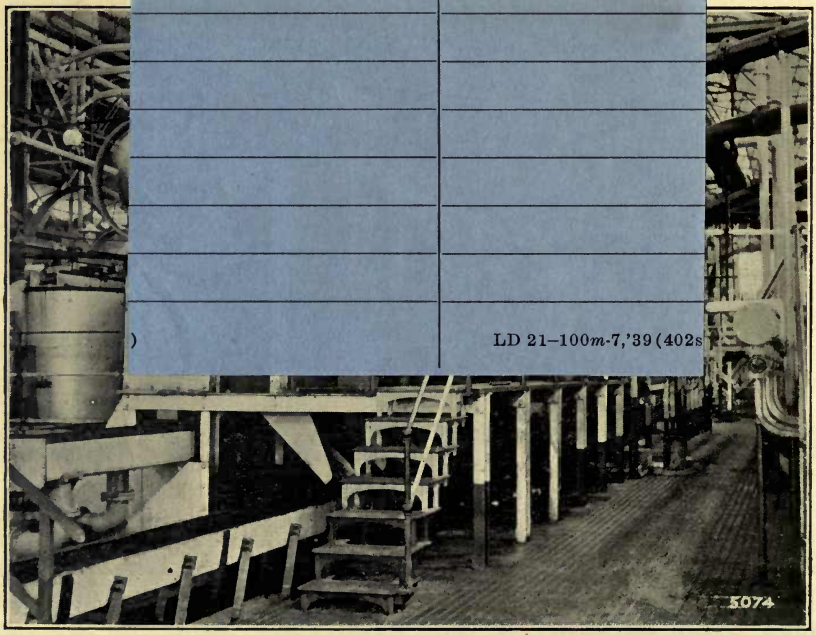
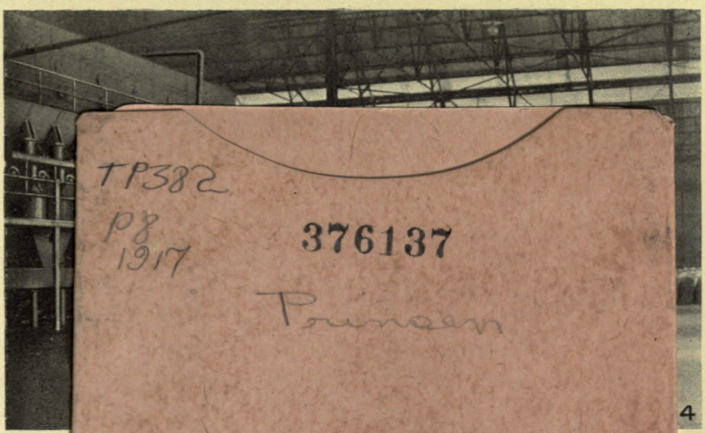
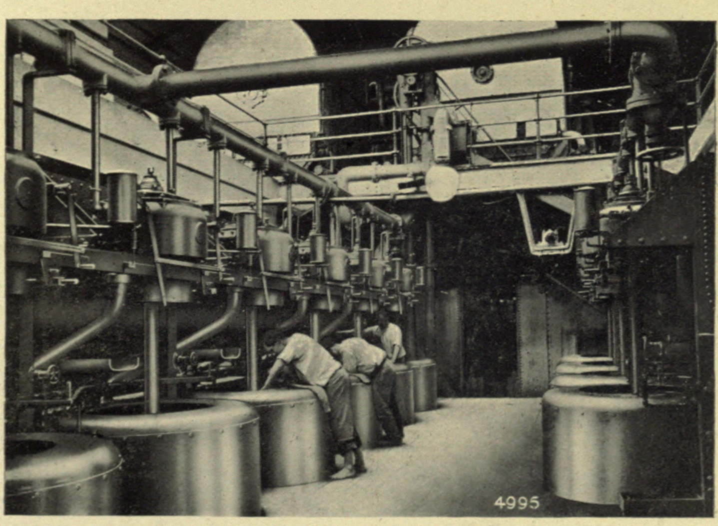




Electrically-driven Centrifugals in a Sugar Factory in Java.

CENTRIFUGALS





Water-driven Centrifugals in a Belgian Sugar Refinery.

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