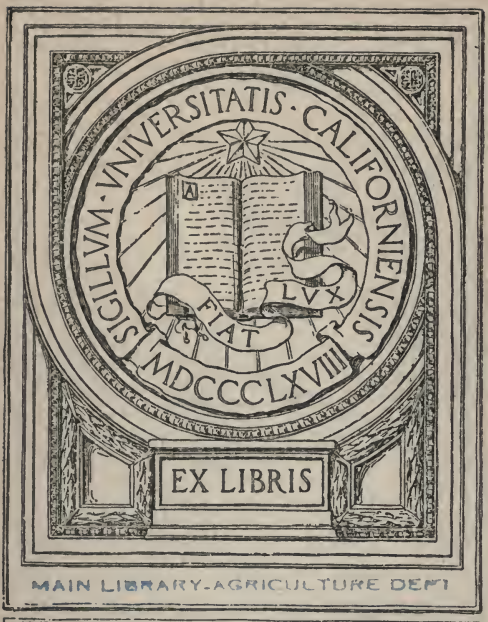

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H. W. WILEY, CHIEF OF BUREAU.

ANALYSES OF SUGAR BEETS, 1905 TO 1910,

TOGETHER WITH

METHODS OF SUGAR DETERMINATION.

BY

A. HUGH BRYAN,

Chief, Sugar Laboratory.

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1911.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., June 14, 1911.

Sir: I have the honor to submit for your approval a report prepared in the sugar laboratory of this bureau on the analyses of sugar beets made during the years 1905 to 1910, inclusive, together with methods of determining the percentage of sugar in the beet. This compilation, representing, as it does, beets from many different localities, will be useful in answering the many inquiries received as to the quality of beets grown in the various sections of the country and the best methods for determining their sugar content. I recommend, therefore, that the manuscript be published as Bulletin No. 146 of the Bureau of Chemistry.

Respectfully,

H. W. Wiley,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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ANALYSES OF SUGAR BEETS, 1905 TO 1910,

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METHODS OF SUGAR DETERMINATION.

INTRODUCTION.

Many requests are received at this department for reports on analyses of beets grown in different localities and also for information as to the fitness of certain sections for growing beets. Many inquiries are also received as to the best methods for the analysis of beets. This report, including a résumé of the analyses made of beets grown in various sections of this country throughout a period of six years, and also a statement of the methods used for beet analysis, with a discussion of their comparative accuracy, has been compiled to meet this demand.

As early as 1862 [1] the Department of Agriculture became interested in sugar-beet work, and for the past 30 years this bureau has been engaged in the analysis of sugar beets and in making investigations for the improvement of this industry. The following bulletins have been published giving the results of this work: No. 3*, The Northern Sugar Industry, 1883; No. 5*, The Sugar Industry of the United States, 1885; No. 27*, The Sugar-Beet Industry, 1890; Nos. 30*, 33*, 36*, 39*, and 52*, devoted to experiments with sugar beets in the years 1890, 1891, 1892, 1893, and 1897; Nos. 64, 74, 78, 95, and 96, devoted to a five years' study of the influence of environment upon the composition of the sugar beet, undertaken in 1900 to 1904, inclusive.

The bulletins marked with an asterisk (*) are out of print and are not available for distribution; the others may be had on application. Also, as a part of Progress of the Beet Sugar Industry of the United States, published yearly as a special report of the Secretary of Agriculture, there has been issued in the years 1897, 1898, 1899, and 1900 a report covering the analytical figures obtained in the analyses of samples of beets for these years. Since 1900 there has been no publication of results of analyses of beets made in the Bureau of Chemistry other than those published in the study of the influence of environment on the composition of the beet. Many samples have been analyzed since that time.

[1] U. S. Dept. Agr., Bureau of Chemistry Bul. 52, p. 12.

During the years 1901–1904 many samples of beets were analyzed for local sugar projects, but their results are not included. The results from 1905 on to 1910 have been tabulated by States and counties. The location of the county in the State is noted by the usual sign, namely: □ center of State; □- east of center of State; ⌐□ southwest of center of State, etc. The figures given are for the average weight of beets (expressed in ounces), per cent of sugar in juice, and purity of the juice (the per cent of sugar in the solids of the juice). The condition of the sample as received is also stated. In this table no averages for States or counties are given, as so many factors enter into the results that conclusions based on such data might be misinterpreted. In fact, one can only form a comparative opinion as to the fitness of a certain region for beet growing from these analyses. The reasons for this may be briefly stated and serve also to illustrate the need for very careful work before passing final judgment on the possibilities of any section for beet culture.

FACTORS TO BE CONSIDERED IN INTERPRETING ANALYTICAL RESULTS.

A sugar beet is a plant that is greatly influenced by environment, cultivation, etc. Beets from the same seed may be grown in the same soil and under the same climatic conditions and the sugar contents at maturity be very different, owing to different methods of cultivation. A farmer who has grown beets a number of years in succession may raise a better crop than one in the same locality who has had no experience. Many of the samples herein reported came from farmers who had never raised beets before; some of the crops were no doubt raised on land entirely unsuitable for beet culture, and the results from the latter experiments would be of value as a test only if the soil of the plat were representative of this particular section. The large number of persons applying for beet seeds during a year made it impossible to keep a detailed record of the varying cultural and climatic conditions, although instructions were sent in all cases regarding the selection of the plat for the work and cultivation methods.

Correct sampling methods are also important to insure comparable results. Many people believe that the more prolific the growth of a beet the higher will be the percentage of sugar, and so select large beets from a patch for testing. This is not true, however, except in rare cases. Again, the sugar content varies with the degree of ripeness. As a beet matures the percentage of sugar increases; so selection with regard to this point is important. Two persons going through a field for sampling may draw samples that will vary as much as 3 or 4 per cent in sugar content. But if one is familiar with the work, the results from 20 or even fewer beets may fairly

represent the field at that particular stage of growth. As no attention was paid to the method of sampling in over 90 per cent of the cases here reported, the results, as a basis for judging of the suitability for a given area for beet cultivation, are apt to be misleading.

Another factor which may affect the amount of sugar found is the condition of the beets when received for analysis. The healthy beet when taken from the ground is crisp, but on exposure to air and heat it soon loses moisture and becomes wilted; the next step is rotting. In losing water, the percentage of sugar present will, of course, be increased, but this increase is seldom in the same ratio as the loss in weight. Experiments conducted in 1891[1] at the Schuyler station in Nebraska show what may happen under these conditions. Beets were dug on October 3, carefully cleaned, and the leafy tops removed. They were then placed in the sun and reweighed at the end of each 24 hours. The daily temperature was 68° F. and the mean maximum 90° F. A heavy wind was blowing most of the time. Beginning with 152 pounds of beets, the loss in weight after one day was 13.2 per cent, after two days 23.8 per cent, after three days 32.4 per cent, and after four days 37.5 per cent. A sample drawn from the fresh beets showed 15.1 per cent of sugar, while at the end of the fourth day a sample drawn showed 17.1 per cent, an increase of only 2 per cent of sugar. Calculating the original sugar content of 15.1 per cent for the loss in weight, the beets should contain at the end of the four days 24.2 per cent, showing a loss of 7.1 per cent in sugar in the beet. This is a remarkable loss, but the experiment was carried on under severe weather conditions, great heat and wind.

A second trial was made in which clean beets were divided into three portions of 25 pounds each. One portion was left in the field, another was kept in the air but under a shed where the direct rays of the sun did not come in contact with the beets, while the third portion was analyzed. At the end of three days there was a 20 per cent loss in weight for the shed beets and a 22 per cent decrease for the field beets. The sugar content of the fresh beets was 16.2 per cent, of the shed beets 19.6 per cent, and of the field beets 18.3 per cent. Figuring the loss in weight as moisture, the sugar percentage of the shed beets should be 20.2 per cent at the end of the three days and of the field beets 20.7 per cent. The sugar losses here noted are not so large as in the previous experiment, being only 0.6 per cent when beets were kept away from the direct rays of the sun, but 2.4 per cent when they were placed in the sun.

Other experiments that have been tried indicate that after harvesting sun and heat work great detriment to the sugar content. An interesting experiment, showing that under certain conditions the

[1] U. S. Dept. Agr., Bureau of Chemistry, Bul. 36, p. 62.

sugar content does increase in proportion to the loss in weight, was tried at the same station. Twenty beets of about the same size and of the same degree of ripeness were selected. Ten were analyzed immediately and the other 10 were wrapped in oiled paper and sent to Washington for examination. The results are given in the following table:

Comparative analyses before and after shipment.

Time of analysis.	Loss in weight.	Per cent of sugar in beets.	Grams of sugar in beets.
	Per cent.		
Fresh		14.7	47.9
After shipment to Washington	12	16.6	47.9

There was a loss in weight during shipping of 12 per cent, but an increase of 1.9 per cent in the beet is noted, and the actual amount of sugar in the beet remains unchanged.

In the case of the samples herein reported the directions for shipping beets to Washington for analysis were to wrap each beet separately in oil paper, this paper being sent the grower, together with the shipping tag. In many cases the beets were fresh when received, but in a large percentage of instances they had evidently dried out before wrapping them for sending. It is important in using the analytical data contained in the tables to remember that these factors may have influenced the results.

For commercial purposes a beet of over 12 per cent sugar content, 12.5 to 13.5 per cent of sugar in the juice, and at least 80 per cent purity, and which weighs over 1 pound but under 4 or 5 pounds, is considered the most desirable. The contracts of most sugar companies with the farmers are based on these figures, but at times deviations from them are accepted. With these facts in mind one may form an opinion of the manufacturing value of the beets reported in the tabulated data (see p. 23).

METHODS OF SAMPLING.

The accuracy of the determination of sugar in the beet depends largely upon mechanical processes and accurate results are difficult to obtain unless a stated procedure is strictly followed, thus eliminating many chances of error. As with many other procedures, the statement of methods for the analysis of sugar beets is not sufficiently detailed and its limitations are not pointed out, so that an inexperienced worker may obtain accurate results. For example, all methods for beet analysis presuppose a finely divided pulp. With some methods the pulp must be much finer than with others. This is especially true of "instantaneous" methods or those obtaining the

sugar by digestion in the cold. The sampling and subsampling of the beets are important details, for unless the sample is representative the results obtained are of little value.

SAMPLING FROM THE FIELD.

The beet chemist is often called upon to take a sample from the field. This sample should accurately represent the whole crop to be of any value as an index of the condition of the field. There are many methods of accomplishing this, some of a mathematical nature. The method to be employed depends somewhat upon the size of the field and the purpose for which the results are to be used. If the plat is small and it is the purpose to sample often, then a smaller sample may be used, but when the fields are extensive a larger sample should be drawn.

As an example of a mathematical method of sampling, the following is given: Look over the plat, noting the stand, and remove all beets that are not up to the average condition of the field. Go through again and dig every fourth to tenth beet (according to size of plat) for the analytical sample; every twentieth beet should be taken if the plat is very large. From 20 to 100 beets should constitute a sample. Another method is to remove all the beets in one row or a measured portion of a row and use these as the analytical sample. Care must be exercised that the row selected is representative.

To ascertain for factory purposes whether or not the crop is ripe and ready for harvest, the general practice is to walk across the field from one corner to the opposite one, noting the stand and the general condition of the beets as indicated by their leaves, general appearance, etc.; then on returning to dig from 5 to 20 beets at random, selecting those in average condition. Here the judgment of the sampler is wholly relied upon, but with experience and a knowledge of the variety under cultivation, a representative sample should be obtained.

Whatever method is used, it is essential in digging and cleaning the beets not to injure the skin and not to break the roots too short. The topping should consist only in removing the leaves, the crown being left in place for the chemist to remove; this prevents drying of the sample, etc.

SAMPLING FROM PILE, WAGON, OR CAR.

In sampling from a pile instead of from a field the judgment of the sampler again must be relied upon. A good procedure is to examine the pile of beets, noting the general shape and average size, and then to select from 10 to 50 beets for analysis, depending on the size of the pile. A proportionate number of large, small, and irregular-shaped beets should be used as they occur in the pile.

In drawing samples from a wagonload or carload of beets, it is customary to adopt one of the following procedures: When a dumping

wagon is used, a bushel basket is placed on the bin in the path of the falling beets and withdrawn after the load is dumped. The beets in the basket constitute the analytical sample. If an ordinary wagon is used a bushel basket full of the beets is forked out during the unloading. In case the sample is taken directly from the cars, three or more samples should be selected from different portions of the car as it is being unloaded in the same manner as from the ordinary wagon.

LABORATORY SAMPLING AND PULPING.

The sampling of beets in the laboratory is a very important matter, as for the final analysis only a very small portion is used. The samples offered for analysis are composed of from 10 to 100 beets, and in an ordinary laboratory it is practically impossible to pulp all of the larger sample; therefore, one must resort to removing a section from each beet and pulping this. The removal of the right section is a difficult matter, since the sugar is not evenly distributed throughout the beet. Many persons have studied the localization of the sugar content of the beet. Prominent among them are Violette, Wiesner, De Vries, and Marek.[1] The latter went into the subject quite thoroughly in 1882. Proskowetz a number of years later worked out the localization of the sugar content in the beet as follows: By dividing a beet into four or five equal horizontal sections, as is shown in figure 1, he obtained the following percentages of sugar in the various portions:

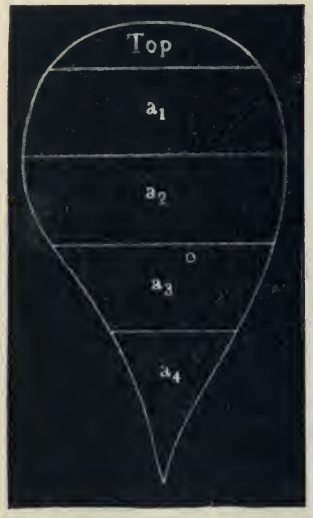


FIG. 1.—Horizontal sectioning of beets.

Percentages of sugar in horizontal sections of the beet.

Part of beet.	Sample 1.	Sample 2.	Sample 3.
In top....	12.30	14.08	17.52
A_1.....	12.62	14.36	17.82
A_2.....	12.57	14.42	17.68
A_3.....	11.95	14.50	17.26
A_4.....	(1)	14.20	(1)

[1] Only four sections made.

From this it is shown that the bulged section (A_1) has the highest percentage of sugar. Other observers by dividing the beet into more and smaller sections obtained the same result, namely, that the highest sugar content is located in the region of the point of

[1] Within the last few months Floderer and Herke have reviewed the previous work on this subject and have also added a large amount of careful experimental work. They come to practically the same conclusions as are here given. Osterr.-Ung. Zts. Zuckerind. Land., 1911, 40: 385.

gravity of the beet mass and diminishes on both sides toward the top and the tip. Dividing the beet as is shown in figure 2—that is, cutting it into circular portions from the center to the skin—the following results were obtained:

Percentage of sugar in different vertical sections of the beet.

Section of beet.	Per cent sugar.
B_1	13.99
B_2	14.12
B_3	14.13
B_4	12.98

From these data it is seen that the zone next to the outside of the beet contains the highest sugar per cent, the next inside zone being nearly as high, while the outside and the central zones are lower. If the beet were cut into more zones, it would be found that the highest sugar occurred in a zone about three-fourths of the way from center to the outside.

FIG. 2.—Vertical sectioning of beets.

Plant physiology shows that some cells contain much more sugar than others. If the beet is perfect in form a section taken throughout its complete length and passing to the center of the beet would be representative. If the beet is not of even form an error is apt to creep in, as it has been found that the per cent of sugar is higher in the portion of the beet that is depressed than in the well-expanded portions. If the weights of the sections removed in sampling could be so regulated that they bore an exact ratio to the whole weight of the beet, and this were constant for all, then these sections would accurately represent the large sample. Unfortunately this condition can only be approached, as it is possible to cut a beet in half or even in quarters, but beyond that it is difficult to subdivide by hand. The hand method is the one usually employed, however, in sampling beets, although machines in the form of cone-shaped rasps, which remove a section from the beets, are manufactured. The rasp is circular in form, thicker at the center and tapering to the edge. By running a beet over this fast-revolving rasp, the section is removed in the form of a fine pulp, and may be caught in a basket or box placed below it. When using from 20 to 50 beets the sample of ground pulp is quite large, and for accurate work it must be rapidly mixed and quartered, drawing one or more samples for analysis. In mixing it is necessary

to guard against evaporation and also squeezing of the pulp; evaporation causes, of course, a higher sugar content than is naturally present, while squeezing may result in either a higher or lower sugar content, depending on the sample drawn. With quick mixing, however, little loss occurs.

In case the section has been removed by hand, it must be reduced to a pulp. There are many machines made for this purpose; in general, any meat chopper which yields a finely divided product may be used, but some forms are preferable to others. An evenly cut or shredded pulp should be obtained by grinding with little or no pressing. Machines that operate by feeding the beets by means of a screw to the cutting knife are very liable to express some of the juice, while if the screw is fitted with knives which do the cutting as well as the feeding the pressure on the pulp is lessened. Other machines have a revolving bowl with rotatory knives constantly turning, the two being driven by the same power. This yields a fine pulp with little pressing, but is hardly capable of receiving halves or even quarters of beets to be sliced. An ordinary horse-radish grater serves admirably for reducing sections of beets to a fine pulp. This grater has a rotating drum provided with nails extending from its surface about a quarter of an inch. An adjustable chute extends to the drum, so that the beets can be fed to it by hand. The nails may be replaced by embedding hacksaw blades in the drum and allowing the coarse teeth to stand out above the surface. In using such a grater care must be exercised not to feed too fast and to have the carrier for the beets just touch the points of the drum. In this way the beet is cut squarely off and no portion goes through uncut. It is highly important to feed beets into this machine in such a way that the grater comes in contact with the skin of the beet first, otherwise it is difficult to shred the skin, which is generally very tough. When one sample is finished all of the beet particles must be carefully brushed off of the drum and machine to avoid mixing the samples. This, however, is true with any machine. After shredding, the sample may be thoroughly mixed by hand.

SAMPLING AND TESTING SEED BEETS.

Beets that are to be used for seed production are tested for sugar content, and it is essential to obtain a sample from them without injuring their productiveness. This is usually accomplished by boring a hole through the beet in some such way as is shown in figure 3, and collecting the borings for analysis. It is highly important to control the direction of the passage of this rasp through the beet. As has been shown, the sugar is not equally distributed throughout the beet. It behooves one, therefore, to cut through as many zones as possible and the same cut should be made in all cases if the results

are to be comparable. Much work has been done to determine the point of sampling and it has been shown that the rasp should enter near the edge of the leaf scar and take a direction at an angle of 45° to the main axis through the beet. This can be accomplished by having the beet placed on a moving board tilted at the proper angle and pressed against the rasp, or the rasp may be pressed against the beet. Rasps are manufactured which remove this core whole, or collect the cuttings in the shaft of the drill (fig. 4). The sample obtained this way seldom amounts to 26 grams and it is difficult to press this quantity and obtain sufficient juice to determine the dry substance and also the sugar. The per cent of sugar is determined direct by one of the instantaneous methods or by the hot-water digestion method.[1] Ten grams of the beet pulp may be digested, made up to 38.7 cc; and polarized in a 200 mm tube; the reading will be the per cent of sugar. Or 6.48 grams of the cuttings may be digested, made up to 50 cc, and a reading made in a 400 mm tube. Again, the beet cuttings in the rasp can be placed in a tared dish and the whole weighed. The pulp is then washed into a 100 cc flask if the sample amounts to about 13 grams, or into a 200 cc flask if it is nearly 26 grams, and a water digestion is made in the usual way. The per cent of sugar obtained, multiplied by the relation of the weight of sample used to 26 grams gives the percentage of sugar present. A correction should be made for the space occupied by the marc, 26 grams of pulp occupying 0.6 cc.

FIG. 3.—Correct position of boring rasp in beet.

The basic lead acetate solution is practically the only one used for clarifying beet solutions for polarization. The clarifying power of this solution depends somewhat upon its basicity. Browne[2] has shown that as the basicity increases the polarization of a raw cane

FIG. 4.—Boring rasp.

sugar or cane sirup increases. As large an increase will hardly take place in the polarization of a beet, but it shows that care must be taken in the preparation of the basic lead acetate solution, "Three well-defined subacetates have been prepared by the digestion

[1] See pages 18 and 19.

[2] U. S. Dept. Agr., Bureau of Chemistry Bul. 122, p. 223.

of litharge with normal lead acetate. These are 3PbAc2PbO the one usually prescribed for clarification, PbAcPbO the monobasic, and PbAc2PbO the diabasic."[1] Variations in time of digestion, in quantities of litharge used, and in temperature of digestion will result in solutions containing mixtures of all of these.

To prepare this reagent boil 3 parts (by weight) of neutral lead acetate and 1 part of yellow litharge with 10 parts of water until the reaction is completed or the material is practically all dissolved. This generally takes not over half an hour. Cool and dilute the solution with water to a specific gravity of 1.25 or 53.7 Brix. The solution is filtered or allowed to stand until clear. The bottle should be kept tightly corked, as the composition of the solution changes. It may also be prepared by dissolving dry lead subacetate (containing 72.81 per cent of lead) in water until the specific gravity of the solution is 1.25 or 53.7 Brix.

METHODS FOR DETERMINING SUGAR.

Methods for the determination of sugar in the beet may be divided into two general classes, namely, direct and indirect. The former may be subdivided again according to the solvent used and the temperature of extraction. There is only one indirect method and this will be considered first.

INDIRECT METHOD.

The indirect method depends on pressing the juice from the beets, determining the sugar in the juice, and then by a factor calculating the per cent of sugar in the beet. In practice this is accomplished by inclosing the beet cuttings in a jute or cotton cloth, placing the whole in a press, and catching the juice in a vessel large enough to hold it all. The juice is thoroughly mixed, poured into a cylinder, and allowed to stand until the air bubbles have collected at the surface; generally from 20 to 30 minutes is necessary. This foam is brushed aside when the Brix hydrometer is placed in the liquid to obtain a reading on the content of solids. The hydrometer is allowed to come to rest before a reading is made, and should float free of the sides during the reading. After observing the reading and noting the temperature of the solution, the normal or double normal amount of the juice is either drawn up in a sucrose pipette (Spencer's method, *A*, frontispiece) or is weighed. This portion is run into a 100 cc flask with water, and a solution of basic lead acetate added in a sufficient quantity to produce a complete precipitation, but an excess is to be avoided. The flask shown at *B*, frontispiece, is an excellent shape for sugar analysis, because the slanting sides prevent

[1] U. S. Dept. Agr., Bureau of Chemistry Bul. 122, p. 223.

air bubbles from remaining on its surface. The flask is then filled to the mark with water, shaken, filtered, and polarized. The percentage of sugar in the juice thus obtained is multiplied by a factor to obtain the amount of sugar in the beet. This factor corrects for the marc or solid portion of the beet. It is not, however, accurate to determine the marc by the usual method, namely, by washing away the soluble portion of the beet, drying, and weighing, calculating the per cent of solids, subtracting this from 100, and using the figure found for the juice factor. With this procedure the results will be too high for the reason that the marc contains water other than that holding the sugar and no correction is made for it. The marc of beets varies from 4 to 5.5 per cent, with an average of about 4.7 per cent. The juice factor calculated from this figure would be about 95.3, but when the colloidal water or water of marc is considered the figure is from 88 to 95, depending on the condition of the beets and the pressure used. A factor as low as 82 may be obtained if the beets are badly wilted from long standing in a dry climate, such as Colorado. This factor may be determined for a given locality by selecting beets of average condition and finding the per cent of sugar in the juice by the indirect method just given; then on a small portion of the same sample of beets determining the per cent of sugar in the beet by one of the direct methods, and dividing the per cent of sugar in the beet by the per cent of sugar in the juice. Such a factor is applicable to beets of like condition.

The indirect method is used somewhat extensively, for by its use in addition to the percentage of sugar the purity of the juice (the per cent of sugar in the solids of the juice), which is considered by some to be an important factor in beet analysis, is obtained. This method is advantageous in that large quantities of pulp, representing many beets, can be used for pressing; therefore it is very easy to obtain an average sample when the original quantity is large. The main objection to it is that it does not give the sugar in the beet direct, the use of a factor being necessary. This average factor varies somewhat in different localities, ranging from 91.5 to 93, and its use works to the advantage of one sample and to the disadvantage of another. If not much depends on the accuracy of the results, this method can be used, but it can hardly be recommended when exactness is desired.

ERRORS OF THE METHOD.

Errors in the actual determination of the percentage of sugar creep in from the following sources, but with beets of 15 or even 20 per cent sugar content these errors may be within the error of reading or the limits of the sensibility of the instrument:

(1) Use of the wrong normal weight. Most polariscopes that have been purchased during the last five or six years are standardized for

26 grams of sugar, dissolved and made up to 100 true cubic centimeters with water at 20° C., and the polarization made in a 200 mm tube at the same temperature. The old normal weight of 26.048 grams of sugar was for 100 Mohr cubic centimeters, and probably the polarization was to be made at 17.5° C.

(2) Use of the wrong flask, namely, Mohr cubic centimeter flasks in place of true cubic centimeter flasks or vice versa.

(3) Use of old polariscopes whose accuracy has not been checked. A polariscope scale can be checked against pure sugar, but ordinarily it is much better to check against a standardized quartz plate.

(4) Use of sucrose pipette in place of a normal weight. This pipette can be easily standardized and the error due to this source checked, but in general it is better to obtain the normal or double normal amount of juice by weighing.

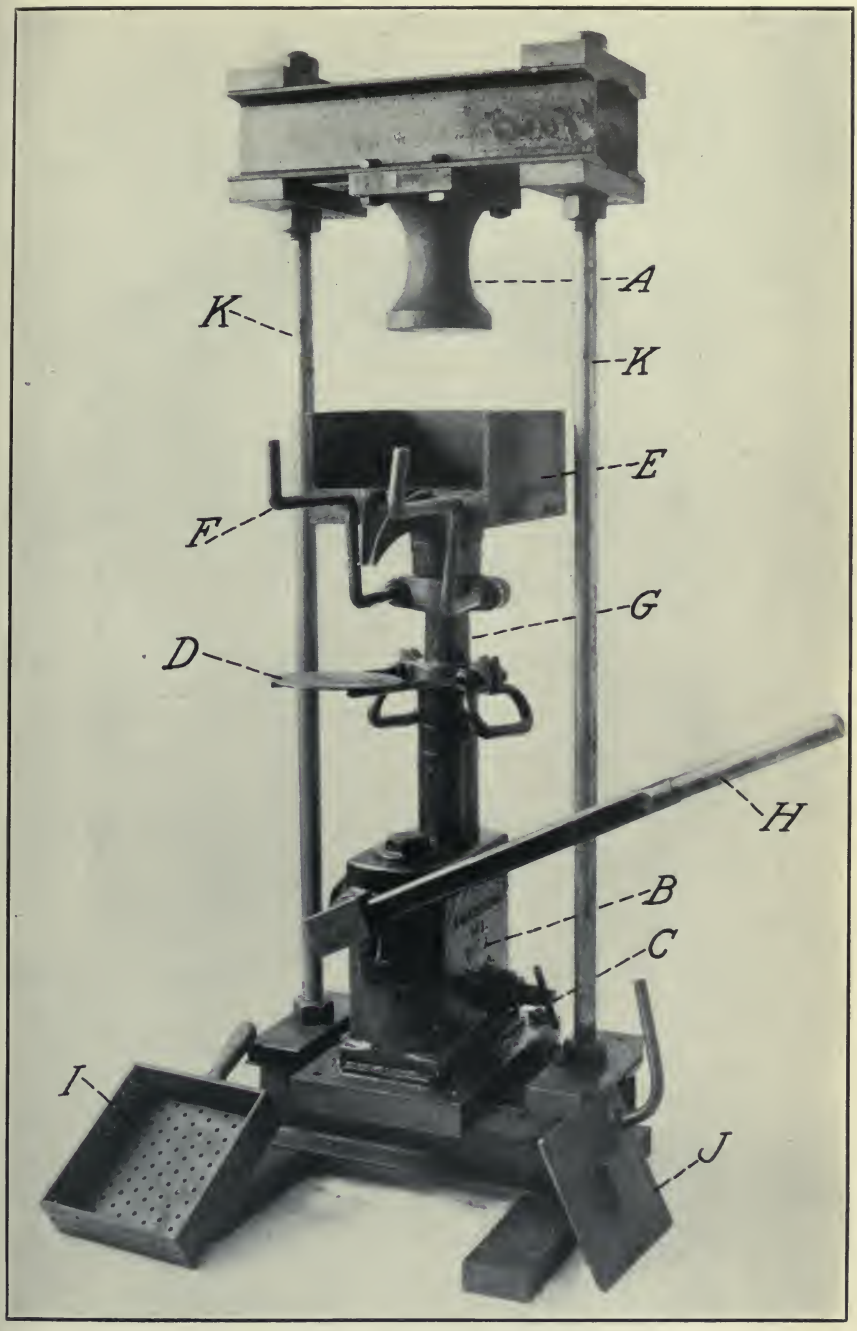
An error that may amount to several per cent can be introduced by using the same jute cloth for pressing beets when the per cents of sugar in the two samples vary greatly. A large error may also enter from dilution by not removing all of the water used in washing out the press after each sample. Errors in reading the Brix hydrometer are sometimes due to air in the juice and also to the adherence of the hydrometer to the sides of the cylinder. If these chances of error are guarded against, the reading of the per cent of sugar in the juice should be accurate. The following table[1] shows the possible error from the use of a wrong factor:

Variations in results obtained by using different factors.

Sugar in juice.	Sugar in beet calculated by factor—					
	90	91	92	93	94	95
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
12	10.8	10.92	11.04	11.16	11.28	11.40
13	11.7	11.83	11.96	12.09	12.22	12.35
14	12.6	12.74	12.88	13.02	13.16	13.30
15	13.5	13.65	13.80	13.95	14.10	14.25
16	14.4	14.56	14.72	14.88	15.04	15.20
17	15.3	15.47	15.64	15.81	15.98	16.15
18	16.2	16.38	16.56	16.74	16.92	17.10
19	17.1	17.29	17.48	17.67	17.86	18.05
20	18.0	18.20	18.40	18.60	18.80	19.00
21	18.9	19.11	19.32	19.53	19.74	19.95

Should the juice polarize 20° and a factor of 90 be used when 95 is the correct one, the resulting figure for the sugar in the beet is just 1 per cent too low. If the results by this method are used as a basis for the price paid for beets, the grower would lose the price of an extra per cent of sugar per ton, which varies from 20 to 25, or 33 cents.

[1] Taken from report of E. E. Ewell, Fifty-sixth Congress, first session, Doc. No. 699, p. 147.



HYDRAULIC PRESS FOR BEET ANALYSIS.

A, Head block. *B*, Hydraulic jack with ram *G*. *C*, Release valve of jack. *D*, Stand for vessel to receive juice. *E*, Receiving box fastened to ram *G*. *H*, Handle for pumping up jack. *I*, *J*, Porous box and cover for beet sample.

HYDRAULIC PRESS.

In Plate I is shown a form of press that has been used successfully for beet pressing by this laboratory. It consists of a hydraulic jack *B* fastened to two pieces of I beam clamped together for the base. Fastened to these clamps are two upright steel rods *K*, and to them are fastened I beams with clamps to hold the head block *A*. Fitted to the ram *G* of the jack is an iron box with lip *E*, also the bent rods *F* and the platform *D*. To operate this press the porous cast-iron pan *I* is placed in the box *E*. A square of jute cloth is then placed in the pan, and the sample of beet cuttings poured into it. The edges of the cloth are folded over and the plate *J* is placed on top. A jar for receiving the juice is placed on the platform *D*, and by means of the handle *H* the jack is jumped up against the head block *A*. When the juice has stopped running, the release valve at *C* is opened and the ram quickly returns to place. The pan *I* can be slid out on the rods *F*, the press cake removed, and a new sample inserted. It is essential to have a pressure gauge on the chamber of the jack, since in analyzing beets by this method the same pressure should be maintained throughout.

DIRECT METHODS.

In the direct methods the per cent of sugar is determined directly on the beet. These methods may be classified according to the solvent used for extraction, namely, water or alcohol, and these may be again divided into extraction in the cold and with heat. So many slight modifications of these different methods are known and used that all of them can not be discussed; only statements of the representative methods can be given.

WATER METHODS.

COLD-WATER DIGESTION METHOD OF PELLET.

Weigh the normal amount of beet cuttings, 26 or 26.048 grams, and transfer to a large-mouth flask (*C*, frontispiece) with a mark at 200.6 cc.[1] Add 5 cc of basic lead acetate solution (see p. 13), shake, and add water up to the shoulder of the flask. Mix the contents by rotating in the hand, and allow to stand 25 minutes in order to expel the air bubbles. Beat down the collected froth with an ether spray and fill the flask to the mark with water. Then shake the contents vigorously, placing the hand over the mouth of the flask, filter, and polarize in a 200 or 400 mm tube after adding a drop of acetic acid.

For this method it is necessary to have the finest divided pulp possible and it is also advisable to have a pear-shaped flask instead

[1] Numerous experiments have shown that the marc of the normal weight of average beets occupies about 0.6 cc of space.

of the ordinary round, ball-shaped one in general use, so that the entrained air bubbles may seek the surface and not remain on the sides of the vessel. This method has been much criticized because a finely divided pulp is necessary to prevent an imperfect extraction of the sugar, and also because ordinary shaking will not disengage all of the air bubbles from the pulp, thereby causing the use of a smaller quantity of water to fill the flask to the mark, and thus giving too high results for sugar in the beet.

COLD-WATER DIGESTION METHOD OF SACHS LE DOCTE.

This is a modification of Pellet's method for the purpose of removing the error resulting from the entrained air. Weigh 26 grams of the fine beet pulp into a tin-lined copper vessel (*D*, frontispiece), add 5 cc of basic lead-acetate solution and 172 cc of water. Put the cover *E* in place and shake the whole vigorously, then allow it to stand for three minutes, remove the cover, filter, and polarize the solution in a 200 mm tube after adding a drop of acetic acid and double the reading, or polarize in a 400 mm tube, in which case the reading gives the per cent of sugar in the beet.

In this method it is assumed that beets contain 95 per cent of juice with an average specific gravity of 1.07. The volume of the juice contained in a normal weight would then be

$$\frac{26\times 0.95}{1.07}=23.08 \text{ cc}$$

and (200–23.08 cc) 176.92 cc of water would be necessary to complete the volume to 200 cc. A special pipette (*F*, frontispiece) has been designed to deliver this amount. A quarter turn of the stopcock opens the entrance *G* for the lead acetate, so that 5 cc can be measured, then another quarter turn opens the water entrance *H* to fill the burette to the overflow, and a half turn delivers the whole into the dish.

As in the preceding method, the beet pulp must be very fine, otherwise an imperfect extraction will occur. This method is also open to criticism in that all beets do not contain 95 per cent of juice and all beet juice does not possess a specific gravity of 1.07. It is rightly claimed, however, that the errors introduced by the use of these constants are so small that they will fall within the limits of accuracy of the readings.

HOT-WATER DIGESTION METHOD.

Weigh 52 grams of the beet cuttings and transfer them with water to a large-mouth flask (*C*, frontispiece) of 201.2 cc content; add from 5 to 10 cc of lead subacetate solution, fill the flask to the mark with

hot water, and shake. Immerse the flask in a water bath at 80° C. and shake at intervals by rotating. Add water from time to time so that at the end of the heating, about 30 minutes, the water in the flask is a little above the mark. Remove the flask from the water bath and allow it to cool to standard temperature; add a sufficient quantity of concentrated acetic acid to make the solution very slightly acid in reaction (generally less than 0.5 cc is necessary) and a few drops of ether to break the foam; complete the volume. Mix thoroughly, filter, and polarize in a 200 mm tube.

With this method a coarser beet pulp can be used than for the cold-water methods, but over 30 minutes may be necessary for digestion, if very coarse cuttings are used. To obtain correct results, care must be exercised to make up to volume at the standard temperature of 20° C. (if the instrument and flasks are standardized at that temperature) and to digest the beet cuttings with as large a quantity of water as possible. Not over 5 cc in any case should be added during digestion and final cooling to complete the volume. Where smaller quantities of water are used during digestion and then a large quantity of water is added at the last to make to volume, the sugar has not become equally diffused and the results are too low. Differences of over 1 per cent in sugar content are often caused by lack of care in this particular.

HOT-WATER DIGESTION METHOD OF SACHS LE DOCTE.

The procedure in the Sachs Le Docte cold-water extraction method (p. 18) is modified as follows for hot digestion: The weighing and the vessels used are the same, also the quantities of lead subacetate and water are the same, namely, 177 cc. A special rubber disk cover (*I*, frontispiece) is provided for the digestion vessels. Put this in place and after shaking the vessel immerse it in a water bath kept at 80° C. for 30 minutes, or for 25 minutes if the temperature is 85° C. The temperature during extraction should not, however, exceed this figure. Remove the cups and immerse in cold water, bringing the temperature down to 20° C., shake, remove the covers, filter, and polarize, after adding a drop or so of acetic acid.

The chance of error due to contained air or unequal diffusion of the pulp is removed by this method. As in the former case the cuttings need not be so fine as with the cold-water extraction methods.

HERZFELD'S MODIFICATION OF THE SACHS LE DOCTE METHOD.

Instead of the tin-coated copper beakers used in the preceding method, Herzfeld uses an extraction vessel of nickel-plated sheet iron made as shown in figure 5. The vessel is round. He also uses small weighing glasses, holding 26 grams of material, which can be introduced with the beet cuttings into the extraction vessel. These

watch glasses are filled to equal weight and numbered consecutively, as are also the extraction vessels. The procedure is as follows:

Weigh 26 grams of the beet pulp on a watch glass and transfer to the extraction vessel, then run in 177 cc of dilute basic lead-acetate solution (5 parts of basic lead-acetate solution, Brix 53.5, to 100 parts of water), shake and place a stopper which has been covered with tinfoil lightly in the opening. Submerge the whole in a water bath at 75° to 80° C. for 30 minutes, shaking intermittently. When all air has been expelled (generally after five minutes), tighten the stopper in the vessel. At the expiration of the time remove and cool. Take out the stopper after shaking thoroughly, filter, and polarize in a 400 mm tube, after addition of a drop of acetic acid to determine the per cent of sugar in the beet.

FIG. 5.—Herzfeld's metallic beaker.

This method does not require very fine pulp and is open to few chances of error. It, together with the Sachs Le Docte method, has a decided advantage over the other hot digestion method, in that there is little chance of a loss of sample by the container breaking. When working with glass flasks one is likely to ruin many determinations. For quick work and when many samples are to be run, large heating and cooling vessels can be used and the dishes taken from the one and placed immediately in the other to cool, without risk of losing the determination, thereby saving considerable time. This method has been adopted by the Society of the German Sugar Industry, and with a few modifications in apparatus, but not of procedure, by a number of other sugar associations of Europe.

ALCOHOL METHODS.

The methods using alcohol as the solvent may be divided into two classes—digestion and extraction methods. The former is again divided into hot and cold digestion methods.

COLD ALCOHOL DIGESTION METHOD.

Weigh 52 grams of the beet cuttings and transfer to a flask (having a capacity of 201.2 cc) with 90 per cent alcohol, add 4 cc of lead subacetate solution and shake, then add more 90 per cent alcohol with shaking to remove the air bubbles, complete the volume, allow to stand half an hour, and add alcohol if a decrease in volume is noted. Thoroughly shake the flask and filter, keeping the filter covered to prevent loss by evaporation. Polarize in a 200 mm tube.

With this method very fine pulp is necessary and the greatest care must be exercised to remove all of the air from the beet cuttings to insure an even digestion. For accurate readings the polarization should be made at the standard temperature of the instrument and flasks and allow of no evaporation. This method is but little used.

HOT ALCOHOL DIGESTION METHOD.

The same procedure is followed as in the preceding method up to the point of adding more alcohol. In this method add only enough 90 per cent alcohol to fill the flask three-fourths full. Then connect the flask with a return condenser, place in a water bath, and allow to boil for 20 minutes. Cool the flask and contents to the standard temperature and bring up to the mark with 90 per cent alcohol, shake and allow to stand for awhile, filter, and polarize.

This method does not require so fine a pulp as the former one and is not open to error from entrained air bubbles, but to obtain correct results it must be worked carefully to prevent evaporation and changes of temperature during polarization.

ALCOHOL EXTRACTION METHOD.

The alcohol extraction method has been recognized as the standard method for sugar determination and is the one with which other methods are compared, but its execution is difficult and the results are liable to error if the greatest care is not exercised. For the inexperienced chemist it is not a suitable method, but by familiarizing oneself with its details and difficulties, correct results can be obtained.

A Soxhlet extraction apparatus is necessary for this method. The usual form has been improved by opening the siphon tube with a short tube and cork as shown in the frontispiece, *K*. In this way one can test the progress of the extraction by withdrawing a sample without interfering with the work. The best procedure for this method is to weigh 26 grams of the beet pulp and transfer to a 100 cc flask with about 50 cc of 90 per cent alcohol and from 3 to 5 cc of basic lead-acetate solution. Connect a return condenser to the flask and place in a boiling water bath for from 10 to 15 minutes. Then pour the whole into the extractor, washing out the flask with fresh portions of 90 per cent alcohol. A return condenser is connected with the Soxhlet extractor and also a 100 cc flask, the latter by means of a cork. Add more 90 per cent alcohol until the siphon is started and the lower flask is about three-fourths full. Place the containing flask in a covered water bath held at a heat that will make the alcohol boil freely. Continue the extraction for from one to four hours, or until a test of the alcohol in the extractor gives no color with α-naphthol solution (see p. 22). Remove the flask and add 90 per cent alcohol to the mark after cooling to the standard temperature, shake and filter. Polarize in 200 mm tube.

Care must be exercised to prevent evaporation and changes of temperature and also to use only a minimum amount of basic lead acetate, generally nearer 3 cc than 5 cc, for clarification. By digesting the beet pulp with the alcohol before extraction, the time of extraction is greatly shortened, the pulp becomes thoroughly impregnated with the alcohol, and all air is removed, resulting in a good extraction of the whole material. If the pulp is fine and tends to clog the siphon, alcohol-washed cotton may be used as a plug in the extractor before adding the beet pulp, and a fine mesh screen may be placed over the pulp to keep the whole compact in the extractor.

To determine whether all of the sugar has been extracted or not the following qualitative test is used:

α-naphthol test for sugars.—Add four or five drops of a 20 per cent alcoholic α-naphthol solution to a few drops of the alcohol coming from the extractor and 2 cc of water contained in a small test tube. Shake well, tip the test tube, and allow from 2 to 5 cc of colorless concentrated sulphuric acid to flow down the side of tube; then hold the tube upright, and if sucrose is present a color varying from a faint to a deep violet will be noted at the junction of the two liquids. On shaking, the whole solution becomes a blue violet color. This test is suitable for the results required of it in this work, but it must be remembered that other sugars and substances besides sucrose give this color reaction.

DISCUSSION OF METHODS.

For a number of years the proper methods for determining sugar in the beet have been discussed by sugar chemists, especially as to the relative merits of alcohol and of water extraction. As a general rule German sugar chemists favored alcohol methods, while the French favored water methods. Within the last year a truce has been declared and it is acknowledged that for very accurate or control work the alcohol extraction method should be used, but for general work, one of the hot-water digestion methods will give good results and the analyst is less likely to introduce errors in the manipulation. With the average sample of beets, the two methods when carefully applied will yield duplicate results but in the case of very abnormal beets one method might give higher figures than another. The instantaneous methods (cold extraction) are only suitable with very fine pulp and the results can be depended upon only when they have been checked against a standard method. With these instantaneous methods as many samples of beets can be analyzed per day as by the indirect method, and it is claimed by many that the Sachs Le Docte hot digestion method or the Herzfeld modification will yield as many determinations in a given time as the indirect method, with the same amount of work, provided the laboratory is fitted for the work.

DETAILED ANALYTICAL DATA, 1905–1910.

Sugar-beet analyses, made in the Bureau of Chemistry.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Alabama	Shelby	*Ounces.*	*Percent.*				
	Calera	13	13.0	77.6	Fair	7064	Aug. 20, 1909
Arizona	Yuma						
	Yuma	16	14.6	77.2	Wilted	5626	Aug. 13, 1908
Arkansas	Cleveland						
	Kingsland	8	11.4	80.3		4374	Aug. 25, 1906
	Craighead						
	Jonesboro	14	7.40	57.6	Bad	7931	Oct. 17, 1910
	Dallas						
	Ramsey	16	13.30	82.5	Good	7887	Oct. 3, 1910
	Do	20	13.00	80.8	do	7889	Do.
	Eaglette	14	12.15	79.7	do	7898	Oct. 8, 1910
	Faulkner						
	Conway	5	15.2	78.8		5151	Nov. 15, 1907
	Pope						
	Hector	16	13.0		Bad	7071	Aug. 21, 1909
California	Imperial						
	Imperial	11	15.7	83.1	Good	7147	Oct. 3, 1909
	Modoc						
	Alturas	40	13.75	76.3	do	7966	Oct. 24, 1910
	San Diego						
	Lakeside	24	21.40	88.7	Fair	7888	Oct. 3, 1910
	Shasta						
	Cassell	40	14.8	82.2	Good	7203	Oct. 19, 1909
	Siskiyou						
	Macdoel	16	14.6	85.8	do	5721	Oct. 8, 1908
	Do	16	12.0	79.5	do	5722	Do.
	Do	10	8.0	63.5	Poor red	5725	Oct. 9, 1908
	Do	15	15.3	86.8	Good	5741	Oct. 12, 1908
	Do	4	15.5	85.6	Dry	5778	Oct. 17, 1908
	Do	16	18.1	91.8	Good	5792	Oct. 19, 1908
	Do	25	15.5	79.0	do	7128	Sept. 29, 1909
	Do	24	12.2	79.2	do	7142	Oct. 3, 1909
	Do	24	13.0	78.3	do	7145	Do.
	Do	8	12.7	76.8	do	7150	Do.
	Do	28	14.6	80.6	do	7175	Oct. 9, 1909
Colorado	Boulder						
	Broomfield	20	10.00	70.6	do	8002	Nov. 1, 1910
	Eagle						
	Avon	21	14.7	81.5		3760	Nov. 1, 1905
	Do	22	16.2	83.7		3761	Do.
	Bilkin	26	20.2	88.2		3769	Do.
	Eagle	26	15.9	85.0		3770	Do.
	Do	8	18.1	88.3		3771	Do.
	Do	40	20.9	88.7		3778	Nov. 8, 1905
	Avon	24	17.3	84.0		3802	Nov. 14, 1905
	Do	16	18.7	81.7		3811	Nov. 27, 1905
	Gypsum	32	14.6	78.6		3812	Do.
	Do	52	12.9	75.0		3816	Dec. 4, 1905
	Do	48	15.6	82.1		3817	Do.
	Do	20	22.6	89.3		5232	Dec. 9, 1907
	Do	17	18.1	84.1		5248	Dec. 23, 1907
	El Paso						
	Ramah	16	16.3	83.2	Good	5700	Oct. 5, 1908
	Garfield						
	Glenwood Springs	36	15.0	84.7		3701	Oct. 5, 1905
	Do	36	10.8	71.1		3702	Do.
	Do	44	15.4	75.5		3703	Do.
	Garfield	24	17.5	86.6		3765	Nov. 1, 1905
	Do	18	14.2	86.6		3766	Do.
	Do	24	11.9	78.8		3767	Do.
	Do	26	19.1	86.8		3768	Do.
	Do	56	17.5	83.5		3777	Nov. 18, 1905
	Do	24	19.2	83.5		3792	Nov. 14, 1905
	Kit Carson						
	Seibert		10.7	66.5	Wilted	5660	Sept. 30, 1908
	Do	15	18.2	84.2	Good	5708	Oct. 6, 1908
	Burlington	19	10.7	72.3	do	5728	Oct. 9, 1908
	Seibert	22	15.0	87.2	do	5745	Oct. 12, 1908
	Do	16	16.4	88.6	Fair	5751	Oct. 13, 1908
	Do	24	9.8	71.2	do	5753	Do.
	Do	16	16.7	85.2	Good	7149	Oct. 3, 1909

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Colorado	Lincoln	*Ounces.*	*Percent.*				
	Limon	18	14.3	81.2	Good	7207	Oct. 19, 1909
	Do	24	9.0	58.8	do	7815	Aug. 6, 1910
	Otero						
	Rocky Ford	24	14.7	77.4	Very bad	7962	Oct. 21, 1910
	Pitkin						
	Aspen	14	17.0	77.8		3803	Nov. 20, 1905
	Routt						
	Steamboat Springs	14	14.1	77.0	Good	7923	Oct. 15, 1910
	Washington						
	Cope	4	14.8	78.7	Very small	5702	Oct. 5, 1908
	Do	15	17.5	82.3	Good	7196	Oct. 15, 1909
	Akron	48	14.0	75.2	do	7329	Nov. 8, 1909
	Do	32	17.4	78.4	Soft	7330	Do.
	Do	38	15.6	81.7	Good	7331	Do.
	Do	48	14.9	79.2	do	7332	Do.
	Do	32	16.2	81.8	do	7333	Do.
	Do	40	15.3	80.1	do	7334	Do.
	Do	45	16.1	82.1	do	7335	Do.
	Do	33	18.3	81.3	do	7336	Do.
	Do	29	20.9	86.4	Soft	7337	Do.
	Do	40	19.0	86.0	do	7338	Do.
	Do	56	18.7	81.3	Good	7339	Do.
	Do	29	18.6	83.4	do	7340	Do.
	Do	36	16.4	82.8	Good, soft	7341	Do.
	Do	28	17.7	80.8	Good	7342	Do.
	Do	37	18.4	84.0	Soft	7343	Do.
	Do	32	19.3	85.4	Good	7344	Do.
	Do	45	16.7	87.0	do	7345	Do.
	Do	26	19.4	85.8	do	7346	Do.
	Do	29	21.6	84.7	do	7347	Do.
	Do	40	19.7	86.3	do	7348	Do.
	Do	48	19.4	84.5		7349	Do.
	Weld						
	La Salle	24	19.9	85.6		3804	Nov. 21, 1905
	Carr	16	17.0	83.7	Fair	5774	Oct. 16, 1908
District of Columbia.	Washington.						
	Do	8	19.2	81.5	Soft	7350	Nov. 8, 1909
	Do	14	20.1	83.3	do	7351	Do.
	Do	28	18.5	75.5	do	7433	Dec. 2, 1909
	Do	22	21.6	78.7	do	7434	Do.
	Do	20	20.7	78.3	do	7436	Do.
	Do	28	13.1	60.1	Rotten, soft	7437	Do.
	Do	56	17.2	70.1	do	7438	Do.
	Do	52	16.4	70.3	Bad	7439	Do.
	Do	36	17.2	71.1	Soft	7441	Do.
	Do	30	20.0	75.2	Fair	7442	Do.
Georgia	Chattooga						
	Summerville	10	6.2	58.3	Good	7857	Sept. 23, 1910
	Coweta						
	Newman	12	14.0	88.1	do	7903	Oct. 10, 1910
	Floyd						
	Rome	14	8.9	71.6	Good	7176	Oct. 9, 1909
	Greene						
	Penfield	48	7.8	66.6	Soft	5736	Oct. 10, 1908
	Do	17	12.3	80.9	Fair	5735	Do.
Idaho	Blaine						
	Picabo	10	16.5	84.1	Good	8017	Nov. 4, 1910
	Twin Falls						
	Twin Falls	24	20.1	89.5		4381	Oct. 10, 1906
	Do	24	17.7	82.9	Good	8091	Nov. 19, 1910
Illinois	Bond						
	Greenville	20	11.2	74.7	do	8044	Nov. 14, 1910
	Bureau						
	Princeton	48	14.9	76.4	do	7223	Oct. 21, 1909
	Do	21	12.1	76.6	do	7234	Oct. 23, 1909
	Do	20	12.8	77.4	do	7245	Oct. 25, 1909
	Do	48	11.7	72.6	do	7272	Oct. 28, 1909
	Do	32	12.8	76.6	do	7275	Do.
	Do	16	10.8	73.9	do	7290	Nov. 1, 1909
	Do	21	14.9	79.7	do	7294	Do.
	Do	60	10.5	73.2	do	8025	Nov. 8, 1910
	Cook						
	Blue Island	12	19.8	88.0	Fair	5856	Nov. 2, 1908

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Illinois	Henry	*Ounces.*	*Per cent.*				
	Geneseo	32	12.9	80.1		3753	Oct. 31, 1905
	Do	20	10.5	70.2		3754	Do.
	Do	16	12.1	77.7		3755	Do.
	Do	24	11.1	76.1		3756	Do.
	Do	24	12.1	71.6		3757	Do.
	Do	8	14.7	84.0		3758	Do.
	Do	16	11.7	73.3		3759	Do.
	Do	22	13.7	74.6	Withered	4408	Nov. 26, 1906
	Do	16	15.2	78.4	do	4409	Do.
	Do	20	18.3	85.9	do	4410	Do.
	Do	22	16.6	82.6		4413	Do.
	Do	18	17.2	81.2		4414	Do.
	Do	16	19.0			4415	Do.
	Do	16	17.4			4416	Do.
	Do	14	18.9			4417	Do.
	Do	10	20.0			4418	Do.
	Do	10	17.7			4419	Do.
	Do	18	16.2	81.4		4420	Do.
	Do	14	14.7	76.6		4421	Do.
	Do	24	18.4	81.3	Withered	4427	Nov. 27, 1906
	Do	16	18.9	82.9	do	4428	Do.
	Do	38	16.9	81.7	do	4429	Do.
	Do	18	15.9	82.4	do	4430	Do.
	Do	38	13.4	80.7	do	4431	Do.
	Do	16	16.5	81.7	do	4432	Do.
	Do	16	17.8			4434	Do.
	Do	28	16.6	85.1	do	4435	Do.
	Do	16	17.2	86.0	do	4436	Do.
	Do	24	19.1	86.3	do	4437	Do.
	Do	16	17.2	83.0	do	4438	Do.
	Do	20	16.4	80.0	do	4439	Do.
	Do	14	16.7	86.6	do	4440	Do.
	Do	18	14.8	76.3	do	4441	Do.
	Lake						
	Waukegan	21	13.2	80.0	do	4442	Nov. 31, 1906
	Union						
	Reynoldsville	37	8.1	64.8	Good	7224	Oct. 21, 1909
	Woodford						
	Eureka	44	8.9	66.6	Withered	8007	Nov. 2, 1910
Indiana	Huntington						
	Warren	24	12.4	76.8	Good	7173	Oct. 8, 1909
	Newton						
	Goodland	36	13.8	79.7	do	8026	Nov. 9, 1910
	Ripley						
	Versailles	48	9.5	70.0	do	7970	Oct. 27, 1910
	Starke						
	North Judson	16	16.0	85.1	do	7129	Sept. 29, 1909
Iowa	Allamakee						
	Harpers Ferry	20	11.5	74.0	do	7146	Oct. 3, 1909
	Do	10	14.7	81.6	do	7228	Oct. 21, 1909
	Fayette						
	Clermont	39	9.9	70.7	Good-large	7095	Sept. 20, 1909
	Do	52	13.0	78.3	do	7151	Oct. 3, 1909
	West Union	16	13.0	79.1	Good	7235	Oct. 23, 1909
	Do	16	10.4	74.3	do	7246	Oct. 25, 1909
	Clermont	50	12.4	76.1	Good-large	7289	Oct. 30, 1909
	Jefferson						
	Fairfield	32	12.1	78.6		3737	Oct. 27, 1905
	Lyon						
	Rock Rapids	5	19.0	90.4	Fair	5719	Oct. 8, 1908
	Palo Alto						
	Cylinder	21	10.8	69.7		3725	Oct. 27, 1905
	Do	21	15.2	81.3		3726	Do
	Emmetsburg	30	10.2	73.4		3727	Do.
	Do	20	13.1	83.2		3728	Do.
	Do	42	10.3	74.9		3729	Do.
	Do	17	9.7	70.9		3730	Do.
	Do	17	15.3	84.3		3731	Do.
	Do	18	12.3	78.0		3732	Do.
	Do	32	11.7	79.0		3733	Do.
	Do	20	9.5	71.8		3734	Do.
	Do	40	10.7	74.3		3735	Do.
	Osgood	12	12.2	74.2		3738	Do.
	Rodman	26	9.8	69.6		3739	Do.
	Polk						
	Runnells	15	13.3	74.6		3779	Nov. 9, 1905

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Iowa	Winneshiek	*Ounces.*	*Per cent.*				
	Calmar	24	12.8	73.5	Good	7218	Oct. 21, 1909
	Decorah	48	8.2	63.5	do	7319	Nov. 4, 1909
	Ridgeway	28	12.8	81.0	do	7328	Nov. 8, 1909
	Woodbury						
	Fallow	24	13.7	79.2		3736	Oct. 27, 1905
	Sioux City	28	13.9	78.5		4893	Oct. 24, 1907
	Do	32	14.0	80.9		4894	Do.
	Do	16	15.2	81.3		4895	Do.
	Do	28	16.8	82.4		4899	Do.
	Do	32	14.6	80.7		4900	Do.
	Do	28	14.4	80.0		4901	Do.
	Do	28	15.6	78.8		4902	Do.
	Do	24	14.7	82.6		4903	Do.
Kansas	Chase						
	Elmdale	26	8.7	67.4	Withered	5674	Oct. 1, 1908
	Chautauqua						
	Chautauqua	24	14.6	80.4		4867	Oct. 10, 1907
	Do	24	14.0	80.5		4869	Do.
	Do	12	11.7	76.5		4890	Oct. 22, 1907
	Do	23	11.1	70.6	Slightly wilted.	5030	Nov. 7, 1907
	Do	12	8.6	58.9	Wilted	5031	Do.
	Do	16	9.5	63.3	do	5032	Do.
	Do	33	9.7	69.8	do	5033	Do.
	Do	19	12.6	77.8	do	5034	Do.
	Do	11	13.5	82.3	do	5035	Do.
	Peru	14	7.7	64.7	Withered	5036	Do.
	Chautauqua	9	11.8	71.7		5152	Nov. 15, 1907
	Finney						
	Garden City	32	15.0	80.2	Fair	5935	Nov. 6, 1908
	Kearny						
	Deerfield		14.7	82.1	do	5666	Oct. 1, 1908
	Do		9.2	71.9	do	5667	Do.
	Do		10.0	72.5	do	5669	Do.
	Marion						
	Florence	10	12.4	70.4	Good	8024	Nov. 8, 1910
	Rice						
	Sterling	26	10.7	76.9	do	5790	Oct. 19, 1908
	Russell						
	Russell	9	17.9	74.0	Very bad	7967	Oct. 24, 1910
	Do	2	19.3	91.2	Good (dirty)	7997	Oct. 31, 1910
	Wichita						
	Leoti	24	16.1	82.1	Good	7425	Nov. 29, 1909
Louisiana	Caddo						
	Shreveport	5	9.5	70.8	do	7863	Sept. 27, 1910
Maryland	Frederick						
	Frederick	21	17.4	79.8	Wilted	3823	Dec. 16, 1905
	Garrett						
	Garrett	6	17.6	83.1	Good	8031	Nov. 9, 1910
	Do	22	17.2	87.6	do	8032	Do.
	Do	8	13.5	80.0	do	8034	Do.
	Do	3	10.4	83.1	do	8035	Do.
	Do	17	17.6	90.7	do	8095	Do.
	Do	32	14.8	81.1	do	7933	Oct. 17, 1910
	Mountain Lake Park.	11	16.6	83.5	do	8036	Nov. 9, 1910
	Montgomery						
	Chevy Chase	19	13.9	77.6	do	7938	Oct. 18, 1910
Michigan	Kalkaska						
	South Boardman	19	16.4	85.4	Good	7354	Nov. 10, 1909
	Gratiot						
	Ithaca	16	19.3	83.5		4447	Nov. 2, 1906
	Do	16	20.0	88.2		4448	Do.
	Do	16	20.6	85.1		4449	Do.
	Do	16	22.2	89.1		4450	Do.
	Do	14	19.3			4451	Do.
	Do	18	18.1	84.7		4473	Nov. 19, 1906
	Do	26	16.6	83.4	Slightly moldy.	4491	Dec. 15, 1906
	Do	22	16.8	85.7	Very moldy.	4492	Do.
	Do	24	16.4	82.4	Good	4493	Do.
	Do	16	16.6	79.4	Moldy, dry	4494	Do.
	Do	22	15.2	82.2	Dry	4495	Do.
	Do	26	16.5	81.7	Shriveled and moldy.	4496	Do.
	Do	28	14.5	78.8	Good	4497	Do.
	Do	29	13.9	76.8	do	4498	Do.

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
		Ounces.	*Per cent.*				
Michigan	Gratiot	29	16.0	82.0	Good	4499	Dec. 12, 1906
	Ithaca	23	17.3	81.2	do	4500	Do.
	Do	25	16.1	81.7	do	4501	Dec. 15, 1906
	Lenawee						
	Blissfield	10	18.3	83.9		3782	Nov. 14, 1905
	Do	10	18.2	82.7		3783	Do.
	Do	8	18.8	82.5		3784	Do.
	Do	10	19.1	83.8		3785	Do.
	Do	16	19.8	83.2		3786	Do.
	Do	10	19.1	84.7		3787	Do.
	Do	16	18.4	82.5		3788	Do.
	Do	16	17.8	81.3		3789	Do.
	Do	10	18.5	82.6		3790	Do.
	Do	10	17.7	84.7		3791	Do.
	Do	24	9.8	70.3		3795	Nov. 16, 1905
	Do	12	13.1	73.8		3796	Do.
	Do	20	15.1	80.5		3797	Do.
	Do	24	8.4	67.2		3799	Do.
	Monroe						
	Dundee	12	20.9	92.5		3821	Dec. 9, 1905
	Do	20	17.7	87.6		3822	Do.
	St. Clair						
	Marine City	12	18.9	86.7		3772	Nov. 6, 1905
	Do	24	19.0	89.6		3773	Do.
	Do	16	18.2	86.3		3774	Nov. 4, 1905
	Do	16	20.0	86.6		3775	Do.
	Do	12	15.5	81.6		4424	Nov. 9, 1906
	Do	17	17.1	85.6		4480	Nov. 23, 1906
	Do	21	15.4	82.7		4481	Do.
	Tuscola						
	Caro	24	17.1	86.5		4377	Sept. 29, 1906
	Kingston	18	16.3	80.1		4388	Oct. 20, 1906
	Caro	16	14.7	80.6		4389	Oct. 30, 1906
	Kingston	24	16.0	82.5		4391	Oct. 27, 1906
	Do	22	22.2	88.5		4392	Do.
	Do	28	16.9	84.9		4394	Do.
	Colling	16	17.2	86.5	Good	7119	Sept. 28, 1909
	Washtenaw						
	Manchester	16	15.1	85.8		3815	Dec. 1, 1905
	Ypsilanti	34	13.5	81.0		4382	Oct. 11, 1906
	Milan	32	14.4	82.1		4484	Nov. 26, 1906
	Do	26	14.1	81.6		4485	Do.
	Do	15	14.8	83.6		4894	Oct. 24, 1907
	Do	22	18.0	88.7		4939	Nov. 5, 1907
Minnesota	Beltrami						
	Bemidji	9	9.8	66.6	Good	7994	Oct. 29, 1910
Mississippi	Adams						
	Natchez	32	1.3	17.5	do	7072	Aug. 23, 1909
	Do	26	6.4	43.8	Bad, rotten	7073	Do.
	Clay						
	West Point		13.0	78.3		5658	Sept. 29, 1908
	Lincoln						
	Brookhaven	10	11.3	76.4		7092	Sept. 20, 1909
	Do	12	12.0	75.9	Good	7114	Sept. 27, 1909
	Do	6	11.4	76.1	Poor, soft	7130	Sept. 30, 1909
	Do	10	10.9	74.1	Good	7193	Oct. 14, 1909
	Do	20	9.7	72.7	do	7895	Oct. 7, 1910
Missouri	Barton						
	Lamar	2	9.7	70.2	Poor, small	7108	Sept. 21, 1909
	Carter						
	Hunter	11	7.0	63.6	Good	7932	Oct. 17, 1910
	Hickory						
	Quincy	20	8.9	62.6	Poor, soft	7131	Sept. 30, 1909
	Do	19	10.0	69.3	Fair	7232	Oct. 22, 1909
	Howell						
	Willow Springs	8	14.0	84.3	Good	5791	Oct. 19, 1908
	Jasper						
	Jasper	13	12.0	77.3	do	7860	Sept. 26, 1910
	McDonald						
	Powell	9	8.2	65.6	do	7918	Oct. 11, 1910
	Newton						
	Seneca	6	12.1	75.0	Small	7177	Oct. 9, 1909
	Texas						
	Houston	6	9.8	72.9	Good	7891	Oct. 8, 1910
	No county.						
	St. Louis	32	14.0	86.2		6011	Nov. 14, 1908
	Washington						
	Mineral Point	5	14.3	84.9	Fair, small	7120	Sept. 28, 1909
	Wayne						
	Gads Hill		10.3	68.7		5657	Sept. 28, 1908

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Montana	Fergus	*Ounces.*	*Percent.*				
	Moore	22	16.6	84.8	Good	8043	Nov. 14, 1910
	Lewis and Clark						
	Augusta	24	16.7	76.8	do	7321	Nov. 4, 1909
	Yellowstone						
	Billings	5	16.9	87.4	do	7899	Oct. 8, 1910
Nebraska	Boyd						
	Butte	18	9.2	67.2	do	5732	Oct. 9, 1908
	Johnson						
	Cook		10.1	69.2	Fair	5671	Oct. 1, 1908
	Lancaster						
	Havelock	32	12.0	71.4	Good	7326	Nov. 8, 1909
	Lincoln						
	North Platte	21	9.5	69.8	Fair	5951	Nov. 9, 1908
	Do	18	9.9	69.2	do	5952	Do.
	Do	17	9.2	66.1	do	5953	Do.
	Scotts Bluff						
	Morrill	21	15.9	84.4	Good	7293	Nov. 1, 1909
	Do	24	18.7	85.0	Fair	7424	Nov. 29, 1909
	Do	17	16.3	82.5	Good	7426	Do.
Nevada	Churchill						
	Fallon	24	15.5	91.7	do	5809	Oct. 23, 1908
	Hazen	16	18.3	87.1	do	5949	Nov. 7, 1908
	Fallon	40	17.9	84.4	Fair	5992	Nov. 10, 1908
	Do	21	15.0	82.8	Good	6004	Nov. 12, 1908
	Do	9	17.4	83.2	Fair	6022	Nov. 17, 1908
	Do	24	16.4	83.2	Good	7148	Oct. 3, 1909
	Do	11	16.1	83.6	do	7188	Oct. 12, 1909
	Do	24	16.7	81.0	do	7277	Oct. 29, 1909
	Do	24	16.7	84.2	do	7278	Do.
	Do	19	19.5	89.0	do	7279	Do.
	Do	21	18.9	87.5	do	7280	Do.
	Do	17	20.3	91.4	do	7281	Do.
	Do	20	19.0	90.0	do	7282	Do.
	Do	27	21.0	92.5	do	7283	Do.
	Do	20	20.0	90.5	do	7284	Do.
	Do	24	19.6	89.5	do	7285	Do.
	Do	24	19.6	89.5	do	7286	Do.
	Hazen	48	16.6	82.6	do	7394	Nov. 19, 1909
New Jersey	Hudson						
	Bayonne	16	8.3	63.5	Fair	7091	Sept. 20, 1909
New Mexico	Chaves						
	Roswell	13	19.5	87.3		4619	Jan. 16, 1907
	Do	10	19.2	84.2		4620	Do.
	Do	10	20.4	86.4		4621	Do.
	Do	13	17.7	81.6		4622	Do.
	Colfax						
	Cimarron	28	17.5	80.4	Wilted	5207	Nov. 29, 1907
	Do	18	16.1	81.1	Fair	5690	Oct. 3, 1908
	Do	28	16.0	85.1	Good	5703	Oct. 5, 1908
	Curry						
	Texico	25	19.7	92.1	do	5946	Nov. 7, 1907
	St. Vrain	28	19.1	86.0	Fair	5948	Do.
	Eddy						
	Artesia	17	9.5	75.4	Red, soft	5795	Oct. 19, 1908
	Lincoln						
	Carrizozo	15	18.5	87.2		5255	Dec. 30, 1907
	Mora						
	La Cueva	16	19.7	84.9		5048	Nov. 8, 1907
	Do	16	18.2	80.9		5049	Do.
	Do	16	22.3	86.9		5238	Dec. 13, 1907
	Do	24	21.7	86.9		5239	Do.
	Do	19	17.0	78.7	Good	6033	Nov. 20, 1908
	Do	24	18.8	84.6	Fair	6082	Dec. 28, 1908
	Levy	18	12.0	73.9	Good	7187	Oct. 12, 1909
	Do	16	17.5	86.9	do	7323	Nov. 4, 1909
	Wagon Mound	30	16.6	82.5	do	7353	Nov. 9, 1909
	Quay						
	Nara Visa	6	10.7			6042	Nov. 23, 1908
	Roosevelt						
	Portales	18	15.2	82.3		4386	Oct. 12, 1906
	Claudell	7	20.9	88.6	Fair	5779	Oct. 17, 1908
	Upton	9	18.5	88.5	Poor	5815	Oct. 26, 1908
	Elida	17	19.4	95.1	Fair	5838	Oct. 27, 1908
	Portales	12	10.9	72.6	Good	7153	Oct. 5, 1909

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
New Mexico....	San Miguel □-	*Ounces.*	*Per cent.*				
	East Las Vegas...	18	15.7	78.5	.....	4908	Oct. 28, 1907
	Do.....	36	18.2	79.8	.....	5058	Nov. 8, 1907
	Las Vegas.....	12	20.6	90.4	.....	5079	Nov. 11, 1907
	Do.....	60	18.3	78.5	.....	5080	Do.
	Rociada.....	16	18.7	81.3	.....	5081	Do.
	San Jose.....	46	13.6	70.5	.....	5082	Do.
	Las Vegas.....	10	20.8	88.8	.....	5085	Nov. 12, 1907
	East Las Vegas...	22	18.1	80.4	.....	5149	Nov. 14, 1907
	Do.....	15	22.2	90.2	.....	5206	Nov. 25, 1907
	Las Vegas.....	8	22.1	.....	Withered...	5240	Dec. 13, 1907
	Do.....	4	11.9	76.0	Withered, small.	5241	Do.
	East Las Vegas...	16	14.3	85.6	Fair.....	6052	Nov. 24, 1908
	Los Alamos.....	22	10.0	80.6	Poor.....	6056	Do.
	East Las Vegas...	32	13.6	77.3	Good.....	7248	Oct. 26, 1909
	Las Vegas.....	56	14.8	77.3	.....do.....	7395	Nov. 19, 1909
	Do.....	17	16.8	77.0	Withered...	8156	Dec. 8, 1910
	Santa Fe □						
	Otto.....	24	16.7	83.5	Fair.....	5688	Oct. 3, 1908
	Do.....	9	16.9	86.2	Small.....	5695	Oct. 5, 1908
	Do.....	34	17.1	86.3	Fair.....	5698	Do.
	Stanley.....	32	16.1	83.0	Good.....	5699	Do.
	Otto.....	11	15.6	83.9	.....do.....	5701	Do.
	Stanley.....	15	15.7	86.7	.....do.....	5704	Do.
	Otto.....	17	16.5	89.2	.....do.....	5706	Oct. 6, 1908
	Hyer.....	35	16.0	84.6	.....do.....	5707	Do.
	Otto.....	13	13.8	80.0	Fair.....	5709	Do.
	Hyer.....	12	19.5	85.9	Good.....	5713	Do.
	Otto.....	13	17.4	87.8	.....do.....	5720	Oct. 8, 1908
	Do.....	30	15.7	85.3	.....do.....	5726	Oct. 9, 1908
	Stanley.....	11	14.2	82.5	.....do.....	5730	Do.
	Do.....	13	18.2	91.0	Fair.....	5733	Do.
	Otto.....	52	10.5	71.9	Good.....	5752	Oct. 12, 1908
	Stanley.....	19	17.0	85.0	Fair.....	5783	Oct. 17, 1908
	Do.....	16	21.5	95.1	.....do.....	5784	Do.
	Do.....	27	15.9	91.0	Good.....	5800	Oct. 20, 1908
	Otto.....	35	11.9	84.3	.....do.....	5808	Oct. 23, 1908
	Stanley.....	15	21.9	.....	.....	5934	Nov. 6, 1908
	Sierra □						
	Arrey.....	24	12.9	72.5	Soft.....	7231	Oct. 22, 1909
	Taos □						
	Taos.....	22	17.0	73.8	Withered...	4464	Nov. 14, 1906
	Torrance □						
	Moriarty.....	28	17.3	84.0	.....	5675	Oct. 2, 1908
	Do.....	19	17.4	80.2	Withered...	5676	Do.
	Do.....	18	18.7	85.0	Fair.....	5689	Oct. 3, 1908
	McIntosh.....	24	15.7	86.2	Good.....	5696	Oct. 5, 1908
	Moriarty.....	24	17.6	85.4	.....do.....	5697	Do.
	Do.....	12	16.9	84.5	.....do.....	5710	Oct. 6, 1908
	Do.....	11	18.5	81.0	.....do	5727	Oct. 9, 1908
	Do	10	17.3	88.3	.....do.....	5731	Do.
	Do.....	12	16.0	94.7	.....do.....	5742	Oct. 12, 1908
	Do.....	18	16.5	83.4	Fair.....	5746	Do.
	Estancia.....	20	11.0	72.6	.....do.....	5747	Do.
	Do.....	33	13.2	81.6	Good.....	5749	Do.
	Moriarty.....	20	16.0	82.8	.....do.....	5750	Oct. 13, 1908
	Do.....	17	15.0	80.2	.....do.....	5754	Oct. 12, 1908
	Do.....	16	19.8	73.0	Fair.....	5772	Oct. 15, 1908
	Do.....	29	13.2	83.5	Good.....	5793	Oct. 19, 1908
	Do.....	64	16.5	80.4	.....do.....	5796	Do.
	Do.....	4	13.5	85.4	Very small..	5812	Oct. 24, 1908
	Do.....	24	16.9	78.2	Fair.....	5901	Nov. 4, 1908
	Do.....	24	15.6	80.0	.....do.....	5903	Do.
	Union ☐						
	Amistad.....	4	22.0	93.6	Very small..	5839	Oct. 28, 1908
	Clayton.....	12	17.0	86.2	Good.....	7195	Oct. 15, 1909
	Do.....	16	16.3	86.2	.....do.....	7202	Oct. 19, 1909
	Do.....	9	14.5	75.5	.....do	7221	Oct. 21, 1909
New York.....	Erie -□						
	Buffalo.....	12	13.3	80.0	.....do.....	8008	Nov. 2, 1910
	Kings □						
	Brooklyn.....	8	15.7	86.9	.....do.....	7862	Sept. 26, 1910

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
North Carolina.	Ashe	*Ounces.*	*Percent.*				
	River Side	24	15.0	80.2	Good	7322	Nov. 4, 1909
	Beaufort						
	Washington	16	16.4	87.7	Wilted	4864	Oct. 10, 1907
	Do	16	14.0	83.3	do	4865	Do.
	Aurora	7	9.5	76.5		4885	Oct. 15, 1907
	Washington	36	11.6	75.3	Good	5620	July 31, 1908
	Do	16	7.8	70.0	Small	5655	Sept. 26, 1908
	Buncombe						
	Asheville	13	16.2	84.8		4936	Oct. 30, 1907
	Davie						
	Advance	5	11.0	78.5	Poor, small	7107	Sept. 21, 1909
	Guilford						
	Julian	32	11.8	82.5		4879	Oct. 14, 1907
	Haywood						
	Canton	24	14.2	82.7	Good	7974	Oct. 28, 1910
	Moore						
	Carthage	8	15.1	85.1	do	7144	Oct. 3, 1909
	Robeson						
	Maxton	16	12.5	83.3	Wilted	4866	Oct. 10, 1907
	Do	18	9.6	68.1		4868	Do.
	Watauga						
	Sands	18	17.6	86.5	Good	7204	Oct. 19, 1909
North Dakota.	Barnes						
	Valley City	52	14.8	76.7	do	7992	Oct. 29, 1910
	Cavalier						
	Sarles	7	14.8	80.8	do	8000	Nov. 1, 1910
	Sargent						
	Cogswell	28	9.0	67.0	do	7891	Sept. 30, 1910
	Richland						
	Great Bend	28	11.4	68.8		3723	Oct. 18, 1905
	Do	44	11.5	68.2		3724	Do.
	Do	24	11.3	73.9		3749	Oct. 31, 1905
	Do	32	12.6	67.2		3750	Do.
	Do	48	14.7	78.4		3751	Do.
	Do	32	18.9	86.7		3752	Do.
	Walsh						
	Grafton	10	15.7	83.0	Good	7995	Oct. 29, 1910
	Wells						
	Hurdsfield	11	18.0	82.2	Fair	5687	Oct. 3, 1908
	Do	12	14.3	80.3	Good	5794	Oct. 19, 1908
	Do	24	16.2	85.7	do	5799	Oct. 20, 1908
	Do	17	16.6	86.5	do	5816	Oct. 26, 1908
	Do	10	16.0	94.1	Fair	5842	Oct. 27, 1908
	Do	20	16.1	90.9	Hard	5931	Nov. 5, 1908
	Do	15	8.2	65.5	Poor	5954	Nov. 9, 1908
Ohio	Brown						
	Ripley	16	10.0	73.0	Fair	6072	Dec. 9, 1908
	Columbiana						
	East Liverpool	24	10.4	69.3	Good	7919	Oct. 12, 1910
	Guernsey						
	Birds Run	13	14.6	80.6	do	8014	Nov. 3, 1910
	Hocking						
	Logan	24	16.8	84.6	do	7154	Oct. 6, 1909
	Marion						
	Marion	10	15.9	85.8	Fair	7233	Oct. 23, 1909
	Ottawa						
	Oak Harbor	20	17.5	84.9		4490	Dec. 12, 1906
	Paulding						
	Paulding	35	17.9	82.6		4407	Oct. 27, 1906
	Do	37	16.0	78.8		4422	Nov. 9, 1906
	Do	36	16.8	78.9		4423	Do.
	Haviland	12	21.2	88.0		4905	Oct. 28, 1907
	Do	8	21.0	86.4		4906	Do.
	Do	16	19.4	89.8		4907	Do.
	Do	18	19.3	89.8		5050	Nov. 8, 1907
	Do	22	16.8	88.2		5051	Do.
	Do	18	17.9	90.4		5052	Do.
	Do	15	18.4	89.3		5053	Do.
	Do	14	19.8	90.8		5054	Do.
	Do	12	19.8	91.7		5055	Do.
	Do	13	17.2	88.2		5056	Do.
	Do	13	16.9	89.2		5057	Do.
	Broughton	9	21.0	81.6	Dry, wilted	5158	Nov. 20, 1907
	Haviland	16	21.7	82.2	Badly wilted	5160	Nov. 22, 1907
	Van Wert						
	Scott	8	19.4	87.4	Wilted	5159	Do.
	Do	20	17.0	85.6		5211	Dec. 2, 1907
	Williams						
	Bryan	8	16.9	83.3	Very dry	4617	Jan. 9, 1906

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Oklahoma	Beaver	*Ounces.*	*Percent.*				
	Floris	48	14.9	86.6	Fair	5849	Oct. 31, 1908
	Do	26	14.2	79.7	Good	6003	Nov. 12, 1908
	Do	20	15.1	79.1	Fair	6012	Nov. 14, 1908
	Do	34	15.5	81.5	do	6014	Do.
	Do	11	14.1	80.6	do	6019	Nov. 16, 1908
	Do	8	16.7	83.9	do	6035	Nov. 20, 1908
	Do	7	17.4	84.6	Good	7201	Oct. 19, 1909
	Do	10	15.0	74.2	do	7209	Do.
	Do	6	17.5	78.5	do	7392	Nov. 19, 1909
	Do	20	13.4	77.6	Fair	8160	Dec. 13, 1910
	Carter						
	Ardmore	24	12.9	91.9	Good	7327	Nov. 8, 1909
	Comanche						
	Chattanooga	13	11.0	68.7	do	7427	Nov. 29, 1909
	Harmon						
	Vinson	7	16.2	78.2	Fair	7109	Sept. 24, 1909
	Kiowa						
	Mountain Park	22	11.6	78.6	Good	7861	Sept. 26, 1910
	Swanson						
	Snyder	24	14.9	81.6	do	7836	Sept. 19, 1910
	Do	9	16.6	89.8	do	8020	Nov. 8, 1910
	McIntosh						
	Hoffman	15	12.7	91.3	Good, soft	7106	Sept. 21, 1909
	Grayson	10	5.8	50.0	do	7185	Oct. 12, 1909
	Muskogee						
	Braggs		11.5	76.1		5668	Oct. 1, 1908
	Do	19	10.1	72.7	Good	7094	Sept. 20, 1909
	Do	26	13.6	75.8	do	7113	Sept. 27, 1909
	Wybark	12	14.0	80.7	do	7115	Do.
	Braggs	16	10.9	71.2	Fair	7117	Sept. 28, 1909
	Do	32	6.2	50.8	do	7152	Oct. 5, 1909
	Council Hill	2	13.2	77.0	Fair, small	7184	Oct. 11, 1909
	Okfuskee						
	Castle	16	8.5	64.9	do	7229	Oct. 21, 1909
	Roger Mills						
	McArthur	26	11.9	74.4		4887	Oct. 18, 1907
	Grimes	4	16.5	83.5	Good	7199	Oct. 16, 1909
	Washita						
	Port	26	13.4	78.8		5150	Nov. 15, 1907
	Woods						
	Alva	20	20.8	81.1	Dry	5237	Dec. 11, 1907
Oregon	Crook						
	Tumalo	16	17.0	85.0	Very dry	3704	Oct. 12, 1905
	Do	16	13.0	76.9		3705	Oct. 16, 1905
	Klamath						
	Klamath Falls	32	21.9	92.0	Wilted	5037	Nov. 8, 1907
	Do	15	15.7	77.7		5083	Nov. 11, 1907
	Merrill	30	16.5	79.6		5210	Dec. 2, 1907
	Klamath Falls	16	20.6	90.7	Fair	5748	Oct. 12, 1908
	Do	10	16.5	86.8	do	5775	Oct. 17, 1908
	Do	24	16.3	81.0	do	6015	Nov. 14, 1908
	Do	37	18.3	76.0	Withered	8029	Nov. 9, 1910
	Merrill	18	14.5	76.0	Good	7896	Oct. 7, 1910
	Do	10	14.5	80.8	do	7897	Oct. 8, 1910
	Do	32	14.5	77.1	Bad	7969	Oct. 27, 1910
	Do	16	18.0	87.9	Good	8009	Nov. 3, 1910
	Do	16	18.8	87.8	do	8011	Do.
	Do	13	19.3	87.7	do	8012	Do.
	Do	13	18.3	88.8	do	8013	Do.
	Do	16	20.4	88.7	do	8015	Do.
	Do	26	13.4	74.7	do	8016	Do.
	Do	35	17.3	76.1	Withered	8027	Nov. 9, 1910
	Do	28	15.9	74.7	do	8028	Do.
	Do	12	18.5	88.0	Good	8041	Nov. 14, 1910
	Do	24	16.0	82.0	do	8042	Do.
	Do	20	18.5	88.3	do	8048	Nov. 19, 1910
	Lincoln						
	Elk City	32	12.8	67.9	Withered	4446	Nov. 30, 1906
Pennsylvania	Center						
	State College	12	14.9	81.4	Good	7181	Oct. 11, 1909
	Lancaster						
	Manheim		16.9	84.0	Fair	5665	Oct. 1, 1908
	Philadelphia						
	Philadelphia		10.3	71.5	Small	5661	Sept. 30, 1908
	Potter						
	Ulysses	3	16.1	79.7		5208	Dec. 2, 1907
	Do	18	17.5	91.6	Good	5717	Oct. 7, 1908

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
South Dakota..	Butte	*Ounces.*	*Percent.*				
	Vale	16	18.0	75.3	Pithy	4903	Oct. 24, 1907
	Stanley						
	Philip	14	19.5	83.7	Very soft	7428	Nov. 30, 1909
Tennessee	Coffee						
	Tullahoma	12	8.7	69.6	Fair	7096	Sept. 21, 1909
	Do	5	11.9	77.1	Good	7222	Oct. 21, 1909
	Do	17	8.7	66.4	do	7247	Oct. 25, 1909
	Do	22	13.8	76.7	Fair	7429	Nov. 30, 1909
	Dickson						
	Tennessee City	19	7.6	62.2	Good	7088	Sept. 16, 1909
	Franklin						
	Winchester	24	10.8	75.5	Fair	7172	Oct. 8, 1909
	Grainger						
	Rutledge	21	13.6	81.7	Good	7236	Oct. 23, 1909
	Hamblen						
	Morristown	16	10.1	73.7	do	7118	Sept. 28, 1909
	Do	12	10.9	76.2	Fair	7288	Oct. 30, 1909
	Hickman						
	Vernon	21	8.0	61.6	Poor	7090	Sept. 20, 1909
	Do	20	9.3	73.2	Good	7093	Do.
	Do	7	10.2	71.3	do	7393	Nov. 19, 1909
	Do	40	6.9	60.0	do	7999	Oct. 31, 1910
	Humphreys						
	McEwen	4	13.9	83.2	Fair	7089	Sept. 17, 1909
	Do	9	14.7	85.6	Good	7886	Oct. 4, 1910
	Warren						
	McMinnville	22	5.9	47.2	Fair	7205	Oct. 19, 1909
Texas	Armstrong						
	Goodnight	22	15.4	84.2	Good	7902	Oct. 8, 1910
	Brown						
	Blanket	19	13.1	74.0	do	6038	Nov. 20, 1908
	Carson						
	Groom	60	12.8	76.4		3706	Oct. 16, 1905
	Do	10	13.3	74.5		3707	Do.
	Do	56	12.8	71.5		3708	Do.
	Do	64	13.2	73.3		3710	Do.
	Do	35	14.0	80.5		5233	Dec. 10, 1907
	Cass						
	Avinger	20	8.3	64.9	Good	8023	Nov. 8, 1910
	Castro						
	Summerfield	6	15.9			6043	Nov. 23, 1908
	Comanche						
	Comanche	18	13.0	77.4	Soft	6037	Nov. 20, 1908
	Dallam						
	Dalhart	24	14.2	81.6	Small, very dry.	3712	Oct. 18, 1905
	Do	12	13.9	79.1	Very dry	3713	Do.
	Do	16	13.0	73.6	Dry	3714	Do.
	Do	12	14.0	79.3	do	3715	Do.
	Do	19	15.3	81.2		5028	Nov. 7, 1907
	Do	12	16.5	86.0	Good	6010	Nov. 13, 1908
	Texline	26	12.0	71.4	do	7182	Oct. 11, 1909
	Do	16	14.2	77.1	do	7183	Do.
	Do	16	12.5	70.5	do	7273	Oct. 28, 1909
	Do	16	15.4	79.6	do	7291	Nov. 1, 1909
	Dallas						
	Dallas	16	3.0	35.7		5084	Nov. 11, 1907
	Donley						
	Jericho	44	10.3	70.3		3709	Oct. 16, 1905
	Do	32	13.8	74.6		4444	Nov. 31, 1906
	Clarendon	31	15.5	77.4		4465	Nov. 14, 1906
	Do	25	12.6	73.3		5153	Nov. 19, 1907
	Erath						
	Stephenville	20	12.2	70.1	Fair	6039	Nov. 20, 1908
	Dublin	35	11.4	72.1	do	6040	Do.
	Fannin						
	Honey Grove	20	17.8	82.9	do	7864	Sept. 27, 1910
	Do	12	14.2	80.8	Good	7872	Oct. 1, 1910
	Do	28	15.2	80.7	do	7873	Sept. 30, 1910
	Do	28	17.3	84.7	do	7874	Do.
	Do	16	13.4	70.5	do	7890	Oct. 3, 1910
	Do	13	11.6	75.5	do	7941	Oct. 19, 1910
	Gray						
	McLean	16	10.0	70.2	Very dry	3721	Oct. 18, 1905
	Do	20	7.9	58.5	do	3722	Do.
	Do	40	11.9	77.8		4375	Sept. 25, 1906
	Do	40	16.3	82.9		4379	Oct. 8, 1906
	Do	26	15.3	74.7		4445	Nov. 31, 1906
	Do	16	14.2	83.5	Fair	5850	Oct. 31, 1908

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Texas	Hamilton	*Ounces.*	*Percent.*				
	Hico	36	13.3	79.3	Good	8022	Nov. 8, 1910
	Hartley						
	Channing	7	10.7	72.3		3716	Oct. 18, 1905
	Do	20	13.6	78.6	Very dry	3717	Do.
	Do	12	7.5	60.0	do	3718	Do.
	Do	20	13.6	76.8	do	3719	Do.
	Do	20	13.0	73.0	do	3720	Do.
	Hartley	32	11.5	69.3	Withered	4395	Oct. 27, 1906
	Channing	33	17.9	79.4	do	4443	Nov. 31, 1906
	Do	30	14.3	72.9	do	4453	Nov. 5, 1906
	Hunt						
	Cash	11	12.2	77.2	Fair	6018	Nov. 16, 1908
	Jeff Davis						
	Valentine	16	18.0	86.5	do	6051	Nov. 24, 1908
	Kaufman						
	Terrell	10	10.6	66.1	do	7922	Oct. 14, 1910
	Oldham						
	Wildorado	16	16.5	83.3	do	6069	Dec. 5, 1908
	Parmer						
	Bovina	28	13.8	72.2		4387	Oct. 19, 1906
	Do	6	18.7	89.5	Good	7324	Nov. 4, 1909
	Polk						
	Onalaska	33	8.3	53.2	Fair	7040	July 26, 1909
	Potter						
	Amarillo	40	11.1	70.0		3741	Oct. 31, 1905
	Do	36	16.7	82.8		3742	Do.
	Do	36	17.0	82.1		3743	Do.
	Do	32	12.8	78.8		3744	Do.
	Do	24	11.3	76.0		3745	Do.
	Do	16	16.3	84.0		3746	Do.
	Do	28	16.0	83.1		3747	Do.
	Do	32	18.3	87.7		3748	Do.
	Do	16	11.2	75.2		4380	Oct. 8, 1906
	Do	21	16.7	81.8		4463	Nov. 13, 1906
	Do	27	15.4	73.2		4884	Oct. 15, 1907
	Do	7	16.5	80.5	Healthy	4937	Oct. 31, 1907
	Do	6	20.1	85.5	do	4938	Do.
	Do	27	13.1	76.7		5059	Nov. 9, 1907
	Do	19	14.4	81.8	Good	5994	Nov. 10, 1908
	Do	10	14.3	75.2	do	7356	Nov. 16, 1909
	Do	16	14.9	77.2	do	7357	Do.
	Do	16	15.6	78.7	do	7358	Do.
	Do	18	15.8	78.6	do	7359	Do.
	Do	16	15.3	79.2	do	7360	Do.
	Do	16	16.4	79.2	do	7361	Do.
	Do	18	15.5	79.0	do	7362	Do.
	Do	16	17.5	81.3	do	7363	Do.
	Do	16	17.9	83.2	do	7364	Do.
	Do	16	18.4	84.0	do	7365	Do.
	Do	10	18.2	78.1	do	7366	Do.
	Do	13	16.4	77.0	do	7367	Do.
	Do	13	17.0	79.5	do	7368	Do.
	Do	10	17.4	77.2	do	7369	Do.
	Do	10	18.1	79.4	do	7370	Do.
	Do	16	15.8	75.9	do	7371	Do.
	Do	10	17.4	80.2	do	7372	Do.
	Do	13	17.7	77.6	do	7373	Do.
	Do	16	16.7	77.7	do	7374	Do.
	Do	16	16.7	79.1	do	7375	Do.
	Randall						
	Canyon	25	15.7	89.2	do	5744	Oct. 12, 1908
	Reeves						
	Pecos	18	16.4	75.2	Fair	6077	Dec. 28, 1908
	Runnels						
	Ballinger	12	14.0	79.1	Fair	6055	Nov. 24, 1908
	Scurry						
	Hermleigh	32	9.9	75.6		5680	Oct. 2, 1908
	Do	48	13.1	82.3	Poor	5681	Do.
	Do	11	15.6	81.2	Dry	5777	Oct. 17, 1908
	Pyron	16	16.5	80.0	Fair	5987	Nov. 10, 1908
	Winston	32	14.2	79.3	do	6028	Nov. 17, 1908
	Sherman						
	Stratford	16	16.3	74.0	Wilted	4502	Dec. 28, 1906
	Do	11	16.0	74.3	do	4503	Do.
	Tarrant						
	Keller	5	5.0	51.0	Small, soggy	5729	Oct. 9, 1908
	Fort Worth	13	10.4	69.8	Fair	6036	Nov. 20, 1908

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Texas	Van Zandt	*Ounces.*	*Per cent.*				
	Canton	16	9.0	79.6	Poor	5743	Oct. 12, 1908
	Victoria						
	Victoria	56	7.3	52.9	Wilted and moldy.	5603	July 1, 1908
	Wheeler						
	Ramsdell	16	16.5	88.2	Good	6025	Nov. 17, 1908
	Wilbarger						
	Vernon	32	10.9	79.0		4371	Sept. 24, 1906
	Do	32	10.2	73.9		4372	Do.
	Do	20	11.5	78.3		4373	Do.
	Do	16	13.4	74.6	Withered	4452	Nov. 3, 1906
Utah	Juab						
	Nephi	9	11.9	75.1	Good	7206	Oct. 19, 1909
	Do	9	13.6	80.8	do	7208	Do.
	Do	6	14.3	80.5	do	7214	Do.
	Do	8	15.1	80.6	do	7215	Do.
	Millard						
	Oasis	13	14.2	80.0	do	7929	Oct. 15, 1910
	Do	24	15.8	80.1	do	7940	Oct. 19, 1910
	Do	36	14.1	73.6	do	7971	Oct. 27, 1910
	Do	13	16.8	91.5	do	7996	Oct. 31, 1910
	Do	24	15.8	85.1	do	8006	Nov. 2, 1910
	Do	24	15.6	80.3	do	8019	Nov. 8, 1910
	Do	18	18.2	89.3	do	8053	Nov. 18, 1910
	Hinckley	16	16.6	84.0	do	7954	Oct. 20, 1910
	Do	22	15.3	80.7	do	7955	Do.
	Do	52	14.7	80.7	do	8004	Nov. 2, 1910
	Uinta						
	White Rocks	35	16.0	90.9	Fair	5857	Nov. 2, 1908
	Do	20	15.0	86.2	Good	7904	Oct. 10, 1910
Virginia	Alexandria						
	Arlington	16	19.0	93.1	Fair	6026	Nov. 17, 1908
	Do	16	15.4	79.0	do	6027	Do.
	Do	21	16.0	84.6	do	6045	Nov. 23, 1908
	Do	33	12.0	73.6	do	6046	Do.
	Do	27	10.6	69.8	do	6047	Do.
	Do	23	12.2	75.3	do	6048	Do.
	Do	20	13.9	80.3	do	6049	Do.
	Do	8	10.7	76.9	Good	8037	Nov. 10, 1910
	Augusta						
	Stuarts Draft	16	14.7	87.5	do	5813	Oct. 23, 1908
	Do	12	14.7	83.0	Fair	6016	Nov. 16, 1908
	Do	10	17.0	92.4	do	6017	Nov. 14, 1908
	Do	17	12.5	78.4	Good	7132	Oct. 1, 1909
	Do	11	12.9	79.9	Fair	7133	Do.
	Do	9	14.0	80.2	Good	7211	Oct. 19, 1909
	Do	13	16.0	86.4	do	7212	Do.
	Do	24	13.9	79.7	do	7213	Do.
	Botetourt						
	Troutville	22	12.2	86.5	do	5806	Oct. 22, 1908
	Do	19	14.4	86.7	Fair	5807	Do.
	Do	18	16.3	92.0	Good	5814	Oct. 23, 1908
	Do	20	13.9	81.8	do	6008	Nov. 13, 1908
	Clarke						
	Berryville	15	14.1	85.4	Fair	5932	Nov. 5, 1908
	Do	16	12.6	75.9	Good	7097	Sept. 21, 1909
	Do	16	12.7	78.2	Fair	7098	Do.
	Do	16	13.6	80.4	Good	7099	Do.
	Do	17	10.5	76.6	do	7100	Do.
	Do	12	14.1	76.0	Fair	7127	Sept. 29, 1909
	Do	17	17.0	85.0	Good	7197	Oct. 16, 1909
	Do	18	16.9	82.8	do	7198	Do.
	Do	18	15.0	79.8	do	7226	Oct. 21, 1909
	Do	16	16.3	87.0	do	7227	Do.
	Do	26	15.0	76.1	do	7295	Nov. 1, 1909
	Fauquier						
	Rectortown	15	15.0	88.2	Fair	6001	Nov. 12, 1908
	Loudoun						
	Round Hill	20	13.8	80.7	Good	5805	Oct. 22, 1908
	Bluemont	18	16.0	81.6	Fair	5962	Nov. 10, 1908
	Do	12	15.8	85.4	Good	5988	Do.
	Round Hill	8	14.4	81.3	Fair	5998	Nov. 11, 1908
	Do	20	15.7	87.7	Good	6002	Nov. 12, 1908
	Bluemont	30	15.4	81.8	do	6009	Nov. 13, 1908
	Montgomery						
	Blacksburg	12	18.4	88.9	Fair	6034	Nov. 20, 1908
	Childress	32	5.3	62.0	do	6041	Nov. 21, 1908

Sugar-beet anaylses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Virginia	Pulaski	*Ounces.*	*Percent.*				
	Dublin	32	16.5	86.4	Fair	5781	Oct. 17, 1908
	Do	13	17.5	88.8	do	5782	Do.
	Pulaski	26	14.0	87.5	do	5843	Oct. 30, 1908
	Do	18	15.5	83.7	do	5845	Do.
	Dublin	12	17.5	95.1	Good	5950	Nov. 7, 1908
	Pulaski	10	13.4	84.8	do	7122	Sept. 28, 1909
	Do	18	13.7	85.0	do	7123	Do.
	Do	17	12.5	79.6	do	7125	Do.
	Do	16	14.2	81.8	do	7238	Oct. 23, 1909
	Do	11	16.6	85.8	do	7239	Do.
	Do	16	15.3	84.5	do	7240	Do.
	Do	21	14.0	82.8	do	7241	Do.
	Dublin	16	10.4	71.2	do	7101	Sept. 21, 1909
	Do	24	11.7	76.4	do	7102	Do.
	Do	10	12.0	76.4	Fair	7103	Do.
	Do	14	12.0	78.4	do	7104	Do.
	Do	13	14.2	76.7	do	7242	Oct. 25, 1909
	Do	19	14.6	80.0	Good	7243	Do.
	Do	20	14.6	79.2	do	7244	Do.
	Do	14	12.5	77.1	do	7271	Oct. 27, 1909
	Roanoke						
	Roanoke	16	14.0	.....	Fair—soft	7124	Sept. 28, 1909
	Do	18	11.1	74.3	Good	7143	Oct. 3, 1909
	Do	34	13.4	78.2	do	7230	Oct. 22, 1909
	Rockingham						
	Grottoes	39	10.5	68.1	Fair	6013	Nov. 14, 1908
	Smyth						
	Seven Mile Ford	30	14.6	89.2	do	5737	Oct. 10, 1908
	Marion	22	16.6	91.6	do	5738	Do.
	Seven Mile Ford	48	13.9	86.3	do	5844	Oct. 30, 1908
	Atkins	23	16.5	85.1	do	5900	Nov. 4, 1908
	Do	29	16.0	71.1	do	5902	Do.
	Marion	21	16.5	86.3	Good	5945	Nov. 7, 1908
	Do	32	11.8	77.6	do	5947	Do.
	Seven Mile Ford	28	15.9	81.5	do	5989	Nov. 10, 1908
	Do	35	15.4	80.7	Fair	5990	Do.
	Do	24	15.3	79.3	do	5991	Do.
	North Holston	13	15.3	85.7	Good	7121	Sept. 28, 1909
	Do	22	13.6	83.2	do	7126	Do.
	Chilhowie	17	12.5	81.1	Fair	7134	Oct. 1, 1909
	Do	5	12.0	77.2	Good	7135	Do.
	Marion	32	12.5	76.2	do	7136	Do.
	Seven Mile Ford	42	13.4	77.2	do	7138	Oct. 2, 1909
	Do	13	10.7	72.7	do	7139	Do.
	Do	49	8.3	62.7	do	7186	Oct. 12, 1909
	North Holston	10	14.8	81.5	do	7191	Oct. 13, 1909
	Do	12	14.5	80.5	do	7192	Do.
	Marion	40	13.8	81.4	do	7210	Oct. 19, 1909
	Seven Mile Ford	42	14.3	82.5	do	7237	Oct. 23, 1909
	Do	28	11.3	70.6	do	7276	Oct. 28, 1909
	Chilhowie	13	11.3	77.6	do	7965	Oct. 24, 1910
	Do	17	11.3	74.0	do	8045	Nov. 14, 1910
	Southampton						
	Ivor	17	14.0	79.0	Fair	7105	Sept. 21, 1909
	Tazewell						
	Burkes Garden	20	13.6	81.4	Good	6005	Nov. 12, 1908
	Tazewell	30	17.1	87.7	do	6023	Nov. 17, 1908
	North Tazewell	8	8.4	60.8	do	7180	Oct. 11, 1909
	Warren						
	Linden	20	13.7	79.1	do	6000	Nov. 11, 1908
	Do	36	15.5	83.7	do	6029	Nov. 17, 1908
	Washington						
	Abingdon	15	16.9	85.3	do	5928	Nov. 5, 1908
	Do	15	16.8	89.8	do	5929	Do.
	Do	15	16.4	87.2	do	5930	Do.
	Konnarock	24	13.2	81.9	do	7116	Sept. 27, 1909
	Abingdon	17	14.5	78.8	do	7140	Oct. 2, 1909
	Glade Spring	10	14.9	82.7	do	7141	Do.
	Konnarock	18	15.0	83.3	do	7189	Oct. 13, 1909
	Do	34	13.0	81.2	do	7190	Do.
	Abingdon	19	14.8	82.6	do	7194	Oct. 14, 1909
	Do	24	11.1	76.0	do	7930	Oct. 17, 1910
	Do	36	13.0	81.9	do	7956	Oct. 20, 1910
	Do	24	14.4	82.9	do	8005	Nov. 2, 1910

Sugar-beet analyses, made in the Bureau of Chemistry—Continued.

State.	County and town.	Analysis.			Condition of sample.	Serial number.	Date of analysis.
		Average weight.	Sugar in juice.	Purity.			
Virginia	Wythe	*Ounces.*	*Per cent.*				
	Rural Retreat	16	13.8	78.8	Good	4883	Oct. 14, 1907
	Do	16	17.0	83.7		5154	Nov. 20, 1907
	Do	10	14.6	88.0	Fair	5996	Nov. 11, 1908
	Do	11	14.7	89.1	do	5997	Do.
	Do	34	17.7	84.6	Good	6032	Nov. 19, 1908
	Do	31	16.3	84.0	do	6044	Nov. 23, 1908
	Wytheville	8	19.0	82.5	Soft	7423	Nov. 23, 1909
Washington	Kitsap						
	Manette	9	19.2	89.0	Wilted	8157	Dec. 10, 1910
West Virginia	Jefferson						
	Shenandoah Junction.	16	12.3	70.1	Good		
	Charlestown	16	12.2	74.8	do	7928	Oct. 15, 1910
	Do	48	13.6	79.5	do	7957	Oct. 21, 1910
	Do	16	12.6	71.3	do	7958	Do.
	Do	32	15.0	82.6	do	7960	Do.
	Do	20	12.7	77.4	do	8018	Nov. 5, 1910
	Shenandoah Junction.	20	16.2	78.8	do	7968	Oct. 26, 1910
	Do	16	13.8	80.0	do	7972	Oct. 27, 1910
	Do	20	20.3	78.2	Bad	8003	Nov. 2, 1910
	Do	36	14.6	80.4	Good	8010	Nov. 3, 1910
	Kearneysville	20	13.2	81.1	do	7964	Oct. 24, 1910
	Do	16	14.7	77.3	do	8038	Nov. 10, 1910
	Do	6	17.7	84.0	do	8092	Nov. 23, 1910
	Summit Point	10	7.3	59.5	do	8021	Nov. 8, 1910
	Preston						
	Reedsville	21	18.3	86.9	do	8039	Nov. 10, 1910
	Roane						
	Bloomington	20	6.9	63.0	do	8001	Nov. 1, 1910
	Summers						
	Lowell	32	11.8	79.3	do	7993	Oct. 29, 1910
Wyoming	Carbon						
	Baggs	22	14.8	79.4	do	7892	Oct. 18, 1910
	Crook						
	Forest	32	11.5	74.2	do	7274	Oct. 28, 1909
	Laramie						
	Cheyenne	23	12.8	73.4		4886	Oct. 15, 1907
	Do	11	19.3	82.8		4891	Oct. 23, 1907
	Chugwater	25	15.9	80.9	Red—small	5213	Dec. 3, 1907
	Do	10	6.4	55.1	do	5225	Do.
	Cheyenne	18	16.0	81.6	Good	5705	Oct. 6, 1908
	Do	16	24.3	92.0	Fair	5773	Oct. 15, 1908
	Sheridan						
	Kendrick	14	9.5	68.8	Poor	5804	Oct. 22, 1908
	Weston						
	Cambria	8	17.8	86.2	Fair	7137	Oct. 2, 1909
	Horton	14	11.2	79.0	do	7939	Oct. 18, 1910
	Uinta						
	Lyman	26	15.7	83.1	Good	5780	Oct. 17, 1908

YEARLY AVERAGE ANALYTICAL DATA BY STATES, FROM 1884 TO 1900, AND FROM 1905 TO 1910.

The following table contains the yearly average analytical figures of the bureau for beets grown in the various States since 1884, with the exception of the years 1901–1904. The figures are of value in showing the variability of the sugar content and purity by years and in providing a basis for a comparison of the various States as sugar-beet producers. Unlike the preceding table, the sugar content has been figured by a factor to the sugar in the beet. The results for the years up to 1898 are taken from Bulletin No. 52 of the Bureau of Chemistry, while the results for 1898, 1899, and 1900 are taken from

the Report of Progress of Beet Sugar Industry in the United States for these years. The results for 1905 to 1910 are based on the figures given in this report.

Yearly average of analyses of beets, by States, made in Bureau of Chemistry, 1884 to 1900 and 1905 to 1910.

State and year.	Number of samples.	Average weight.	Sugar in beet.[1]	Purity.
Alabama:		*Ounces.*	*P. ct.*	
1893	.....	.....	5 9	66.7
1898	4	18	8.5	73.2
1909	1	13	12.4	77.6
Arizona:				
1891	2	51	7.7	56.9
1897	7	23	9.3	70.4
1908	1	16	13.9	77.2
Arkansas:				
1891	2	40	6.4	58.8
1892	3	12	9.4	64.7
1897	2	18	11.3	71.5
1898	6	23	7.1	67.5
1899	5	15	6.0	55.5
1900	2	9	6.7	61.6
1906	1	8	10.8	80.3
1907	1	5	14.4	78.8
1909	1	16	12.3	.....
1910	4	16	10.9	75.4
California:				
1884	71	19	13.7	85.3
1890	4	13	14.7	84.6
1891	8	48	11.1	75.8
1892	4	14	14.7	77.6
1897	1	26	16.8	.....
1898	4	25	14.6	80.2
1899	1	11	13.9	82.0
1900	4	13	12.9	78.9
1908	6	13	13.3	82.2
1909	7	23	13.5	79.9
1910	2	32	16.8	82.5
Colorado:				
1890	29	20	12.5	76.1
1891	51	26	13.1	76.1
1892	170	18	14.8	81.7
1893	18	17	13.2	74.9
1897	174	20	13.6	76.7
1898	50	22	13.7	80.1
1899	64	24	14.4	80.2
1900	57	25	14.1	78.7
1905	22	29	16.1	82.6
1907	2	19	19.7	86.7
1908	9	17	13.6	79.5
1909	24	35	16.7	82.8
1910	4	20	11.9	70.9
Connecticut:				
1890	2	14	9.7	76.1
1891	5	27	10.8	77.3
1898	4	21	10.3	76.2
1899	2	17	10.9	75.5
1900	1	20	10.0	73.4
Delaware.				
1898	1	14	11.3	78.8
1899	2	24	12.5	81.4
1900	1	15	10.0	75.6
Georgia:				
1891	2	12	11.1	64.9
1898	4	47	5.8	64.0
1899	10	14	11.0	75.0
1900	1	10	14.2	86.6
1908	2	33	9.6	73.7
1909	1	14	8.5	71.6
1910	2	11	9.6	73.2
Idaho:				
1890	1	4	8.0	68.3
1891	1	15	12.7	74.9
1892	2	34	14.7	79.1
1893	2	78	10.2	76.2
1897	7	21	15.5	79.4
1898	5	28	12.0	78.3
Idaho—Continued.				
1899	1	36	10.8	75.0
1900	19	26	13.5	81.4
1906	1	24	19.1	89.5
1910	2	27	16.3	83.5
Illinois:				
1890	8	31	10.3	72.1
1891	36	32	11.7	76.4
1892	59	15	10.9	75.2
1897	32	17	13.1	75.5
1898	38	20	10.2	75.2
1899	25	25	10.6	72.6
1900	16	27	8.3	65.2
1905	7	20	11.6	76.1
1906	27	19	16.0	81.6
1908	1	12	18.8	88.0
1909	7	29	12.0	76.2
1910	3	41	9.6	71.5
Indiana:				
1890	56	23	10.7	72.7
1891	77	27	11.6	76.9
1892	57	14	11.2	72.5
1893	4	10	10.7	73.1
1897	103	14	13.1	78.9
1898	88	21	10.1	75.5
1899	29	19	11.4	73.4
1900	15	21	9.4	71.1
1909	3	26	11.6	75.6
1910	2	42	11.1	74.8
Indian Territory:				
1891	1	27	11.6	75.9
1898	1	27	9.6	77.1
1900	3	29	7.9	66.2
Iowa:				
1890	30	22	11.8	74.5
1891	321	30	11.8	75.7
1892	30	24	10.9	76.2
1893	7	17	12.8	75.8
1897	130	18	13.3	73.7
1898	147	25	11.4	76.1
1899	67	24	10.9	72.1
1900	39	33	9.5	70.7
1905	16	24	11.3	76.1
1908	2	28	14.8	87.7
1909	10	30	11.3	75.2
Kansas:				
1890	22	32	8.3	69.3
1891	36	33	10.7	68.2
1892	22	25	11.1	74.2
1893	1	.....	14.3	72.8
1897	41	27	11.4	73.8
1898	16	22	10.3	71.3
1899	35	22	9.6	66.0
1900	20	25	10.1	72.1
1907	11	19	10.8	72.3
1908	6	28	11.4	75.2
1909	1	24	15.3	82.1
1910	3	7	15.7	78.5
Kentucky:				
1891	3	34	9.1	63.7
1892	4	13	8.9	77.2
1897	6	16	11.9	71.5
1898	4	14	5.9	61.1
1899	1	5	7.4	.....
1900	12	13	8.5	64.8
Louisiana:				
1893	3	12	10.3	72.2
1910	1	5	9.0	70.8
Maine:				
1900	2	19	8.1	67.7

[1] Calculated from sugar in juice by factor.

Yearly average of analyses of beets, by States, made in Bureau of Chemistry., 1824 to 1900 and 1905 to 1910—Continued.

State and year.	Number of samples.	Average weight.	Sugar in beet.	Purity.
Maryland:		*Ounces.*	*P. ct.*	
1890	83	15	12.2	79.3
1891	2	16	7.4	68.5
1897	29	19	11.4	79.1
1898	31	22	10.4	76.0
1899	6	18	10.2	74.6
1900	1	10	9.3	74.2
1905	1	21	16.6	79.8
1910	9	15	14.5	84.0
Massachusetts:				
1890	6	16	12.0	82.8
1898	4	27	12.0	78.6
1899	9	21	14.6	83.3
1900	2	8	14.0	.....
Michigan:				
1890	30	31	12.0	78.4
1891	50	32	12.6	78.0
1892	71	19	14.1	83.4
1893	88	15	13.3	82.1
1897	450	22	14.7	81.1
1898	34	28	13.2	81.9
1899	236	22	13.1	79.7
1900	478	14	11.3	76.7
1905	21	15	16.4	82.8
1906	28	22	15.9	83.5
1907	2	18	15.6	86.1
1909	2	17	16.0	86.0
Minnesota:				
1890	107	30	11.8	75.2
1891	41	29	12.4	75.7
1892	22	29	12.2	78.1
1893	7	60	10.8	70.8
1897	49	24	11.0	79.2
1898	21	22	12.7	78.7
1899	9	23	12.3	77.5
1900	10	31	10.9	75.9
1910	1	9	9.3	66.6
Mississippi:				
1898	2	20	4.2	65.7
1908	1	.....	12.4	78.3
1909	5	13	9.9	69.9
1910	1	20	9.2	72.7
Missouri:				
1890	2	21	8.4	66.7
1891	67	20	10.4	62.4
1892	13	33	8.1	63.4
1897	324	20	11.7	73.5
1898	43	17	8.5	68.6
1899	19	17	7.1	64.3
1900	9	15	8.5	67.2
1908	3	13	12.2	79.7
1909	5	16	10.5	72.4
1910	4	10	8.7	69.9
Montana:				
1891	35	25	13.2	76.8
1892	6	22	10.9	72.8
1893	2	15	14.3	75.0
1897	4	20	14.4	77.8
1898	7	21	11.2	72.6
1899	2	40	10.7	70.6
1900	4	38	10.4	69.3
1909	1	24	16.0	76.8
1910	2	14	15.9	86.1
Nebraska:				
1890	269	20	11.8	71.9
1891	62	35	11.7	75.3
1892	27	21	14.2	79.3
1893	8	17	10.1	69.7
1897	13	29	12.9	76.9
1898	10	25	12.8	76.8
1899	6	19	11.3	74.4
1900	11	28	9.9	72.1
1908	5	19	9.1	68.3
1909	4	23	15.0	80.8
Nevada:				
1891	18	11	17.2	88.0
1892	81	13	15.9	83.4
1897	21	18	18.3	81.4
1898	42	12	18.5	85.9
1899	24	18	16.9	82.2
1900	3	10	9.6	79.6
Nevada—Contd.		*Ounces.*	*P. ct.*	
1908	5	22	16.0	85.8
1909	13	23	17.5	87.4
New Hampshire:				
1891	1	19	11.6	80.0
1898	2	34	13.5	83.5
1899	4	17	15.5	86.0
1900	9	29	11.1	74.9
New Jersey:				
1891	1	17	7.3	70.8
1897	31	16	14.2	81.4
1898	33	20	11.1	77.5
1899	17	27	11.3	77.3
1900	2	21	11.4	76.7
1909	1	16	7.9	63.5
New Mexico:				
1891	17	28	13.8	74.8
1892	29	19	15.3	83.2
1897	3	13	17.2	82.0
1898	7	20	12.8	78.0
1899	2	22	14.9	82.9
1900	2	23	14.5	77.8
1906	2	20	15.3	78.1
1907	20	21	17.9	83.2
1908	51	19	15.4	84.7
1909	14	19	14.6	80.1
1910	1	17	16.0	77.0
New York:				
1890	10	15	12.1	78.0
1891	4	32	11.6	76.8
1892	8	22	15.4	85.9
1897	225	21	15.0	82.4
1898	328	21	12.6	80.5
1899	142	19	13.0	78.8
1900	51	22	13.3	79.8
1910	2	10	13.8	83.5
North Carolina:				
1892	4	4	9.0	73.4
1897	7	23	9.1	75.3
1898	14	19	6.5	61.8
1899	2	17	7.6	69.0
1900	4	23	10.3	76.4
1907	7	17	12.2	80.8
1908	2	26	9.3	72.6
1909	4	14	14.0	82.6
1910	1	24	13.5	82.7
North Dakota:				
1890	24	25	13.4	71.2
1891	11	23	11.8	73.2
1892	11	24	12.9	76.5
1893	2	27	14.0	80.7
1897	4	28	10.5	81.2
1899	3	22	13.9	78.3
1900	5	22	10.2	71.1
1905	6	35	12.7	73.9
1908	7	15	14.4	83.6
1910	4	24	13.9	76.9
Ohio:				
1890	15	26	9.8	76.0
1891	66	31	11.3	73.5
1892	102	17	14.2	80.2
1897	68	22	13.8	79.1
1898	409	24	11.0	77.1
1899	128	24	11.9	76.1
1900	64	26	10.3	73.1
1906	5	27	17.0	81.7
1907	15	14	18.1	87.8
1908	1	16	9.5	73.0
1909	2	18	15.6	85.2
1910	2	19	11.9	75.0
Oklahoma:				
1891	1	48	6.4	53.3
1897	1	10	11.8	72.5
1898	6	24	10.2	73.3
1899	2	31	10.3	69.3
1900	4	22	10.6	69.8
1907	3	23	14.7	78.1
1908	7	25	13.8	81.2
1909	16	15	12.0	74.5
1910	4	19	13.4	81.9

Yearly average of analyses of beets, by States, made in Bureau of Chemistry, 1884 to 1900 and 1905 to 1910—Continued.

State and year.	Number of samples.	Average weight.	Sugar in beet.	Purity.
Oregon:		*Ounces.*	*P. ct.*	
1890	2	20	15.1	73.4
1891	35	34	12.7	81.1
1892	12	19	14.2	80.2
1898	6	20	14.1	83.4
1899	1	17	15.8	84.3
1900	11	19	12.4	78.9
1905	2	16	14.3	81.0
1906	1	32	12.2	68.0
1907	3	26	17.1	83.1
1908	3	17	17.0	86.2
1910	15	21	15.6	81.3
Pennsylvania:				
1890	10	27	8.0	73.8
1891	7	22	13.3	78.7
1892	8	13	10.8	75.8
1893	1	.....	11.0	78.9
1897	59	18	13.8	79.5
1898	81	21	11.6	78.1
1899	28	31	11.2	75.4
1900	11	21	10.6	74.8
1907	1	13	15.3	79.7
1908	3	18	14.2	82.4
1909	1	12	14.2	81.4
Rhode Island:				
1897	2	21	11.9	74.2
South Carolina:				
1897	13	17	9.9	79.9
1898	4	14	10.2	81.2
1899	4	14	13.0	79.3
1900	3	29	8.4	69.5
South Dakota:				
1890	21	20	13.1	78.6
1891	202	22	12.5	75.3
1892	67	20	13.1	75.5
1897	5	17	15.1	83.2
1898	24	16	13.9	78.6
1899	11	25	10.6	72.8
1900	9	29	10.5	71.7
1907	1	16	17.1	75.3
1909	3	13	16.6	82.8
Tennessee:				
1891	5	20	8.8	65.8
1892	1	10	9.4	72.4
1897	17	11	10.8	71.9
1898	10	17	8.0	69.3
1899	2	54	8.3	67.6
1900	1	15	5.4	54.8
1909	14	15	9.7	71.1
1910	2	25	10.3	72.8
Texas:				
1890	2	38	10.0	69.3
1891	10	23	10.3	69.1
1897	11	22	12.6	76.5
1898	49	25	9.5	69.8
1899	3	12	7.5	53.7
1900	15	29	6.9	56.8
1905	24	27	12.5	75.6
1906	17	27	13.2	75.8
1907	8	19	14.3	73.3
1908	24	20	12.7	77.6
1909	26	15	15.1	77.6
1910	10	20	13.1	76.9
Utah:		*Ounces.*	*P. ct.*	
1897	35	20	14.3	81.1
1898	14	16	13.6	85.3
1899	10	20	15.0	83.6
1900	5	14	13.8	81.3
1908	1	35	15.2	90.9
1909	4	8	13.2	79.4
1910	11	23	14.9	82.7
Vermont:				
1897	8	22	14.2	84.1
1898	68	22	13.2	82.8
1899	16	23	12.8	79.0
1900	3	15	12.1	79.7
Virginia:				
1890	20	15	10.8	74.0
1891	72	21	11.1	76.0
1892	13	12	12.0	79.6
1893	14	16	13.3	83.9
1897	34	21	11.6	76.2
1898	43	20	8.9	72.4
1899	6	17	9.5	74.2
1900	49	18	10.0	74.1
1907	2	16	14.7	81.2
1908	55	21	14.4	83.7
1909	51	19	12.9	79.1
1910	6	20	11.3	78.2
Washington:				
1890	1	16	15.2	84.2
1891	11	18	14.5	83.9
1892	31	18	14.5	76.8
1893	183	28	12.3	74.0
1897	34	27	13.7	80.7
1898	5	27	13.9	81.3
1899	8	23	13.0	77.8
1900	2	24	14.9	85.6
1910	1	9	18.3	89.0
West Virginia:				
1892	12	14	11.3	68.5
1897	14	19	15.4	80.4
1898	4	28	9.1	72.9
1899	3	20	9.1	67.2
1900	4	7	10.7	62.7
1909	1	16	11.7	70.1
1910	16	22	13.2	77.1
Wisconsin:				
1890	10	21	12.8	81.3
1891	432	26	11.1	75.8
1892	21	22	12.7	77.8
1897	42	15	15.8	83.3
1898	16	24	13.0	79.3
1899	25	21	14.8	84.4
1900	18	30	10.0	73.1
Wyoming:				
1890	5	26	15.1	78.8
1891	18	12	13.5	78.1
1892	6	8	15.2	85.2
1893	48	19	15.9	80.5
1897	34	19	17.2	82.3
1898	10	19	13.9	78.1
1899	1	29	15.9	81.9
1900	2	20	13.5	78.5
1907	4	17	13.0	73.0
1908	4	19	15.5	81.4
1909	2	20	14.0	80.1
1910	2	18	12.4	79.2

BIBLIOGRAPHY OF CHEMICAL LITERATURE ON METHODS OF ANALYZING BEETS (1839 TO 1906, INC.).

This bibliography does not pretend to be complete, but it contains titles of papers that have been noted by the author in a search through the complete files of the Pharmaceutische Centralblatt, Chemisches Centralblatt, Zeitschrift des Vereins der Rubenzuckerindustrie and Zeitschrift des Vereins der deutschen Zuckerindustrie, Scheibler's Neue Zeitschrift der Rubenzuckerindustrie, Zeitschrift für angewandte Chemie, La Sucrerie Indigene, and of certain volumes of the Bulletin de l'Association des Chimistes de Sucrerie et de Distillerie, Die deutschen Zuckerindustrie, Osterreichische-Ungarische Zeitschrift für Zuckerindustrie und Landwirtschaft, and Zeitschrift für Zuckerindustrie in Böhmen.

After having completed this review, a volume by E. O. Von Lippmann on "Die Entwicklung der deutschen Zuckerindustrie von 1850 bis 1900" was found in which the author devotes some 10 pages to abstracts, with references, of articles on analysis and valuation of sugar beets. The papers referred to there, with few exceptions, are noted in this bibliography. The list is made by years, with the authors' names in alphabetical order. It has been brought up to 1907, as from that time on such literature will be found in the volumes of Chemical Abstracts, American Chemical Society.

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