Ohio Agricultural Experiment Station.

BULLETIN 126

WOOSTER, OHIO, MARCH, 1901.

SUGAR BEET INVESTIGATIONS IN OHIO IN 1900.

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BULLETIN

OF THE

Ohio Agricultural Experiment Station.

NUMBER 126 MARCH, 1901.

SUGAR BEET INVESTIGATIONS IN OHIO, IN 1900.

BY A. D. SELBY AND J. W. AMES.

Through the continued cooperation of the United States Department of Agriculture, sugar beet seed was distributed to Ohio growers again in 1900. About 900 pounds was supplied by the Department of Agriculture through the Section of Seed and Plant Introduction of the Division of Botany. This seed was imported from Europe for use in the several portions of the country and came from the four growers listed below, Numbers 3941, 3942, 3943, 3944 and 4416. About 100 pounds of sugar beet seed was contributed by F. O. Boyd & Co., New York City. This was from the European grower, Licht; it appears as No. 1900. Some 50 pounds of seed from the Department of Agriculture originally sent to the Bücher & Gibbs Plow Co., of Canton, O., was forwarded to this Station and distributed to the various applicants. The total amount of seed, about 1,050 pounds, was distributed chiefly in March to 203 applicants located in 60 counties of Ohio. As to section, 107 of these recipients were in the northern, 57 in the middle and 39 in the southern section of the state. Early planting of the seed was strongly urged. The cultural directions were the same as in preceding years.

VARIETIES OF SEED AND GERMINATING QUALITY.

The numbers of the four principal varieties are those of the Section of Seed and Plant Introduction of the Division of Botany.

The number 1900 is a record number of this Station.

No. 3941. White Improved Sugar Beet Vilmorin.
No. 3942. Zehringen Klein Wanzlebener Sugar Beet, Strandes.
No. 3943. Russian Grown Klein Wanzlebener Sugar Beet, Mrozinski.
No. 4416. Russian Grown Klein Wanzlebener Sugar Beet, Mrozinski.
No. 3944. German Grown Klein Wanzlebener Elite Sugar Beet, Dippé.
No. 1900. Improved Klein Wanzlebener Sugar Beet, Licht.

The several principal sorts of beet seed were tested by Mr. J. F. Hicks, Assistant Botanist, with the following result:

TABLE I: RESULTS OF GERMINATION TESTS OF SUGAR BEET SEED IN 1900.

	No. 3941 White Improved (Vilmorin.)	No. 3942 Zehringen (Strandes.)	No. 3943 Klein Wanzlebener (Mrozinski.)	No. 3944 Klein Wanzlebener (Dippé.)
Number seed balls planted.	100	100	100	100
Number sprouts end of 5 days ..	9	43	....	56
" " " 6 " ..	55	84	.....	128
" " " 7 " ..	100	97	....	168
" " " 9 " ..	106	109	....	173
" " " 11 " ..	113	122	.....	188
" " " 14 " ..	113	122	about 200	188
Number seed balls germinated....	58	52	'87	82
Number with 4 or more sprouts..	5	7	.....	8
" " 3 sprouts.....	7	4	.....	14
" " 2 "	22	32	....	44
" " 1 "	24	52	.....	82

The results of the seed tests are rather more satisfactory than those of 1899. In no case was there any serious complaint of the germination of the beet seed. In our own plots here at the Station all seed sown gave a satisfactory stand; the Russian seed Nos. 3943 and 4416, was apparently the best of all in this regard. The stand of beets generally secured was superior to previous years.

THE SEASON'S WEATHER CONDITIONS.

The weather conditions were favorable to a good stand of beets and the midseason to a vigorous growth of weeds as well as beets. The temperatures for the growing season have generally been above normal, conspicuously so during August, September and October.

* Unfortunately all other records than this "number of seed balls germinated 87" for sample No. 3943 were mislaid.

The following table is compiled from the Ohio Weather Bureau Reports:

TABLE II: METEOROLOGICAL SUMMARY FOR 1900.

Month.	Rainfall—northern section, inches.		Rainfall—entire state, inches.		Temperatures, entire state. Degrees Fahrenheit.	
	1900.	Normal.	1900.	Normal.	Average 1900.	Normal average.
anuary	1.98	2.64	2.37	2.95	31.1	28.0
February	3.84	2.63	3.53	2.88	26.0	28.4
March	2 20	2.98	2 35	3.42	32 9	38.4
April	2.13	2.69	1.89	2.90	50.1	49.6
May	2 23	3.74	2.40	3.47	62.9	61 0
une	3.00	3.32	2.99	3.41	69.8	70.3
July	5.53	3.70	4 62	3.89	74.1	73.7
August	3.52	2 57	3.68	2.91	76.3	71 3
September	1.89	2 80	1.76	2.64	69.3	65 6
October	2.03	2.35	1.89	2 11	60 5	52.5
November	3.63	3.33	4.15	3.29	41.6	40.4

It seems quite probable that the number of clear days, or better still, perhaps, the total sunshine during the critical periods has very great direct influence, other factors being constant, upon the processes of the plant by which sugar is elaborated. In a certain view temperature and rainfall may be considered indicative of these other matters as well.

TABLE III: CLIMATOLOGICAL DATA FOR FOUR STATIONS IN THE SUGAR BEET DISTRICT DURING FOUR MONTHS OF 1897, 1898, 1899 AND 1900.*

	Napoleon, Henry Co.				Rocky Ridge, Ottawa Co.				Tiffin, Seneca Co.				Vickery, Sandusky Co.				Averages.			
	'97	'98	'99	'00	'97	'98	'99	'00	'97	'98	'99	'00	'97	'98	'99	'00	1897.	1898.	1899.	1900.
JULY.																				
No. Days—																				
Rainy	10	7	7	7	8	7	8	10	10	9	12	14	13	9	9	14	10.25	8.	9.	11.25
Clear	20	19	19	20	11	10	14	9	18	23	21	16	11	13	14	7	15.	18.5	17.0	13.0
Partly Cloudy	2	8	7	7	11	7	10	17	11	6	7	12	15	14	11	19	9.75	8.75	8.75	13.75
Cloudy	9	4	5	4	9	5	7	5	2	1	3	3	5	4	6	5	6.25	3.5	5.25	4.25
AUGUST.																				
No. Days—																				
Rainy	9	6	1	6	11	10	2	9	12	10	3	10	12	10	4	12	11.2	9.1	2.5	9.25
Clear	13	20	25	20	10	12	21	14	18	21	29	21	10	13	19	12	12.75	16.5	24.25	16.75
Partly Cloudy	12	4	4	7	13	10	6	10	9	8	1	10	14	14	8	14	12.	9.0	4.75	10.25
Cloudy	6	7	2	4	8	9	4	7	4	2	1	0	7	4	4	5	6 25	5.5	2.75	4.00
SEPTEMBER.																				
No. Days—																				
Rainy	2	9	4	3	2	8	10	5	2	12	10	5	2	8	6	6	2.0	9.25	7.5	4.75
Clear	27	15	13	25	20	17	14	16	27	20	19	22	17	19	11	16	22 75	17.75	14.	19.75
Partly Cloudy	2	7	9	1	8	6	5	8	2	8	5	6	11	5	11	8	5.75	6.5	7.5	5.75
Cloudy	1	8	8	4	2	7	11	6	1	2	7	2	2	6	8	6	1.5	5.75	8.5	4.5
OCTOBER.																				
No. Days—																				
Rainy	2	5	6	5	4	8	7	3	3	13	7	6	3	1	9	3	3 0	4.25	7.25	4.25
Clear	14	6	21	24	19	4	18	17	22	12	21	21	11	10	12	17	16.5	8.0	18.0	19.75
Partly Cloudy	12	12	2	0	3	12	5	7	6	7	4	8	15	11	11	9	9.0	10.5	5.5	6.0
Cloudy	5	13	8	7	9	15	8	7	3	12	6	2	5	10	8	5	5.5	12.5	7.5	5.25

* No account is here taken of days with merely a trace of rainfall.

To present this phase of the question more fully we have herewith included a tabulation of the number of rainy days, clear days, partly cloudy and cloudy days recorded at Napoleon, Henry county; Rocky Ridge, Ottawa county; Tiffin, Seneca county, and Vickery, Sandusky county, during July, August, September and October for the years 1897, 1898, 1899 and 1900. We are under obligations to J. Warren Smith, Section Director of the Weather Bureau, for his kindness in this connection; the data tabulated will be found in the published reports.

Taking the observations at these four points in the sugar beet belt, their average should give safe results. These show the month of July to vary less than any other during the four-year period. In 1897, the month of September and the first half of October were very favorable to sugar elaboration. That season's beets show very favorably. The season of 1898 may be called "choppy" for all four months; taken as a whole it was unfavorable to sugar content and purity of beets. In 1899 the month of August and the first half of September were characterized by light rainfall and sunshiny weather. The season of 1900 was one of disappointment, although much of September was fine.

Figure 1 is a diagrammatic presentation of the rainfall data for August, September and October, 1897, 1898, 1899 and 1900, showing the amounts and daily distribution as well as the total monthly rainfall for the four months of July, August, September and October of these years. The blank day spaces in this diagram speak commonly for clear weather; from a careful perusal we must conclude that sugar elaboration is a phenomenon of maturity in the beets, and that the season's record of rainfall, especially that of months immediately preceding clear periods, particularly for the month of July, may exercise a powerful influence on the conditions in this regard. The excessive rainfall for July and August, combined, in 1900, together with the distribution of the rains in September and October, may have had a great deal to do with the delayed maturity of the beets in that season. The seasons of 1897 and 1899 were the favorable ones for sugar in the beets, as will be seen from Table VI, page 154.

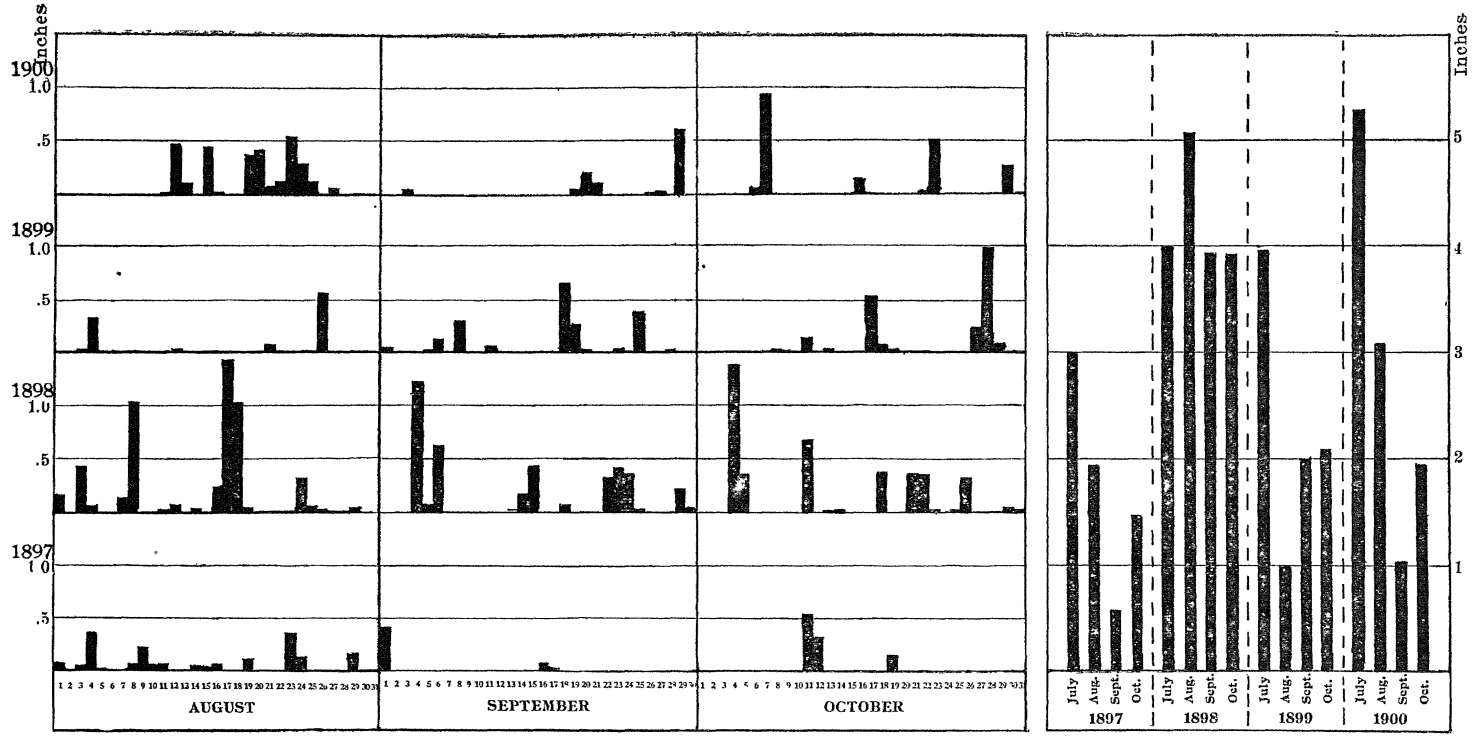

FIGURE 1.—On the left a graphic representation of the average daily rainfall at Napoleon, Rocky Ridge, Tiffin and Vickery, Ohio, during August, September and October of the years 1897, 1898, 1899 and 1900; this average is to represent the climatological variation in the sugar beet district At the right the total rainfall for the months of July, August, September and October for the same years is graphically represented upon the same scale.

RESULTS OF ANALYSES MADE IN 1900.

Of the 203 persons to whom sugar beet seed was sent, 109 have sent samples of beets for analysis. Of the 303 samples analyzed before the closing of the records in this bulletin, 226 are from the northern section, 57 from the middle section and 20 from the southern. The results of the analyses are set forth in detail in Table IV and summarized in Table V. Table VI compares these results with those of previous years.

TABLE IV: DETAILED RESULTS OF SUGAR BEET

Laboratory. No.	Name of grower.	Postoffice.	County.	Character of soil.	Variety.
2941	D. H. Foss	Ashland	Ashland	Sandy	Zehringen.
2942	"	"	"	"	Rus. Kl. Wanz.
2943	"	"	"	"	White Improv.
2944	"	"	"	"	Ger. Kl. Wanz.
	Average, 4 samples.				
2998	R. L. Dowdell	Bethesda	Belmont	Sandy loam	Klein Wanz.
2852	J. E. Davis	Mechanicsburg	Champaign.	Black loam	Zehringen.
2853	"	"	"	"	Klein Wanz.
2854	"	"	"	"	
2855	"	"	"	"	White Improved.
2856	Jasper Demint	"	"	Clay loam	Rus. Kl. Wanz.
2857	"	"	"	"	Ger. "
2870	Iva Creamer	"	"	"	Rus. "
2872	"	"	"	Sandy loam	White Improved.
2873	"	"	"	"	Zehringen
2874	"	"	"	"	Ger. Kl. Wanz.
2974	John M. Diltz	"	"	Clay	"
2975	"	"	"	"	"
3084	Elmer Diltz	Cable	"	"	Rus. Kl. Wanz.
3085	"	"	"	"	Ger. Kl. Wanz.
	Average, 14 samples.				
2893	D. H. Snavely	Springfield	Clark	Mixed clay	Kl. Wanz.
2928	O. M. Trumbo	Donnelsville	"	Gravel loam	Imp. Vilmorin.
2929	"	"	"	"	Rus. Kl. Wanz.
2930	"	"	"	"	Ger. "
2931	"	"	"	"	Zehringen
3073	A. E. Humphreys	Mad River	"	Black loam	Rus. Kl. Wanz.
3074	"	"	"	"	Zehringen.
3075	"	"	"	"	Imp. Vilmorin.
3076	"	"	"	"	Kl. Wanz.
	Average, 9 samples.				
2858	John Wagoner	Coshocton	Coshocton.	Clay loam	Kl. Wanz.
2970	S. G. Leavitt	Keene	"	Clay subsoil	Rus. Kl. Wanz.
2971	"	"	"	Clay loam	Ger. "
2979	Jacob Siegrist	Wills Creek	"	Sandy loam	
3019	John T. Haxton	Mound	"	Clay loam	Ger. Kl. Wanz.
3020	"	"	"	"	Rus. "
3042	J. L. Sicker	Bacon	"	"	" "
3043	Adam Royer	Wills Creek	"	Sand loam	" "
	Average, 8 samples.				
2958	W. Bradley	Strongsville	Cuyahoga	White	Ger. Kl. Wanz.
2959	"	"	"	"	Rus. "
3049	Jacob Pletscher	Berea	"	Yellow clay	" "
3050	"	"	"	"	" "
3051	"	"	"	"	White Improved.
3052	"	"	"	"	Zehringen.
	Average, 6 samples.				
2977	H. Scudder	New Weston	Darke	Sandy	Kl. Wanz.
2978	"	"	"	"	"
3026	Loyal G. Rhotehamel	Greenville	"	Sandy loam	Vilmorin.
3027	" "	"	"	"	Ger. Kl. Wanz.
3028	" "	"	"	"	Zehringen.
3029	" "	"	"	"	Rus. Kl. Wanz.
	Average, 6 samples.				
2996	Chas. Parker	Defiance	Defiance	Black sand	Imp. White.
2997	"	"	"	"	Zehringen.
	Average, 2 samples.				
2848	Edw. W. Kinnel	Delaware	Delaware	Black loam	Zehringen.
2849	"	"	"	"	Ger. Kl. Wanz.
2850	"	"	"	"	Imp. White.
2851	"	"	"	"	Rus. Kl. Wanz.
	Average, 4 samples.				

INVESTIGATIONS IN OHIO FOR 1900.

Date of planting.		Width between rows—inches.	Date of sampling.		Date of analysis.		Average weight of beets—ozs.	Sucrose in beets—per cent.	Purity co efficient.	Laboratory No.
May	2	20	Oct.	29	Nov.	3	11.8	10.9	80.4	2941
"	2	20	"	29	"	3	9.8	11.1	79.5	2942
"	2	20	"	29	"	3	10.	10.1	76.3	2943
"	2	20	"	29	"	3	9.8	10.9	77.8	2944
							10.3	10.7	78.5	
April	5	24	Oct.	25	Nov.	6	6.2	14.3	83.	2998
April	12	22	Oct.	19	Oct.	22	23.7	10.9	78.2	2852
"	12	22	"	20	"	22	14.9	10.6	79.4	2853
"	12	22	"	20	"	22	25.7	11.5	81.7	2854
"	12	22	"	20	"	22	25.1	11.1	82.4	2855
March	26	16	"	20	"	22	21.6	11.2	83.1	2856
"	26	16	"	20	"	22	19.2	12.	83 4	2857
"	31	18	"	22	"	23	14.3	11.5	78.7	2871
"	31	18	"	22	"	23	17.7	10.6	78 3	2872
"	31	18	"	22	"	23	15.5	11.8	78.5	2873
"	31	18	"	22	"	23	21.2	8.6	73.4	2874
May	1	30	"	31	Nov.	3	4.5	12.4	80.2	2974
"	1	30	"	31	"	3	4.7	13.3	81.4	2975
"	7	30	.....	.....	"	17	11.3	11.9	76.7	3084
"	7	30	.....	.....	"	17	8.2	13.8	78.4	3085
							16.2	11.5	79.5	
May	19	20	Oct.	23	Oct.	23	9.9	9.4	74.4	2893
April	19	20	"	25	"	29	19.5	8.5	74.4	2928
"	19	20	"	25	"	29	9.	8.3	66.9	2929
"	19	20	"	25	"	29	14.	10.4	81.5	2930
"	19	20	"	25	"	29	11.7	10.2	79.8	2931
"	20	20	Nov.	10	Nov.	13	17.1	9.1	74.	3073
"	20	20	"	10	"	13	16.1	9.8	82.1	3074
"	20	20	"	10	"	13	16.5	9.	76.4	3075
"	20	20	"	10	"	13	17.3	10.5	83.4	3076
							13.4	9.4	76.9	
May	8	20	Oct.	9	Oct.	22	40.3	13.9	82 5	2858
April		16	"	30	Nov.	3	7.1	7.7	64.3	2970
"		16	"	30	"	3	8.3	5.8	59.2	2971
May	1	20	"	30	"	3	15 3	12.3	80.7	2979
"	1	15	Nov.	2	"	6	15.2	10.1	73.1	3019
"	1	15	"	2	"	6	18.7	7.8	68.3	3020
"	10	24	"	6	"	8	25.	11.	78.9	3042
"	15	18	"	8	"	8	37.3	11.4	83.9	3045
							20.9	10.0	73.8	
May	17	19	Oct.	29	Nov.	3	7.7	11.	76.8	2958
"	17	19	"	29	"	3	4.2	10.8	75.5	2959
April	20	14	Nov.	6	"	9	8.	12.3	81 5	3049
"	20	14	"	6	"	9	5.8	14.9	83.9	3050
"	20	14	"	7	"	9	8.4	13.5	82.5	3051
"	20	14	"	7	"	9	9.6	12.	77.8	3052
							7.8	12.4	79.6	
May	22	26	Oct.	29	Nov.	3	8.6	9.9	73.6	2977
"	22	26	"	29	"	3	9.2	8.9	73 6	2978
April	23	18	Nov.	5	"	6	8.	11.9	83.2	3026
"	23	18	"	5	"	6	14.3	10.	81.3	3027
"	23	18	"	5	"	6	5.5	12.5	81.6	3028
"	23	18	"	5	"	6	4.6	8.1	76.6	3029
							8.4	10.2	78.8	
April	27	20	Nov.	2	Nov.	6	6.8	13.	84.	2996
"	27	20	"	2	"	6	4.1	14.8	83.9	2997
							5.4	13.9	83.9	
April	10	6	Oct.	20	Oct.	22	24.4	10.5	77.6	2848
"	10	6	"	20	"	22	28.8	9.4	76.1	2849
"	10	6	"	20	"	22	26.	9.5	76.9	2850
"	10	6	"	20	"	22	21.	10.9	81.4	2851
							25.0	10.0	78.0	

TABLE IV: DETAILED RESULTS OF SUGAR BEET

Laboratory No.	Name of grower.	Postoffice.	County.	Character of soil.	Variety.
2877	Isaac L. Sollars	Rattlesnake	Fayette	Black loam	Zehringen.
2878	"	"	"	"	Kl. Wanz.
	Average, 2 samples.				
3057	Samuel Taylor	Grove City	Franklin	Black loam	Vilmorin.
3058	"	"	"	"	Kl. Wanz.
	Average, 2 samples.				
2899	N. O. Black	Winameg	Fulton	Sand	Zehringen.
2900	"	"	"	"	Kl. Wanz.
2901	"	"	"	"	White Imp.
2902	"	"	"	"	Kl. Wanz.
3080	E. D. Naugle	Delta	"	Black sand	Vilmorin Imp.
	Average, 5 samples.				
2992	Joseph Schoenherr	Fairfield	Greene	Black loam	Zehrengin.
2921	J. A. Cheney	Findlay	Hancock	Black loam	
2863	P. T. Michael	Deshler	Henry	Black loam	Zehringen.
2864	"	"	"	"	Kl. Wanz.
2966	Simon E. Boyer	"	"	"	Vilmorin.
2967	"	"	"	"	Kl. Wanz.
2968	"	"	"	"	Rus. "
2969	"	"	"	"	Zehringen.
2993	James M. Longbrake	"	"	"	White Vilmorin
2994	"	"	"	"	
2995	"	"	"	"	Ger. Kl Wanz.
3034	M. C. Bowers	Westhope	"	"	"
3035	"	"	"	"	"
3043	Geo. P. Pierce	Deshler	"	"	Rus. "
3066	J. B. Osenbaugh	"	"	"	Zehringen.
3067	"	"	"	"	Vilmorin.
3068	"	"	"	"	Ger. Kl. Wanz.
3069	"	"	"	"	Rus. "
	Average, 16 samples				
2859	Wm. Raby	Welcome	Holmes	Clay	Ger. Kl. Wanz
2860	"	"	"	"	White improved.
2861	"	"	"	"	Zehringen.
2862	"	"	"	"	Rus. Kl. Wanz
	Average, 4 samples.				
2951	D. Coe	Centerburg	Knox		
2952	"	"	"		
	Average, 2 samples.				
3061	W. N. Hulett	Breakman	Lake	Clay	Kl. Wanz
3062	"	"	"	"	Vilmorin.
3063	"	"	"	"	Zehringen.
3064	"	"	"	"	Kl. Wanz.
	Average, 4 samples.				
3059	Ralph Dyer	Rochester	Lorain	Clay loam	
3060	"	"	"	"	
3072	"	"	"	"	
	Average, 3 samples.				
2879	Edward N. Todd	Neapolis	Lucas	Yellow sand	Ger. Kl. Wanz.
2882	Wm. C. Brossia	E. Toledo	"	Black loam	Rus. "
2883	"	"	"	"	Ger. "
2884	"	"	"	"	Zehringen.
2885	"	"	"	"	White Imp.
2937	J. B. Thompson, Jr.	Holland	"	Clay loam	Rus. Kl. Wanz.
2938	"	"	"	"	Ger. "
3016	"	Toledo	"	Black loam	Vilmorin.
3017	"	"	"	"	Zehringen.
3070	G. W. Bamsey	Mitchaw	"	Mixed loam	Ger.l. Wanz.
3071	"	"	"	"	Rus. K "
	Average 11 samples.				

INVESTIGATIONS IN OHIO FOR 1900—Continued.

Date of planting.	Width between rows—inches.	Date of sampling	Date of analysis.	Average weight of beets—ozs.	Sucrose in beets—per cent.	Purity coefficient.	Laboratory. No.
May 1	24	Oct. 23	Oct. 23	13.5	7.5	75.2	2877
April 25	24	" 22	" 23	5.9	7.6	72.7	2878
				9.7	7.5	73.9	
June 15	24	Nov. 9	Nov. 10	10.6	8.5	74.4	3057
" 15	24	" 9	" 10	7.8	9.1	71.1	3058
				9.2	8.8	72.7	
April 25	30	Oct. 22	Oct. 26	29.6	10.4	73.1	2899
" 25	30	" 22	" 26	21.1	7.6	65.9	2900
" 25	30	" 22	" 26	16.1	7.8	62.5	2901
" 25	30	" 22	" 26	30.	11.	73.9	2902
May 16	30	Nov. 13	Nov. 17	28.2	12.7	84.7	3080
				27 0	9.9	72.0	
April 16	18	Nov. 2	Nov. 6	9.4	9.2	69.3	2992
April 25	24	Oct 24	Oct. 29	29.1	10.9	78.1	2921
May 24	20	Oct. 20	Oct. 22	16.5	13.5	82.5	2863
" 26	20	" 20	" 22	16.7	12.7	84.7	2864
April 3	16	" 29	Nov. 3	14.2	13.2	85.3	2966
" 3	16	" 29	" 3	14.	12.8	85.4	2967
" 3	16	" 29	" 3	10.4	12.1	82.	2968
" 3	16	" 29	" 3	9.	13.	84.	2969
June 5	18	Nov. 3	" 6	6.4	13 8	81.9	2993
" 5	18	" 3	" 6	10.6	14.6	84.6	2994
" 5	18	" 3	" 6	7.7	13.2	79.9	2995
April 20	....	" 5	" 8	12.	13.3	85.4	3034
" 20	22	" 5	" 8	10.8	14.5	84.5	3035
May 4	18	" 7	" 8	12.7	11.	78.9	3043
" 20	24	" 8	" 13	13.2	13.3	77.8	3066
" 20	24	" 8	" 13	8.	15.3	83.8	3067
" 20	24	" 8	" 13	8.6	14.4	82.2	3068
" 20	24	" 8	" 13	8.1	11.9	76.1	3069
				11.2	13.3	82.4	
April 2	36	Oct. 19	Oct. 22	21.7	12.7	80.7	2859
" 2	36	" 19	" 22	19.4	13.1	81.8	2860
" 2	36	" 19	" 22	24.7	14 6	83.7	2861
" 2	36	" 20	" 22	17.	12.8	80.3	2862
				20.7	13.3	81.6	
....	.....	.....	Nov. 3	11.4	14.2	83 2	2951
....	.....	.....	" 3	11.5	14.9	85.3	2952
				11.4	14.5	84 2	
April 28	18	Nov. 9	Nov. 13	12.2	12.8	75.6	3061
" 28	18	" 9	" 13	7.1	13.3	78.2	3062
" 28	18	" 9	" 13	14.7	12.8	77.	3063
" 28	18	" 9	" 13	10.6	12.7	77.5	3064
				11.1	12.9	77.0	
May 15	18	Nov. 8	Nov. 10	20.6	8 6	64.5	3059
" 7	36	" 8	" 10	20.1	9.6	64.4	3060
" 7	36	" 8	" 13	28.9	9.1	67.	3072
				23.5	9.1	65.3	
May 2	19	Oct. 20	Oct. 23	19.4	9.9	74.3	2879
April 20	20	" 22	" 23	10.5	12.7	83.7	2882
" 20	36	" 22	" 23	10.5	13.3	88.1	2883
" 20	20	" 22	" 23	21.	12.2	79.5	2884
" 20	20	" 22	" 23	11.	14.	84.	2885
" 24	18	" 29	Nov. 3	6.2	11.	80.	2937
" 24	18	" 29	" 3	6.3	12.3	84.4	2938
May 3	18	Nov. 5	" 6	5.4	11.3	81.5	3016
" 3	18	" 5	" 6	16.6	9 5	80.	3017
April 20	24	" 10	" 13	18.5	13.	83.5	3070
" 20	24	" 5	" 13	13.5	11.6	81.9	3071
				12.6	11.9	81.9	

TABLE IV: DETAILED RESULTS OF SUGAR BEET

Laboratory No.	Name of grower.	Postoffice.	County.	Character of soil.	Variety.
2880	A. D. Hall	Litchfied	Medina	Blk. loam	Ger. Kl. Wanz.
2881	G. L. Damon	"	"	Sdy. bottom	"
2898	N. N. Reese	Chippewa Lake	"	" soil	
2909	S. A. Rhodes	Litchfield	"	Loam clay	Rus. Kl. Wanz
2939	Chauncy Hunt	Mallet Creek	"	Clay	"
2940	Chris. Kaiser	Erhart	"	"	"
2945	J. B. Good	Blake	"	Blk. loam	
2945	J. C. Fortney	Litchfield	"	Sandy	Kl. Wanz.
2947	Wm. Strosaker	Liverpool	"	Loam	"
2950	George Hard	"	"	"	
2961	W. Wiler	Whittlesey	"	Sd. loam	
2976	C. M. Metzger	Liverpool	"	Blk. clay	Kl Wanz.
3018	Geo Rolling	"	"	"	"
3025	Ed Smith	Medina	"	Blk loam	"
3033	Andrew Metzger	Liverpool	"	Clay and sand	"
3035	Nelson Smith	Medina	"	Sand and clay	"
3039	Fred Kleinknecht	Liverpool	"	"	"
3044	Winthorp Hill	Windfall	"	Sdy. loam	"
3048	A. F. Rickert	"	"	"	"
3053	H. L. Walling	Medina	"	Sandy	
3055	F. W. Weidner	Liverpool	"	Blk. loam	Kl. Wanz.
3083	G. M. Brainerd	Windfall	"	" clay	"
	Average, 22 samples.				
2891	W. B. Doner	Wabash	Mercer	Lt. sand	Kl Wanz.
2892	"	"	"	"	Rus Kl. Wanz.
3054	Moore McMillan	Macedon	"	Sandy	
	Average 3 samples				
2836	Karl G. Korn	Dayton	Montgom'ry	Clay loam	Knauer.
2837	"	"	"	"	"
2838	"	"	"	"	"
2839	R. H. Dickey, Jr	"	"	"	"
2840	"	"	"	"	"
	Average 5 samples.				
2903	L. P. & C. B. Roemer	Duncan Falls	Muskingum	Sandy	Zeh ingen.
2904	"	"	"	"	Vilmorin.
	Average, 2 samples.				
2910	John C. Metzger	Oak Harbor	Ottawa		
2841	C. H. Allen	Paulding	Paulding	Blk. loam	
3005	"	"	"	"	
3021	Elmer Jameson	Haviland	"	Blk. clay	
3022	"	"	"	"	White Imp.
3023	"	"	"	"	Kl. Wanz.
3024	"	"	"	"	Zehringen.
	Average, 6 samples.				
2984	J. C. Scott	Diamond	Portage	Clay loam	White Imp.
2985	"	"	"	"	Kl. Wanz.
2986	"	"	"	"	Zehringen
2987	"	"	"	"	Kl. Wanz.
	Average, 4 samples.				
2875	W. W. Dibble	Prentiss	Putnam	Loam	Kl. Wanz.
2876	"	"	"	"	Russian.
2911	Frank Koharst	Ft. Jennings	"	Blk. loam	French Yellow.
2933	John F. Clevenger	Kalida	"	"	Rus. Kl. Wanz.
2934	"	"	"	"	White Improved
2935	"	"	"	"	Zehringen.
2936	"	"	"	"	Ger. Kl Wanz.
2953	A. J. Troyer	Hector	"	Clay loam	Rus. Kl. Wanz.
2954	"	"	"	"	"
2955	"	"	"	"	White Improved.
2956	"	"	"	"	Zehringen.
3022	John A Alkire	Pandora	"	Blk. loam	White Vilmorin
	Average, 12 samples				

INVESTIGATIONS IN OHIO FOR 1900—Continued.

Date of Planting.	Width between rows—inches.	Date of sampling.	Date of analysis.	Average weight of beets—ozs.	Sucrose in beets—per cent.	Purity coefficient.	Laboratory number.
May 21	30	Oct. 22	Oct. 23	12.4	7.	57.8	2880
" 19	36	" 19	" 23	11.4	11.1	76.4	2881
" 15	.....	" 24	" 25	12.5	13.5	82.1	2898
June 2	14	" 25	" 27	14.	13.3	84.3	2909
" 10	30	" 27	Nov 3	9 3	12.9	82.4	2939
May 15	20	" 29	" 3	6.	9.	71.4	2940
" 20	20	" 27	" 3	19.4	13.7	81.8	2945
" 10	12	" 29	" 3	9.2	15.1	86.4	2946
April 28	18	" 28	" 3	14.2	12.3	80.2	2947
....	.....	.....	" 3	43.	9.5	69.	2950
May 15	30	Oct. 29	" 3	7.4	10.4	73.8	2961
" 10	.....	Nov. 3	" 3	11.	11.4	82.2	2976
" 2	16	" 2	" 6	27 5	7.1	68.8	3018
" 10	30	" 5	" 6	11.2	12.8	83.8	3025
June 1	30	" 5	" 8	20.6	11.5	82 3	3033
April 30	20	" 5	" 8	5.3	13.2	82.7	3035
May 5	24	" 5	" 8	18.	13.4	83.4	3039
" 5	.....	" 5	" 8	12.5	12 3	82.2	3044
" 14	30	" 6	" 9	8.1	14.9	85.3	3048
" 30	20	" 6	" 9	12.7	11.5	77.6	3053
April 25	36	" 9	" 10	38.4	9.9	70.3	3055
May 2	18	" 12	" 17	13.5	13 3	83.8	3083
				15.3	11.7	78.3	
April 27	24	Oct. 23	Oct 24	21.6	8.1	70.2	2891
" 27	24	" 23	" 23	24.	7.3	66.3	2892
May 15	20	Nov. 7	Nov. 9	17.3	10.7	73.3	3054
				20.9	8.7	69.9	
June 28	16	Oct. 6	Oct. 15	30.5	9.1	68.6	2836
" 28	16	" 6	" 15	25.3	8.2	64.6	2837
" 28	16	" 6	" 15	17.5	10.5	71.6	2838
May 10	16	" 12	" 15	23.8	6.7	57.7	2839
" 10	16	" 10	" 15	20.2	10.	71.9	2840
				23.4	8.9	66.8	
May 13	26	ct. 25	Oct. 26	15.2	9.	67.3	2903
" 13	20	" 25	" 26	15.6	8.3	67.9	2904
				15.4	8.6	67.6	
.....	.....	.....	Oct.	19.5	14.83	86.7	2910
May 10	30	Oct. 5	" 15	15.4	13.8	78.7	2841
June 8	42	Nov. 10	Nov. 13	16.5	12.7	77.5	3005
April 19	21	" 5	" 6	14.3	11.9	82.3	3021
" 19	21	" 5	" 6	8.2	13.2	87.4	3022
" 19	21	" 5	" 6	10.	13.2	84.2	3023
" 19	21	" 5	" 6	10.1	12.8	88.2	3024
				12.4	12.9	83.0	
April 16	20	Nov. 3	Nov. 6	13.	12.2	77.1	2984
" 16	20	" 3	" 6	17.	12.5	76.7	2985
" 16	20	" 3	" 6	18.1	13.8	80.1	2986
" 16	20	" 3	" 6	11.1	12.8	78.	2987
				14.8	12 8	77.9	
April 28	18	Oc . 22	Oct. 33	22.37	10.5	78.1	2875
" 30	18	" 22	" 23	8.39	12.3	80.7	2876
May 16	36	" 23	" 27	13	7.1	67.5	2911
" 23	18	" 27	Nov. 3	10.1	10.1	75.2	2933
" 23	18	" 27	" 3	17.7	10.5	76.	2934
" 23	18	" 27	" 3	19.4	8.5	70.9	2935
" 23	18	" 27	" 3	17.5	11.5	78.	2936
April 28	24	" 29	" 3	14.	11.2	77.1	2953
" 29	24	" 29	" 3	24.2	9.1	71.1	2954
" 29	24	" 29	" 3	20.7	10.4	81.5	2955
" 18	24	" 29	" 3	11.1	11.3	83.2	2956
May 17	16	Nov. 5	" 8	3.	10.4	75.7	3022
				15.12	10.2	76.2	

TABLE IV: DETAILED RESULTS OF SUGAR BEET

Laboratory No	Name of grower.	Postoffice.	County.	Character of soil.	Variety.
2912	E. M. Ater	Clarksburg	Ross	Blk. muck	Rus. Kl. Wanz
2913	"	"	"	Garden	White Improved
2914	"	"	"	Blk. clay	Zehringen.
2915	"	"	"	"	Ger. Kl. Wanz
	Average, 4 samples.				
2800	Theo. Rosenberger	Fremont	Sandusky		Rus. Kl. Wanz.
2801	"	"	"	Blk. loam	Ger. "
2843	C. H. Thomas	"	"		"
2920	Joseph H. Vine	Vickery	"	Clay	"
2926	I W. Walton	Fremont	"	Blk loam	
2927	"	"	"	Clay loam	
2948	W. F. Conner	"	"	Blk. sand	Kl. Wanz.
2949	"	"	"	"	"
2957	G. W. Parker	Clyde	"	Red. sand	"
3037	T. F. Siegfried	Fremont	"	Blk sand	"
3038	"	"	"	"	"
3040	Theo Rosenberger	"	"	Blk. loam	Rus. Kl. Wanz.
3041	"	"	"	"	Ger. Kl. Wanz.
3046	Henry Herman	Woodville	"	Dark loam	Vilmorin.
3047	Chas. Flicker	Gibsonburg	"		
3056	M. H. Crowell	Fremont	"	Blk. loam	Vilmorin.
3077	Michael Oberst	"	"	"	Orig. Kl. Wanz.
	Average, 17 samples.				
2905	Ernest R. Conklin	McCutchenvile	Seneca	Clay and sand.	Rus. Kl. Wanz.
2906	"	"	"	"	Zehringen.
2907	"	"	"	"	Imp. Vilmorin.
2908	"	"	"	"	Ger. Kl. Wanz.
	Average, 4 samples.				
2865	Barney Schmidt	Botkins	Shelby	Blk. sand	Ger. Kl. Wanz.
2866	"	"	"	"	"
	Average, 2 samples				
2962	F. M. Frederick	Wilmot	Stark	Clay	Rus. Kl. Wanz.
2963	"	"	"	"	"
2964	"	"	"	"	Vilmorin.
2965	"	"	"	"	Zehringen.
	Average, 4 samples.				
2886	Bert M Hart	West Richfield	Summit	Clay loam	Zehringen.
2887	"	"	"	"	White Vilmorin.
2888	"	"	"	"	Ger. Kl. Wanz.
2889	"	"	"	"	Rus. "
	Average, 4 samples.				
2960	C. H. Cook	Johnsonville	Trumbull	Clay loam	White Vilmorin.
2894	C. D. Wells	Van Wert	Van Wert	Sandy	Vilmorin.
2895	"	"	"	"	Zehringen
2896	"	"	"	"	Kl. Wanz.
2897	"	"	"	"	Ger. "
2916	J. M. Geise	Delphos	"	Blk. sand	Rus. "
2917	"	"	"	"	Zehringen.
2918	"	"	"	"	Ger. Kl Wanz.
2919	"	"	"	"	Imp. Vilmorin.
2972	F. B. Collins	Van Wert	"	Sandy	Zehringen.
2973	"	"	"	"	"
2980	David Eichar	Willshire	"	"	"
2981	"	"	"	"	Ger. Imp. Vil.
2982	"	"	"	"	Rus. Kl. Wanz.
2983	"	"	"	"	"
	Average, 14 samples.				
2988	H. P. Paffenbarger	McArthur	Vinton	Sandy loam	Kl. Wanz.
2989	"	"	"	"	"
2990	"	"	"	"	Imp. Vilmorin.

INVESTIGATIONS IN OHIO FOR 1900.

Date of planting.	Width between rows—inches.	Date of sampling.	Date of analysis.	Average weight of beets—ozs.	Sucrose in beets—Percent.	Purity. coefficient.	Laboratory. No.
April 12	24	Oct. 23	Oct. 27	6.5	7.7	72.3	2912
" 8	18	" 25	" 27	8.1	7.2	70.	2913
" 14	24	" 23	" 27	7.1	10.6	81.8	2914
" 12	24	" 25	" 27	6.4	10.	76.6	2915
				7.0	8.9	75.2	
.....	18	....	....	52.	10.9	77.1	2800
.....	18	....	.....	36.5	12.9	79.3	2801
....	....	. .. .	Oct. 18	44.	11.1	78.	2843
May 10	20	Oct. 28	" 27	21.38	11.6	79.5	2920
April 28	20	" 28	" 29	14.2	13.1	82.1	2926
" 28	20	" 27	" 29	11.6	12.8	81.8	2927
May 23	30	" 15	Nov. 3	21.	12.8	80.8	2948
" 23	20	" 30	" 3	21.4	14.3	81.2	2949
April 9	36	" 29	" 3	13.	9.2	73.9	2957
May 7 and 24	.....	" 30	" 8	11.3	15.3	84.7	3037
" 7 and 24	20	" 30	" 8	11.	16.5	87.4	3038
April 19	16	" 17	" 8	18.8	13.	85.1	3040
" 19	16	" 17	" 8	19.	12.3	84.	3041
May 12	20	Nov. 6	" 8	22.	14.2	81.4	3046
....	....	....	" 9	29.6	12.3	77.8	3047
April 30	20	Nov. 8	" 10	16 3	13.4	84.9	3056
May 2	20	" 12	" 13	21.	13.8	79.1	3077
				22.6	12.9	81.2	
June 1	18	Oct. 25	Oct. 27	9.2	10.3	74.5	2905
" 1	18	" 25	" 27	12.8	10.5	76.	2906
" 1	18	" 26	" 27	15.	10.6	73.2	2907
" 1	18	" 25	" 27	12.8	11.1	75 4	2908
				12.4	10.6	74.7	
May 1	42	Oct. 18	Oct. 22	8.9	12.3	77.8	2865
" 1	42	" 18	" 22	9.9	13.2	83.2	2866
				9 2	12.7	80.5	
April 21	30	Oct. 29	Nov. 3	9.3	10.5	81.6	2962
" 21	30	" 29	" 3	8.3	12.3	78.3	2963
" 21	30	" 29	" 3	7.8	10.4	81.5	2964
" 21	30	" 29	" 3	14.2	9.2	78.	2965
				9.9	10.6	79.8	
April 16	30	Oct. 22	Oct. 23	11.	10.	75.6	2886
" 16	30	" 22	" 23	17.	9.3	71	2887
" 16	30	" 22	" 23	11.8	10.2	75.3	2888
" 16	30	" 22	" 23	19.	9.4	75.4	2889
				14.7	9.7	74.3	
June 9	18	Oct. 29	Nov. 3	7.8	13.4	82.4	2960
April 26	24	" 24	Oct. 25	8.7	8.1	70.2	2894
" 26	24	" 24	" 25	8.	9.9	70.3	2895
" 26	24	" 24	" 25	9.4	9.9	71.2	2896
" 26	24	" 24	" 24	10.6	10.6	74.2	2897
March 22	24	" 24	" 27	19.5	9.1	74.4	2916
" 22	24	" 24	" 27	9.2	9.5	71.9	2917
" 22	24	" 24	" 27	17.1	10.6	76.7	2918
" 22	24	" 24	" 27	22.4	9.6	71.6	2919
April 5	36	Nov. 1	Nov. 3	27.8	9.	70.7	2972
" 5	36	" 1	" 3	26.8	5.1	60.	2973
May 10	24	" 1	" 6	14.	9.7	69.9	2980
" 10	24	" 1	" 6	13.5	7.5	67.5	2981
" 10	24	" 1	" 6	10.1	11.4	78.4	2982
" 10	24	" 1	" 6	10.7	10.5	75.5	2983
				14.9	9.3	71.6	
April 3	20	Oct. 30	Nov. 6	6.8	11.2	71.8	2988
" 3	20	" 30	" 6	19.8	6.6	54.5	2989
" 3	20	" 29	" 6	6.	9.7	70.8	2990

TABLE IV: DETAILED RESULTS OF SUGAR BEET

Laboratory. No.	Name of grower.	Postoffice.	County.	Character of soil.	Variety.
2991	H. P. Peffenberger .... Average, 4 samples.	McArthur.....	Vinton.....	Sandy loam	Zehringen.
2922	Mrs. Shumaker.....	Lebanon	Warren.....	Clay loam	Imp. Vilmorin.
2923	"	"	"	"	Zehringen.
2924	"	"	"	"	Kl. Wanz.
2925	" ..... Average, 4 samples.	"	"	"	"
2802	Ohio Agr. Exp. Station	Wooster	Wayne	Silt loam	Kl. Wanz.
2803	" "	"	"	"	White Improved.
2804	" "	"	"	"	Zehringen
2805	" "	"	"	"	Rus. Kl Wanz.
2806	" "	"	"	"	"
2807	" "	"	"	"	"
2808	" "	"	"	"	Imp. White.
2809	" "	"	"	"	Zehringen.
2810	" "	"	"	"	Rus. Kl. Wanz.
2811	" "	"	"	"	"
2812	" "	"	"	"	"
2813	" "	"	"	"	Licht.
2814	" "	"	"	"	Vilmorin.
2815	" "	"	"	"	Zehringen.
2816	" "	"	"	" ..	Rus. Kl. Wanz.
2817	" "	"	"	"	"
2818	" "	"	"	"	"
2819	" "	"	"	"	"
2820	" "	"	"	"	White Improved.
2821	" "	"	"	"	Zehringen
2822	" "	"	"	"	Kl. Wanz.
2823	" "	"	"	"	Rus. Kl. Wanz.
2824	" "	"	"	"	Kl. Wanz.
2825	" "	"	"	"	Vilmorin
2826	" "	"	"	"	Zehringen.
2827	" "	"	"	"	Rus. Kl. Wanz.
2828	" "	"	"	"	"
2829	" "	"	"	"	"
2830	" "	"	"	"	Licht.
2831	" "	"	"	"	Vilmorin.
2832	" "	"	"	"	Zehringen.
2833	" "	"	"	"	Rus. Kl. Wanz.
2834	" "	"	"	"	"
2835	" "	"	"	"	"
2842	I. W. Knestrick	Creston.....	"	.....	.....
2844	H. B. Heckman	Funk.....	"	.....	Zehringen.
2845	"	"	"	.....	Rus. Kl. Wanz.
2846	"	"	"	.....	Vilmorin.
2847	"	"	"	.....	Kl. Wanz.
2867	Joseph Gault.....	Wooster.....	"	Rich bottom.....	Russian.
2868	"	"	"	"	German.
2869	"	"	"	Muck.....	Russian.
2870	"	"	"	"	German.
2932	Edward Amiet.	Koch	"	Sandy loam ...	Zehringen.
2999	Ohio Agr. Exp. Station	Wooster	"	Silt loam	Kl. Wanz.
3000	" "	"	"	"	Vilmorin.
3001	" "	"	"	"	Zehringen.
3002	" "	"	"	"	4416
3003	" "	"	"	"	3943
3004	" "	"	"	"	3944
3005	" "	"	"	"	3941
3006	" "	"	"	"	3942
3007	" "	"	"	"	3943
3008	" "	"	"	"	4416
3009	" "	"	"	"	3944
3010	" "	"	"	"	1900
3011	" "	"	"	"	3941
3012	" "	"	"	"	3942
3013	" "	"	"	"	3943
3014	" "	"	"	"	4416
3015	" "	"	"	"	3944
3030	Timothy Buckley.....	"	"	Muck.....	French.
3031	"	"	"	"	German.
3078	John Begert.....	"	"	Gravel loam.....	Imp. Vilmorin.
3079	"	"	"	"	Rus. Kl. Wanz.
3081	"	"	"	"	"

INVESTIGATIONS IN OHIO FOR 1900.

Date of planting.	Width between rows—inches.	Date of sampling.	Date of analysis.	Average weight of beets—ozs.	Sucrose in beets—per cent.	Purity co efficient.	Laboratory No.
April 3	20	Oct. 29	Nov. 6	16.8	9.8	72.	2991
				12.3	9.3	67.3	
April 15	18	Oct. 27	Oct. 29	5.4	5 4	55.3	2922
" 15	18	" 27	" 29	7.	5.5	57.4	2923
" 15	18	" 27	" 29	8.	3.8	50.6	2924
" 15	18	" 27	" 29	7.5	5.9	66.	2925
				6.9	5.2	57.3	
April 14	.....	Oct. 1	Oct. 2	3.4	9.	72.5	2802
" 14	.....	" 1	" 2	3.7	9.1	76.2	2803
" 14	.....	" 1	" 2	2 6	9.6	76.5	2804
" 14	.....	" 1	" 2	3.6	8 5	70.3	2805
" 14	.....	" 1	" 2	4.5	10.4	74.3	2806
" 14	.....	" 1	" 2	7 4	9.2	72.9	2807
" 27	.....	" 1	" 2	5.	9.7	73.9	2808
" 27	.....	" 1	" 2	4.6	10.2	76.9	2809
" 27	.....	" 1	" 2	3.1	10.2	73.3	2810
" 27	.....	" 1	" 2	4.9	10.7	77.4	2811
" 27	.....	" 1	" 2	3.5	11.4	80.5	2812
May 16	.....	" 1	" 2	2.8	10.4	76.4	2813
" 16	.....	" 1	" 2	3.	10 4	76.7	2814
" 16	.....	" 1	" 2	4.6	9.5	73.	2815
" 16	.....	" 1	" 2	5.	10.4	76.7	2816
" 16	.....	" 1	" 2	4.6	9.5	74.1	2817
" 16	.....	" 1	" 2	6.	9.4	75.	2818
April 14	.....	" 15	" 15	2.8	10.4	74.8	2819
" 14	.....	" 15	" 15	3.	10.4	73.8	2820
" 14	.....	" 15	" 15	3.4	10.	78.3	2821
" 14	.....	" 15	" 15	2.5	10.2	76.9	2822
" 14	.....	" 15	" 15	3.6	10.9	78.7	2823
" 14	.....	" 15	" 15	3.6	11.6	83.6	2824
" 27	.....	" 15	" 16	5.4	10.6	77.2	2825
" 27	.....	" 15	" 16	4.	11.	79.4	2826
" 27	.....	" 15	" 16	5.	10.5	77.6	2827
" 27	.....	" 15	" 16	3.6	11.	78.9	2828
" 27	.....	" 15	" 16	5.9	10.5	80.4	2829
May 16	.....	" 15	" 16	5.6	10.5	77.6	2830
" 16	.....	" 15	" 16	5.3	10.2	78.1	2831
" 16	.....	" 15	" 16	5.4	10.	76.1	2832
" 16	.....	" 15	" 16	4.7	9.7	76.1	2833
" 16	.....	" 15	" 16	4.	9.5	79.4	2834
" 16	.....	" 15	" 16	6.3	10.9	79.8	2835
.....	.....	.....	" 18	3.2	10.4	87.3	2842
.....	.....	Oct. 19	" 20	27.2	9.	76.6	2844
.....	.....	" 19	" 20	28.	6.1	68.4	2845
.....	.....	" 19	" 20	33.7	9.2	76.4	2846
.....	.....	" 19	" 20	25.5	9.	73.1	2847
May 25	.....	" 22	" 22	50.4	8.1	70.8	2867
" 25	.....	" 22	" 22	51.	8.8	75.	2868
" 25	.....	" 22	" 22	26.3	9.	73.6	2869
" 25	.....	" 22	" 22	28.	9.2	76.4	2870
" 20	.....	" 26	" 29	19.	11.5	77.5	2932
April 14	.....	Nov. 5	Nov. 6	51.	11.8	77.	2999
" 14	.....	" 5	" 6	4.4	12.8	79.4	3000
" 14	.....	" 5	" 6	5.4	11.9	76.3	3001
" 14	.....	" 5	" 6	11.5	10.5	76.	3002
" 14	.....	" 5	" 6	4.	12.7	84.3	3003
" 14	.....	" 5	" 6	5.1	12.9	79.1	3004
" 27	.....	" 5	" 6	.....	11.9	78.1	3005
" 27	.....	" 5	" 6	5.1	11.5	79.	3006
" 27	.....	" 5	" 6	4.6	12.3	80.	3007
" 27	.....	" 5	" 6	4.7	11.9	80.6	3008
" 27	.....	" 5	" 6	4.	12.8	80.3	3009
May 16	.....	" 5	" 6	4.3	13.	79.6	3010
" 16	.....	" 5	" 6	5.3	12.8	81.8	3011
" 16	.....	" 5	" 6	6.4	13.9	81.6	3012
" 16	.....	" 5	" 6	5.1	13.7	80.9	3013
" 16	.....	" 5	" 6	3.3	12.6	79.9	3014
" 16	.....	" 5	" 6	3.5	13.8	80.1	3015
" 3	24	" 5	" 7	12.	6.7	67.	3030
" 3	24	" 5	" 7	16.4	6.6	64.8	3031
April 16	24	" 13	" 17	15.	12.9	78.6	3078
" 16	24	" 13	" 17	19.	8.2	69.3	3079
" 16	24	" 13	" 17	22.2	12.2	81.5	3081

TABLE IV: DETAILED RESULTS OF SUGAR BEET

Laboratory. No.	Name of grower.	Postoffice.	County.	Character of soil.	Variety
3082	John Begert	Wooster	Wayne	Gravel loam	Zehringen.
3098	Ohio Agr. Exp. station	"	"	Silt loam	Ger. Kl. Wanz.
3099	" "	"	"	"	White Improved
3100	" "	"	"	"	Zehringen.
3101	" "	"	"	"	Rus. Kl. Wanz.
3102	" "	"	"	"	" "
3103	" "	"	"	"	Ger. "
3104	" "	"	"	"	White Improved.
3105	" "	"	"	"	Zehringen.
3106	" "	"	"	"	Rus. Kl. Wanz.
3107	" "	"	"	"	" "
3108	" "	"	"	"	Ger. "
3109	" "	"	"	"	Kl. Wanz Lich.
3110	" "	"	"	"	White Improved
3111	" "	"	"	"	Zehringen.
3112	" "	"	"	"	Rus. Kl. Wanz
3113	" "	"	"	"	" "
3114	" "	"	"	"	Ger "
	Average, 84 samples				
2890	E. P. Swander	Weston	Wood	Sandy loam	Rus. Kl. Wanz.

INVESTIGATIONS IN OHIO FOR 1900—Concluded.

Date of planting.		Width between rows—inches.	Date of sampling.		Date of analysis.		Average weight of beets—ozs.	Sucrose in beets—per cent.	Purity co-efficient.	Laboratory No.
April	16	24	Nov.	13	Nov.	17	15.5	12.	80.8	3082
"	14	.....	"	19	"	20	4.8	12.3	76.6	3098
"	14	.....	"	19	"	20	3.1	12.3	78.3	3099
"	14	.....	"	19	"	20	4.6	11.5	76.7	3100
"	14	.....	"	19	"	20	4.5	10.2	72 8	3101
"	14	.....	"	19	"	20	5.8	10.4	76.9	3102
"	14	.....	"	19	"	20	5.	10.5	74.5	3103
"	27	.....	"	19	"	20	4.	12.3	78.1	3104
"	27	.....	"	19	"	20	4.7	11.7	78.9	3105
"	27	.....	"	19	"	20	4.	11.6	77.2	3106
"	27	.....	"	19	"	20	3.1	11.6	78.2	3107
"	27	.....	"	19	"	20	4.4	12.3	80.2	3108
May	16	.....	"	19	"	20	4.7	12.7	82.7	3109
"	16	.....	"	19	"	20	4.1	11.9	79.3	3110
"	16	.....	"	19	"	20	4.5	10.4	76.4	3111
"	16	.....	"	19	"	20	2.6	11.	77.3	3112
"	16	.....	"	19	"	20	1.4	11.7	77.3	3113
"	16	.....	"	19	"	20	1.6	11.4	78.4	3114
							8.7	10.7	77.0	
March	20	18	Oct.	22	Oct.	23	9.8	12.1	82.5	2890

TABLE V: SUMMARY OF TABLE IV, 1900.

County.	No. of samples.	Average weight of beets, ozs.	Sugar in beets, per cent.	Purity coefficient.
NORTHERN SECTION.				
Ashland	4	10.3	10.7	78.5
Cuyahoga	6	7.8	12.4	79 6
Defiance	2	5 4	13.9	83 9
Fulton	5	27.0	9.9	72.0
Hancock	1	29.1	10.9	78 1
Henry	16	11.2	13.3	82.4
Lake	4	11.1	12 9	77.0
Lorain	3	23.5	9.1	65.3
Lucas	11	12.6	11.9	81.9
Medina	22	15.3	11.7	78.5
Ottawa	1	19.5	14 8	86.7
Paulding	6	12 4	12 9	83 0
Portage	4	14.8	12.8	77.9
Putnam	12	15.1	10.2	76.2
Sandusky	17	22.6	12.9	81.6
Seneca	4	12.4	10.6	74.7
Stark	4	9.9	10.6	79.8
Summit	4	14.7	9.7	74.3
Trumbull	1	7.8	13.4	82.4
Van Wert	14	14.8	9.3	71.6
Wayne	84	8.7	10.7	77.0
Wood	1	9.8	12.1	82 5
MIDDLE SECTION.				
Belmont	1	6.2	14.3	83.0
Champaign	14	16.2	11.5	79.5
Clark	9	13.4	9 4	76.9
Coshocton	8	20.9	10.0	73.8
Darke	6	8.4	10 2	78.8
Delaware	4	25.0	10.0	78 0
Franklin	2	9 2	8.8	72.7
Holmes	4	20.7	13 3	81.6
Knox	2	11.4	14 5	84.2
Mercer	3	20.9	8.7	69 9
Muskingum	2	15.4	8 6	67.6
Shelby	2	9.4	12.7	80.5
SOUTHERN SECTION.				
Fayette	2	9.7	7 5	73.9
Greene	1	9.4	9.2	69.3
Montgomery	5	23.4	8.9	66 8
Ross	4	7.0	8 9	75 2
Vinton	4	12.3	9 3	67.3
Warren	4	6.9	5 1	57 3
SUMMARY.				
Northern Section	226	12.6	11.3	77.8
Middle Section	57	15.9	10.7	77.4
Southern Section	20	12.5	8.1	67 5
Entire State	303	13.2	10.9	77.1

The results are, as a whole, disappointing to those who looked upon the past season as favorable to sugar beets; the fact is that the season was a favorable one for a stand of beets and possibly also for the tonnage secured, while the most unfavorable for sugar content and purity coefficient in the beets since the present sugar beet experiments were inaugurated, in 1897. The average of the analyses for the northern section is 11.3 per cent. sugar in beets and 77.8 purity coefficient; for the middle section 10.7 per cent. sugar in beets and 77.4 purity; for the southern section 8.1 per cent. sugar and 67.5 purity; while for the whole state the results give an average of 10.9 per cent. sugar in beets and a purity of 77.1. The counties of the northern section appear to be even more decidedly in the lead with respect to quality of beets analyzed, than in other seasons. Sandusky and Henry counties, in which beets were largely grown for the factory at Fremont, indicate the beneficial effects of supervision and better care in growing sugar beets.

Table VI gives a comparison of the general results of the sugar beet analyses by sections and for the entire state during 1897, 1898, 1899 and 1900, and certainly exhibits decided fluctuations; in short the results for 1900 are the most unsatisfactory of all the years covered. It will not be easy to offer a single really adequate explanation of the decided differences in the averages for the years 1897 and 1898 on the one hand, and those of 1899 and 1900 on the other. From fairly satisfactory results in 1897 and 1899 there is much deviation in 1898 and 1900. If we are to seek an explanation we are rather more likely to find one in the conditions which favor or retard the maturity of the beets and their elaboration of sugar; it would seem that these are synchronous.

TABLE VI: COMPARISON OF GENERAL RESULTS FOR 1897, 1898, 1899 AND 1900.

Section.	Number of samples.				Average weight of beets —ounces.				Sugar in beets—per cent.				Purity coefficient.			
	1897.	1898.	1899.	1900.	1897.	1898.	1899.	1900.	1897.	1898.	1899.	1900.	1897.	1898.	1899.	1900.
Southern section	67	51	20	20	31.4	18.4	21.6	12.5	12.2	10.9	12.1	8.1	75.3	76.9	77.5	67.5
Middle section	132	153	18	57	32.6	19.6	23.5	15.9	13.2	11.1	12.0	10.7	78.0	76.9	77.8	77.4
Northern section	355	294	93	226	29.2	25.0	20.5	12.6	13.6	11.6	13.0	11.3	79.4	78.7	81.5	77.8
Entire state	554	498	131	303	30.6	22.7	21.1	13.2	13.3	11.4	12.7	10.9	78.7	77.9	80.2	77.1

TABLE VII: VARIETIES PLANTED MAY 16, 1900

Date of analysis.	Improved Kleinwanzlebener (Licht) 1900.			White Improved (Vilmorin) 3941.			Zehringen (Strandes) 3942.			Russian Kleinwanzlebener (Mrozinski) 3943 and 4416			Ger. Kl. Wanzlebener (Dippé) 3944.		
	Average wt. of beets—grammes	Sugar in beets—per cent.	Purity.	Average wt. of beets—grammes	Sugar in beets—per cent.	Purity.	Average wt. of beets—grammes	Sugar in beets—grammes	Purity.	Average wt. of beets—grammes	Sugar in beets—grammes	Purity.	Average wt. of beets—grammes	Sugar in beets—per cent.	Purity.
October 2, 1900	80	10.4	76.4	86	10.4	76.7	136	9.5	73.	143 131	10.4 9.5	76.7 74.1	171	9.4	75
" 15, 1900	159	10.5	77.6	150	10.2	78.1	154	10.	76.1	141 111	9.7 9.5	76.1 79.4	177	10.9	79.8
November 6, 1900	123	13.	79.6	151	12.8	81.8	179	13.9	81.6	145 94	13 7 12.6	80.9 79.9	98	13.8	80.1
" 20, 1900	132	12.7	82.7	116	11.9	79.3	128	10.4	76.4	75.3 40.6	11. 11.7	77.3 77.3	46.6	11.4	78.4

VARIETY TESTS.

Five varieties of sugar beet seed, from as many European seed growers, were tested on some rather thin land at the Station, under the direction of the Chemist. A good stand of beets was secured at each planting, April 14, April 27 and May 16 respectively. Samples were taken at different dates and the results are exhibited in Table VII.

The maximum of quality in these beets, which were quite small, was obtained for the most part in those sampled November 6th. The details as to varietal differences are fully tabulated. There was a decidedly better stand in the field before thinning from numbers 3942, 3943 and 4416.

The original Kleinwanzlebener is reported to have given the best results in the beet sugar work at the Fremont factory. Six varieties are to be included in the co-operative tests, offered by this Station for 1901

THE BEET SUGAR INDUSTRY IN OHIO.

With the season of 1900, Ohio was enrolled among the states possessing a beet sugar factory; the Fremont works of the Continental Sugar Company, nominally a 350 ton plant, averaging 356 tons per day of 24 hours during the entire run, and slicing as high as 436 tons of beets per day, began running October 25, 1900, and closed December 26, 1900. This factory received 21,500 tons of beets, obtained from about 2,200 acres; by these figures a tonnage showing of about 9.8 tons per acre is the first year's results in this line. While from the sugar making side of the industry the low sugar content and purity of the beets have given, of necessity, less satisfactory results than should occur at another time, the yields of beets have been decidedly promising to the growers. Some failures and some highly profitable crops intersperse, as was to be expected, the general record for the year. Sugar beet growing is new to most of our farmers, and it is not expected that a single season will disclose all the knowledge of beet growing that it is possible for them to acquire. It is, however, from the general outlook, fairly reasonable to predict that this new industry will now claim an increasing amount of attention within our borders. A large modern plant has been constructed, has successfully handled the beets grown for it, and is again before the farming public of its vicinity for agreements as to next year's beet supply. Having started upon acreage contracted for but a single season, possible elements of discord are thereby greatly reduced, if not altogether avoided. After a season, the poorest for the period covered by our Station's sugar beet investigations, and one in which the beet yields have been above, rather than below, well grounded anticipations, Ohio growers are offered a liberal beet agreement for the year of 1901. It would appear to an outside observer that these conditions afford a

good opportunity to test fairly the future of the Ohio beet sugar industry for the region in which the factory is located.

If, as many believe, northern Ohio will be found adapted to the profitable growing of beets and the successful conduct of a beet sugar factory in working those beets, what is soon to be determined will have a marked effect upon the future agricultural practice in the regions concerned. It would seem opportune, therefore, to give some space to the discussion of certain phases of the new sugar industry.

THE BEET SUGAR FACTORY.

A modern beet sugar factory exhibits in the general construction the triumphs of mechanical skill and ingenuity, at the same time that its methods of actual sugar making are the result of careful chemical investigation and are controlled at almost every stage by chemical analysis. Herein we may find much to interest us; every detail of construction and arrangement is planned to serve its particular end.

The accompanying illustration (Figure 2) will convey an idea of the Fremont factory, and comparatively speaking, of other beet sugar factories employing the same processes. The beet storage is provided in sheds, into which the beets are discharged from wagons or unloaded from the cars. Each of these sheds has the bottom sloping to the middle, beneath which is the flume; in it the beets are carried by flowing water to the factory proper, and out of it they are lifted by a wheel and delivered to the washer. After washing, the beets are automatically thrown within reach of the carrier, by means of which they are taken to the top of the building and delivered to the weighing machine; this machine discharges at a definite weight, about 600 pounds, meanwhile recording the number of loads, and the beets drop into the hopper of the slicing machine. The curved knives of the slicer cut the beets into pencil-like strips, or *cossettes*, as they are called, which are in turn delivered to the open diffusion cell or chamber of the diffusion battery below, through the long, sloping spout. About two and one-half tons of *cossettes* are required to each cell of the diffusion battery; after filling, the newly filled chamber is placed last in the line of flow of the hot water passing through these chambers to extract the sugar, or other substances dissolved in the beet juices. Herein is the essential difference between diffusion and direct extraction of saccharine matter by grinding or crushing and subsequent pressure. The slicing into *cossettes* is the preparation of the beet for extraction of its juices by the diffusion process. All are more or less familiar with the primitive crushing and juice extraction practiced with sorghum, with apples and with other fruits as exemplifying the old process of juice extraction. (Figure 3)

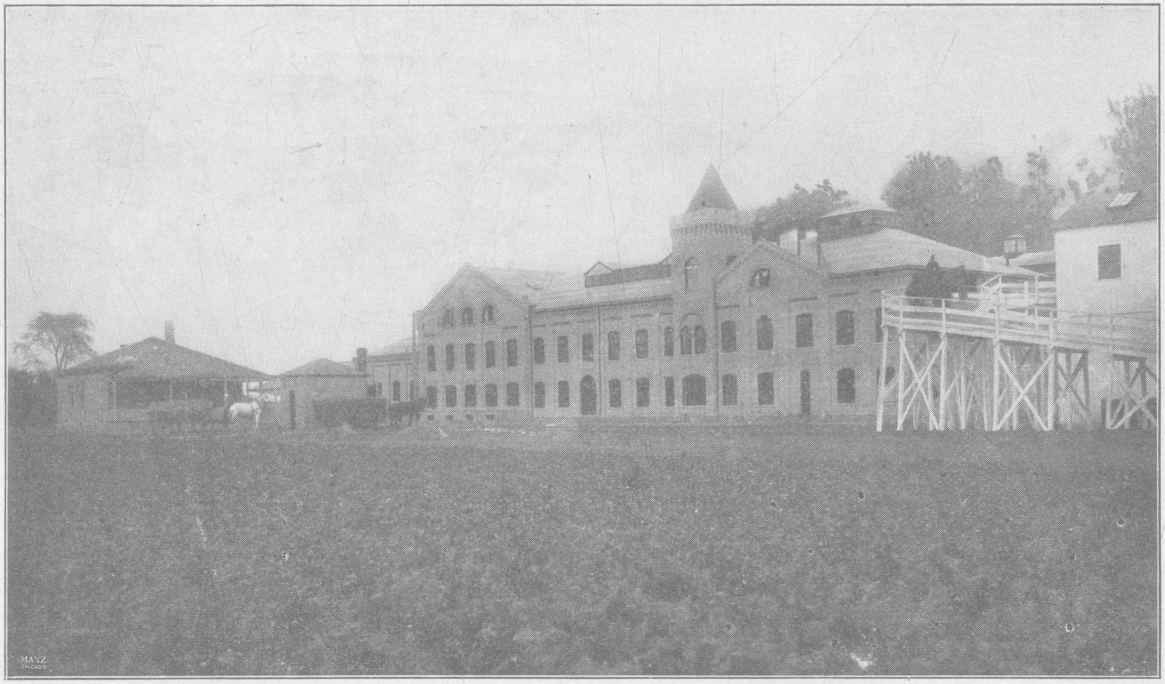

FIGURE 2.—A MODERN SUGAR BEET FACTORY.

The Fremont works of the Continental Sugar Company, Fremont. On the right is shown the end of the beet sheds nearest the factory, with empty wagon descending the incline; a similar incline at the farther end is for the ascent of the loaded wagons. In the center of the factory building, beneath the roof projection at the right hand of the tower, is situated the automatic weighing machine, slicer, and diffusion batteries. It is at this end of the factory that beets are taken in. The white sugar is discharged at the further end. The chemical laboratory is on the first floor, at the extreme left of the main building. The seed house is seen in the background at the left, and in the foreground the offices and scales. A beet field is in front of the factory.

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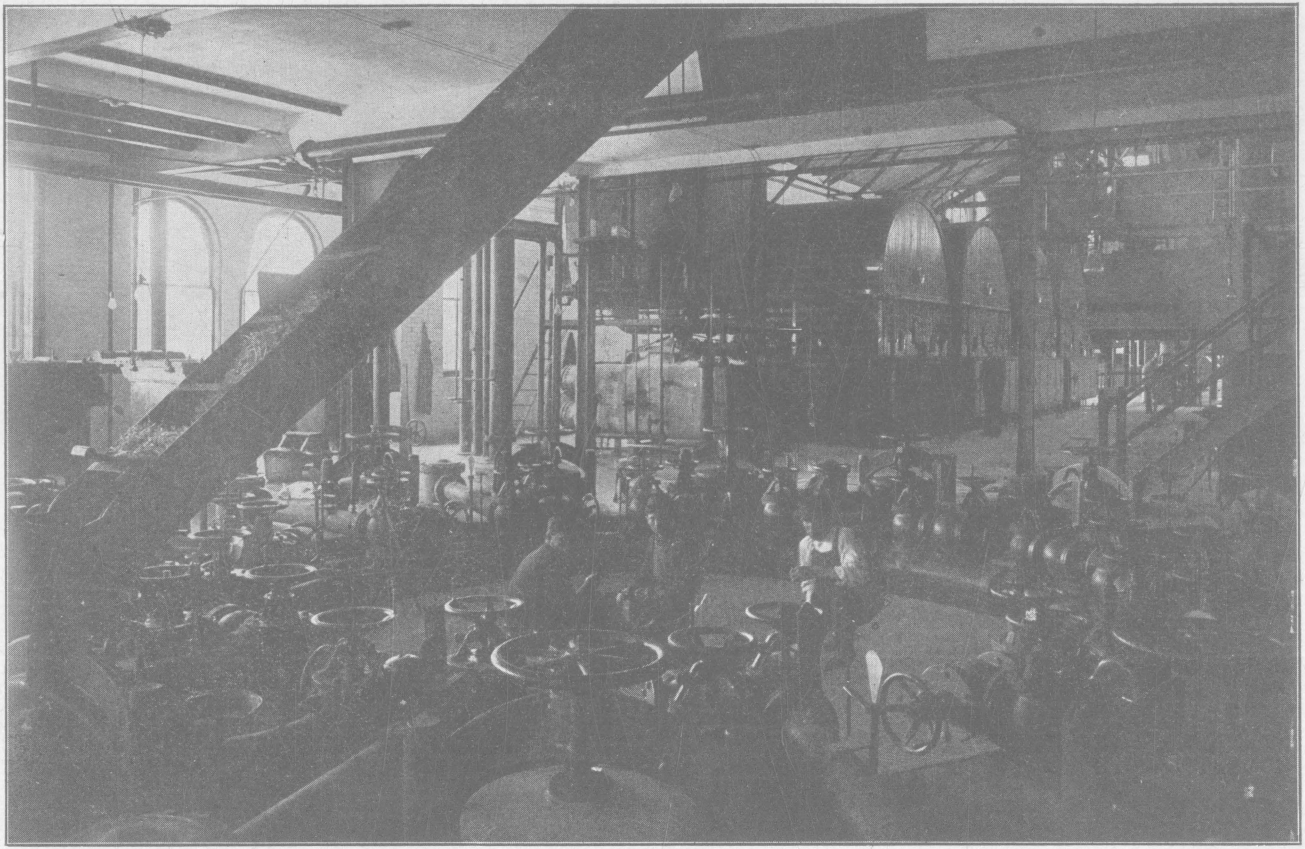

FIGURE 3.—Interior of the same factory, looking from the end toward the beet sheds, and showing in the foreground the diffusion battery, consisting of many large cells, with sliced beets discharging into one of them. In the background are visible the vacuum tanks, and in the extreme background, to the right, is shown that part of the factory in which the sugar is put into the barrels. (From photograph of Continental Sugar Co.)

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The sugar juices from the diffusion cells will be diluted more or less, according to the volume of water used in their extraction; manifestly there is a limit in the extraction of the sugar from the *cosettes*, now become the *pulp*, beyond which profitable extraction cannot be secured because of the dilution of the diffusion juice.

Broadly speaking, about one-half of one per cent. of sugar remains in the pulp for the reasons stated; a more complete extraction would involve greater dilution and mean more water to evaporate in the process of sugar separation. The technical control of such processes involves many factors that will scarcely occur to the non-technical reader, or visitor at a beet-sugar factory.

The juice, or liquor from the diffusion battery, is passed through the sulfuring tanks where bleaching is to be secured by the fumes of burning sulfur; then the same liquor is passed to a tank for first carbonation. This process consists in the addition of lime in excess to precipitate especially the albuminoid substances in the juice and subsequently in passing gaseous carbon dioxid (saved in the process of burning the lime required) through this limed juice to precipitate any excess of lime and reduce, or neutralize the alkaline reaction. From the first carbonation the liquor is passed through the filter presses to remove all precipitated material, such as lime, albuminoid substances, and the like. From the filter presses come the lime cake of the factory. From the first set of filter presses the liquor passes through a second course of liming and carbonation, the "second carbonation" and again through a succeeding set of filter presses.

After the second carbonation, the somewhat changed juice or liquor is ready for the evaporating tanks, or vacuum tanks as they are usually called, where in a series of four tanks the liquor is evaporated, under reduced air pressure, to a "thick liquor" containing about fifty per cent. sugar. The vacuum tanks are interesting as illustrating the effect of the atmospheric pressure upon the boiling point of a liquid. These tanks are closed chambers, connected with each other and capable of containing a large volume of liquor. Through the tanks and liquor are a series of copper pipes. Through pipes of the first tank live steam is passed while the vapor from the evaporation going on in the first tank passes through the copper pipes of the second, and so for each one successively. The air is exhausted from the upper space of each chamber by trickling water and pump, so that a nearly uniform pressure is maintained for each, though different for the several tanks. This means about as follows:

For first vacuum tank normal pressure, boiling at 100 degrees C. (212 F.)

For second, a low vacuum, or a reduction of 2½ to 5 lbs. in the pressure, boiling at about 85 degrees C. (185 degrees F.)

For third, less pressure, about half of normal, boiling at about 65 degrees C. (149 degrees F.)

For fourth, an exhaustion of about 12 pounds, or a pressure of about 3 lbs., boiling at about 53 degrees C. (127.4 degrees F.)

The "thick liquor" from the vacuum tanks, containing, as is stated above, about 50 per cent. of sugar, is drawn off from the fourth tank, filtered through bag filters, sulfured again and then passed into "the vacuum strike pan" on the next level above. In this, evaporation proceeds under even better vacuum, until the desired consistency is reached for subsequent crystallization of the sugar. From the strike pan the thick, pasty mass is discharged into the graining pan, where it is continually stirred to induce proper crystallization; thence it is drawn to the centrifugals, which are chambers, or hollow cylindrical bodies with the outer margin of the hopper of perforated brass, revolving at a very high speed and surrounded by a fixed external jacket. The molasses is thus thrown out of the mass and caught by the external jacket; the crystallized sugar remains behind, is washed to free from adhering molasses and is then ready for drying in a heated dryer, and subsequent pulverizing of any lumps. As the finished sugar drops into the barrels, it is yet warm and almost entirely free from moisture, polarizing between 99.5 and 100 per cent. of sugar; in fact any slight deviation from 100 per cent. in polarization is usually to be attributed to imperfections in drying or to subsequent slight absorption of moisture.

There are further vacuum pans found here for the handling of molasses; and there are special processes, such as Steffen's, Osmose and some others, that have not been introduced into the Fremont works. The largest loss in beet sugar manufacture is undoubtedly in the final molasses, which in our country is not utilized, and is in fact, difficult to utilize even with pulp for stock feeding, as is reported to be the practice in Germany. The beet pulp too is not as yet utilized, though promising to be valuable in cattle feeding; it is dropped into a large silo outside the factory.

So much by way of explanation of the factory processes. Lime kilns, seed houses, cooper shops, boiler sheds and other features of a sugar factory do not differ essentially from similar features of any other industrial enterprise.

THE FARMERS' SIDE OF THE BEET SUGAR INDUSTRY.

It has been well said that the mechanics of the beet sugar industry has been brought to a high state of perfection in America, but that the agriculture of beet growing in our country has not advanced in proportion. If this be true even of states where the industry has been established longer than in Ohio, it is all the more certainly true with our people who have just begun. The point here worth making is that a considerable period of experience must be anticipated before great advances may be realized. If we but consider how much of experience is behind our usual growing of wheat, potatoes and corn, and further how much seems to be unsettled and yet to be acquired, we may appreciate the need for greater knowledge in the handling of a new crop of the

FIGURE 4.—Field operations in sugar beet growing; doubling up teams to haul wagons out of the beet fields. The wagons of this style carry 3 tons of beets.

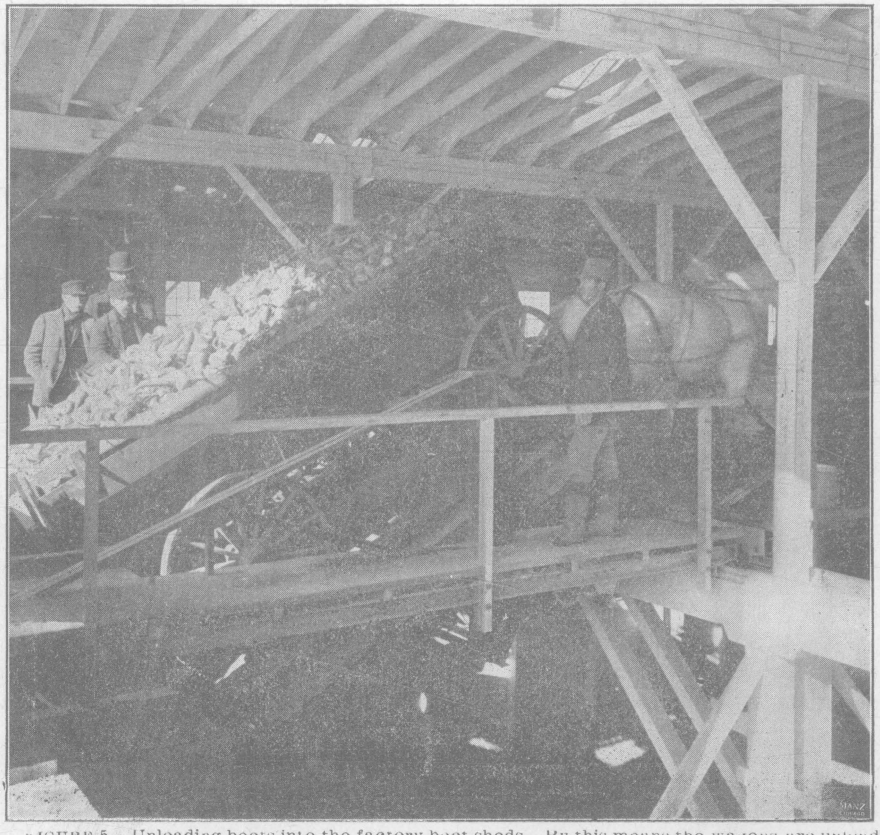

FIGURE 5.—Unloading beets into the factory beet sheds. By this means the wagons are unloaded in 1½ to 2 minutes. (From photograph of Continental Sugar Company.)

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nature of sugar beets. In sugar beet culture the factory exercises a wholesome technical control by which we are supplied at once with a means of judging the results of our efforts; for corn and potatoes and even also for wheat the possible inferiority of the product is very often too much neglected.

The essentials of the agriculture of the beet sugar industry must be some time mastered and possible improvements of methods must be applied before the grower will be able to command the situation in a manner at all desirable or acceptable to the progress of the industry. New experiences in the adaptations of his soil, the matters of proper plowing, the better dates for planting and the most profitable rotation to follow, all crowd to the front and demand solution; nor can the final solution be secured in a limited number of years. Sugar beet growing, like corn growing, wheat culture and stock raising, is a matter to be taken with the grasp that contemplates a future of considerable duration and would utilize every feature for knowledge and for profit. The long, strong effort, not the spasmodic effort, will be of most help.

The matters of distance to plant, space in thinning, and cultivation necessary are covered by factory instructions by men of experience. Repetition need not be made here. One point, that of interspaces should perhaps be mentioned, because of previous suggestions favoring small spaces, a thick stand and small beets. It is apparent that this is not a practicable suggestion. The cost of harvesting and topping is increased by it and without adequate return. With 18 or 20 inch rows, thinning to 8 or 10 inches apart gives larger beets and fewer to top; this plan is that followed by the factory agricultural manager. The conditions of success are much the same as in any other line—close study, continued observation and prolonged effort. Most of the really valuable improvements must be worked out with experience in beet growing.

SUBSOILING AND EARLY PLANTING ESSENTIAL FOR BEETS.

Forethought is an invaluable sort of judgment to exercise. Nowhere is this more indispensable than with a crop like sugar beets, in which both yield and quality are liable to be affected. Forethought applies here in selecting the land sufficiently in advance to prepare it by fall plowing, and in any event by subsoiling. This matter of subsoiling has been well presented in a leaflet just issued by the Continental Sugar Co., entitled "First hints on sugar beet culture." The two illustrations appearing herewith are taken from that leaflet by the kind permission of the company. The significance of the illustrations is many fold. The unbroken hard-pan, too often found in firm soils *sets a limit to the volume of water stored in the soil*, as well as a limit to the downward growth of the beets; the land prepared by subsoiling *stores a larger volume of water* against the time of need. It goes without any detailed statement

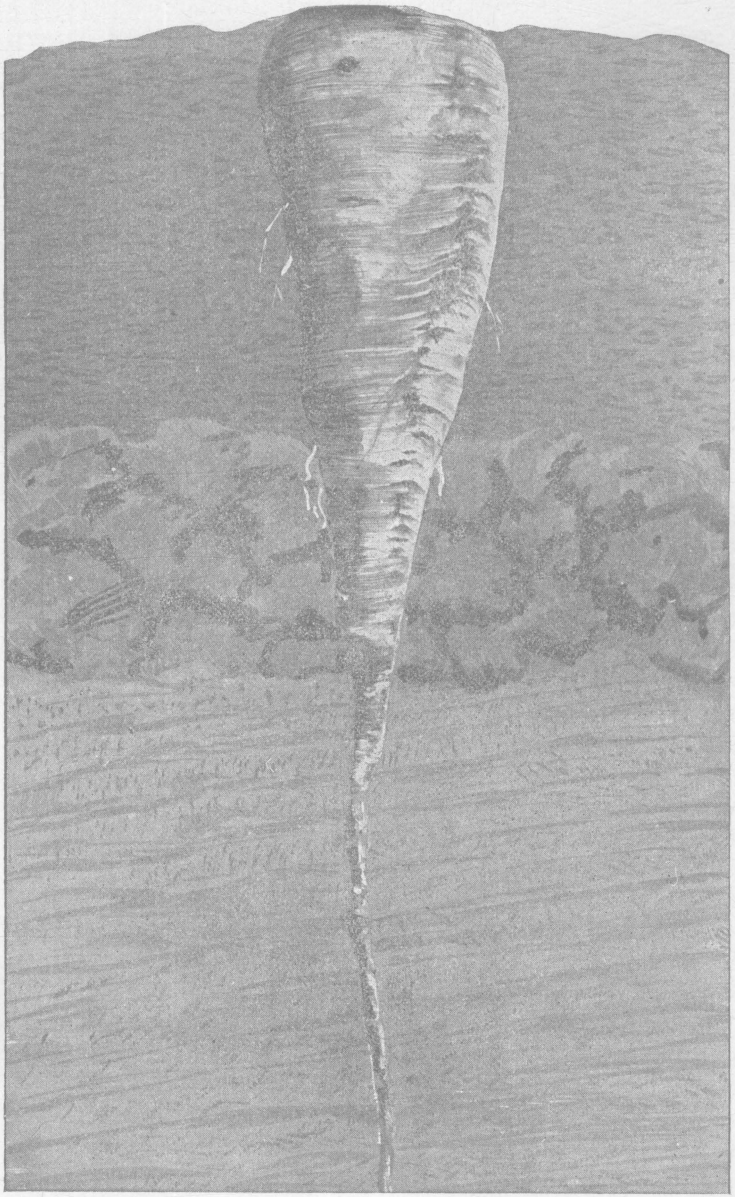

FIGURE 6.—Showing the normal development of the sugar beet in ground properly prepared. Any under-crust, or hardened sub-soil formed by previous handling, has been broken up by subsoiling. The tap-roots of the young beets can then have 14 inches of roots on which to build up the beet instead of 7 inches, as in figure 7. (From cut loaned by the Continental Sugar Company.)

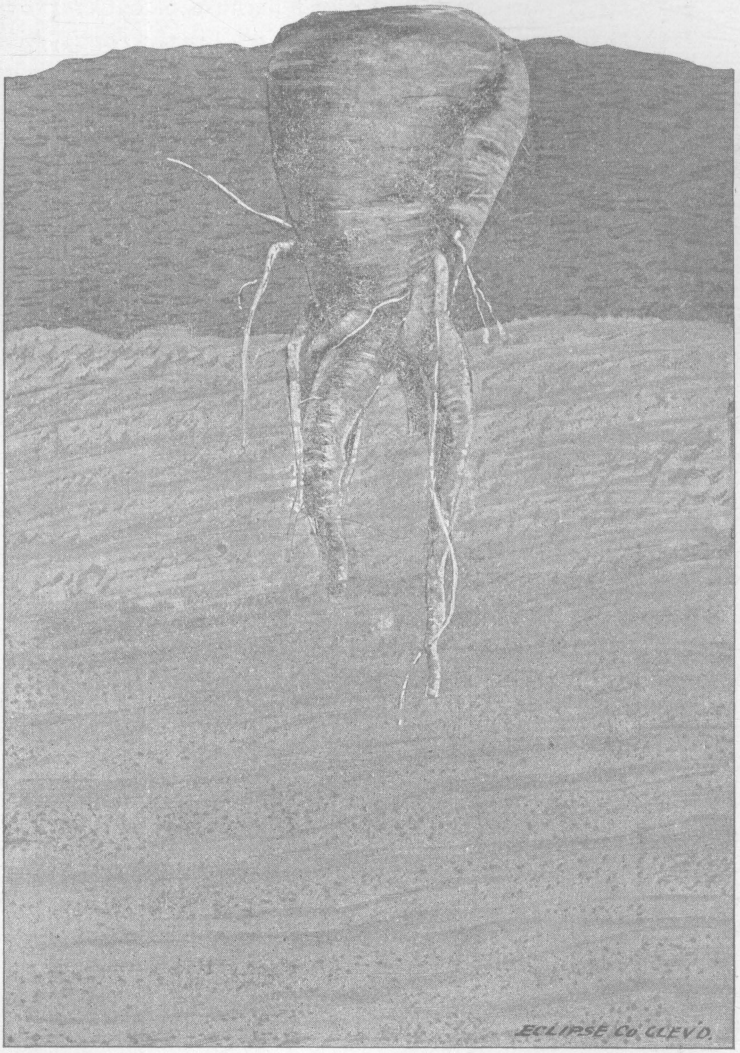

FIGURE 7.—Showing imperfect development of the sugar beet in ordinary 7-inch plowing. Here the tap root has reached the hard-packed, dry soil, which it is unable to penetrate. The root accordingly divides; sends out branches, and in the course of growing the beet is forced out of the ground. The plowing in this case has left an under crust, which is found more impervious than the subsoil below it. (From cut loaned by the Continental Sugar Company.)

of reasons that the plants commanding the greater supply of plant food, and in most equable distribution, will yield the heavier crop. (Figures 6 & 7.)

Fall plowing is invaluable, not alone because of better provision (with subsoiling) for water storage, but *because it makes early planting possible.* No satisfactory results in beet growing can be secured without first having a good stand of beets; early planting, if possible, as early as March, and certainly during April whenever and wherever it can be practiced on suitable beet land, will make for a better stand than late planting. Not only will it do this, but it will result in earlier maturity, other things being equal, and consequently in earlier and more agreeable harvesting and less expensive delivery to cars or factory. I feel assured that a beet grower must determine at an early date where the next year's crop is to be grown, prepare by fall plowing and subsoiling, and that he may not wait to come to a conclusion on these points until he is persuaded to sign a contract for beet growing as the time of planting approaches.

SUGAR BEET DISEASES.

Sugar beet growing is attended by the appearance of certain of the diseases to which this plant is susceptible. The list is, as yet, not a very long one, nor are the damages greater than with older and better known crops. We are prepared now to offer only a brief preliminary discussion of beet diseases; the questions as to beet diseases and their remedies are soon to arise in the course of beet culture.

The diseases of the beet are of various types or classes with respect to the organs attacked, or the effects produced, but broadly speaking they may be said to cause loss to the grower in one, two or three ways:— Either, first, the disease may injure the stand, or the growth of the beets and make a satisfactory crop impossible; or, second, the disease may greatly reduce the sugar content of the beet; or third, as the combined result of the stated influences, notably in the case of leaf diseases of the sugar beet, yield and sugar content may both be unfavorably influenced.

In Europe many diseases attacking the beet have long been known and carefully studied; while it does not follow that the diseases of greatest destructiveness will be the same for both countries, useful lessons may be drawn from European experience. Taking into consideration the beet diseases found in neighboring states, as well as those known to occur in Ohio, we conclude that the beet root is liable to show the effects of root-rot or root-blight, heart-rot or dry-rot, scab, crown gall and bacteriosis, while the leaves may suffer from leaf spot and from the attacks of insects.

ROOT ROT AND DAMPING-OFF (WURZELBRAND.)

The Germans speak of Wurzelbrand, or as we may put it "root-blight," which is a falling of young seedlings, and report upon it in such

a way as to indicate an external variable trouble. Stift[1] passes by the statement of Eidam that the Rizoctonia fungus is an important factor in this disease, but credits it with producing the root-destroying disease, (Würgeltœdter der Rübe) the American root-rot. Pammel[2] supports the observations of both Eidam and Kuehn, as will be seen by his paper; a like interpretation is made by Duggar[3] but with the statement that somewhat of slowness has been observed in the transmission of the beet Rhizoctonia to seedlings of other plants attacked by similar troubles. Duggar treats of this Rhizoctonia fungus in the paper named, more especially in relation to the root-rot of the large beets which he has found in New York. This latter trouble shows its effects later in the season; it affects portions of the beet as shown by the same writer. In growing beet seedlings during the past winter, in the Pathologium of the Botanist of this station, severe damping off has been experienced. The Rhizoctonia fungus has been associated with all the cases so far studied. In view of the recent discovery of the same fungus in great abundance upon potatoes at this Station, growing out of a suggestion by Stewart,[4] as well as its occurrence to a limited extent on sugar beets at harvesting, it would seem necessary to study carefully the disease attributed to it. At present no statements can be made that will indicate the probable losses; the loss on seedlings from this, or similar causes promises to excel those from rotting of large beets.

Remedial measures are, as yet, largely experimental with us. Seed treatment to destroy spores, etc., present in the seed, soil treatment to reach and retard, or destroy, the fungi in the soil, and fertilizer applications, particularly of superphosphates to secure a more vigorous pushing of the seedling beets, have all been supported by good results in particular instances. In Europe, soaking the seed for 20 hours in $\frac{1}{2}$ to 1 per cent solution of carbolic acid, made by dissolving $\frac{1}{2}$ to 1 pound of the given material in $12\frac{1}{2}$ gallons of water, seems to be the commonly recommended seed treatment; after treatment the seed is dried before planting. The same percentages of copper sulfate, and even 2 per cent solutions of the vitrol have been employed in this manner. Either blue vitrol or carbolic acid may be used. Solutions of potassium sulfid, used either by sprinkling or immersion of seed, and the hot water treatment, both essentially the treatments employed for oat smut, have been championed by Jensen for beet seed. The use of Formalin after the method of Bolley is also to be considered.

[1] Die Krankheiten der Zuckerrübe, Nach den Erfahrungen der Wissenschaft und Praxis, bearbeitet von Anton Stift, Director-Stellvertreter der versuchsstation des Centralvereines fur Rübenzucker-Industrie in der Oesterr-ungar Monarchie. Mit 16 farbigen lithographischen Tafeln. Wien, 1900, p. 14.

[2] Bulletin 1o, Iowa Agricultural Experiment Station, pp. 243-25 (1891).

[3] Bulletin 163, Cornell University Agricultural Experiment Station, pp. 346 50 (1899).

[4] F. C. Stewart, New York Experiment Station, Geneva, N. Y., in letter, October 1900.

Liming the soil by moderate applications, specifically stated in most of the foreign papers to be for physiological reasons, such as neutralizing acidity, and supplying calcium oxid, has likewise given good results under particular conditions. The well known work of Halsted[5] on cabbage club root, in which he shows the very great value of quicklime in checking the attacks of the club-root fungus, *Plasmodiophora Brassicæ* Wor. on seedling turnips and on cabbages grown in soil infested by the fungus, as well as the decisive results recently obtained by the writer with quicklime in preventiug the attacks of onion smut, *Urocystis Cepulæ* Frost, upon seedling onions, point to the direct effect of fresh lime, in checking parasitic fungi.

Quicklime, applied preferably as the ground lime, just before planting, is worthy of trial for the damping-off troubles often from both points of view, namely, to check fungi and to favor growth of the seedling beets. There is danger, according to European experience, of reduced sugar content in beets by fresh liming.

The use of phosphatic fertilizers is supported by direct experimentation on beets, as with certain other crops. This treatment secures more prompt and more vigorous growth of the seedling beets, at the same time insuring a larger yield. For the seedling troubles it is recommended to be sown as a light application in the furrows with the beet seed; presumably similar effects will arise from previously drilling in or broadcasting, the fertilizer, and larger quantities may be used with safety. We have found acid phosphate less favorable than Thomas slag. The seed treatment and liming, just considered, may be more local in application, especially the former, while the use of acid phosphate, or Thomas slag, will in all probability be generally profitable.

Experiments under glass have been made to test the effects of these various treatments, or fertilizing substances, upon the germination of the beets as well as upon the amount of damping-off under these conditions. To date the results are negative save as to retarding effects of acid phosphate on the seedling beets compared with Thomas slag.

HEART-ROT OR DRY-ROT HERZ-UND TROCKENFÆULE.

This disease, attributed to *Phoma Betae* Frank and to *Sporodesmium putrefaciens*, is one much discussed in Europe. I am not at all certain as to its distribution in Ohio, although diseased beets have been found at Wooster and referred to this trouble in the past season.

The external evidence of the disease consists in the blackening and dying of the central leaves and later in external rotting of the beet; likewise this disease is prevalent during drouth in August and September—hence the two names by which the disease is known.

While some of the older leaves die at the same time, from without, the death of the point of new growth in this disease will serve to distinguish it sharply from the death of the older leaves as a result of leaf-

[5] Bulletin No. 98, New Jersey Agricultural Experiment Station.

spot. As in the case of the death of the leaves from any cause, new leaves soon put out and the sugar percentage in the beet is reduced.

The pycnidia of the fungus may be found upon the surface of the diseased parts in a sufficiently advanced stage; earlier only mycelium is found. Figure seven, Bulletin 121, shows the details as to the pycnidia and spores of the beet Phoma before named.

The claim is made that this heart-rot is propagated by spores which adhere to the seed, and for this reason seed treatment with copper sulfate has been recommended. The heart-rot would also be progagated by successive cropping with beets. Specimens of this trouble would be thankfully received from beet fields in Ohio.

BEET SCAB.

Scab in potatoes has been attributed to a fungus called *Oospora scabies* Thaxter. The same external roughening and similar injurious effects arise from the scab of sugar beets; it has further been shown that it is the same fungus which produces both the scab of potatoes and that of beets. In the case of seed potatoes, treating the seed with corrosive sublimate solution, or with solution of formalin, has proved effective where this seed is planted in scab-free soil. Land that has produced scabby potatoes, or scabby beets, and usually land that has been recently manured, cannot be rated as free from scab. Since for sugar beets we must look to the soil and not to the beet seed for scab infection, prevention of scab lies in avoidance of land that has yielded scabby potatoes, or scabby beets, the previous season; it may also occur that scab will remain a second season in the infected land.

CROWN GALL OF SUGAR BEET.

Both in the plots at the Experiment Station, Wooster, and in the beet fields delivering to the Fremont factory, several cases of this trouble were observed last season. The disease manifests itself as enlargements, or galls, commonly upon the side of the beet near the crown. In Europe this trouble is known under the name of Wurzelkropf (root-craw) and reduces the sugar percentage of affected beets. The analogous appearance of the growths to those occurring on the crown and roots of fruit trees would suggest that the name of crown gall is strictly appropriate. An illustration of a Wooster specimen is presented herewith (Figure 6). While the contagious nature of the disease is to be inferred, experiments are under way to prove the correctness of this inference. The disease will scarcely prove very injurious, though possessing much interest for the investigator. It will be better to avoid planting again immediately in land that has produced the diseased beets.

FIGURE 8.—Sugar beet attacked by crown gall.

BACTERIAL DISEASE, OR BACTERIOSIS OF SUGAR BEET.

Dr. Arthur and Miss Golden early called attention to a bacterial parasite of the sugar beet.[6] A similar disease, or possibly more than one specific bacterial disease of the sugar beet, has been more recently recognized in Europe. The writer has observed diseased beets in Ohio which exhibited the symptoms described as characteristic of this malady. Affected beets show a tendency to corrugation, or buckling in the leaves; the plants grow less vigorously and remain smaller, and usually die back earlier. Upon cutting across a diseased beet the bundles of fibres, which are arranged as concentric rings in the beet root, are found to be darkened and to be much more prominent than in healthy beets. In Europe the common bacteriosis causes dying of the long root tips, and for that reason is called Rubenschwanzfaule, or rot of the root-tip. The sugar content of the beet is also greatly reduced. Mention is made of this disease to call the attention of growers and others who handle sugar beets to the possible prevalence of such symptoms.

LEAF-SPOT OF THE SUGAR BEET.

Judging from its previous abundance, we have in the leaf-spot fungus of the beet, *Cercospora beticola* Sacc., perhaps the most injurious disease producer for our region. A little reflection will indicate how vital good leaves are when we would grow a good yield of good quality beets. That leaves with dead areas, or impaired color, are not good, efficient leaves for the work of the plant, likewise, needs only to be stated to be apprehended. Both the growth of the beet root and the percentage of sugar contained in it, are impaired in proportion to the attacks of this disease on the leaf.

As shown by the specimens, the leaf-spot fungus causes usually small, dead areas, commonly very numerous and circular in form, in the leaves of the beet. Each spot may be but a small fraction of an inch in diameter, but has a light colored center, often almost white, with a darker border. The larger spots are often approximately $\frac{1}{8}$ inch across, including the border. Ultimately, the affected leaves perish before their time; this is most marked at critical periods, as of prolonged sunshine, etc., just when there is most need for efficient leaves. It is not a natural course of ripening that a large share of the leaves should die, and at times this fungus kills them all in this manner, thus forcing the plant to send out many new leaves. A great danger in this connection is the tendency to regard the death of the beet leaves from the disease as a matter of course, a natural occurrence with the beet.

Just what conditions in detail induce greater abundance of the leaf-spot can scarcely be stated now. Like other fungous diseases, this trouble is worse in showery weather. It has also been observed to be

[6] Bulletin 39, Indiana Experiment Station, 1892.

much worse on soils planted a second time successively in beets. The same disease is rarely absent from garden beets and may therefore be rated as ready to develop when suitable conditions are offered.

Bordeaux mixture sprayed upon the beets has proved very beneficial with garden beets and mangels. Applications may be made as soon as the beets are thinned, but may safely await the appearance of the first spots of this sort, if the growing beets are under close observation. The aim in spraying should be to cover the leaves completely with a fine spray of the preparation, and to repeat at intervals of two to three weeks, until danger is past. The directions contained in the spray calendar, Bulletin 102 or 121, will cover any details of procedure. Rotation of the crop is likely to be required to prevent serious outbreaks of this leaf disease.

RUST AND MILDEW—INSECTS.

White rust, *Cystopus Bliti* (Biv.), Rust, *Uromyces Betae* Tul., and mildew *Peronospora Schactii* Fueckel, are known elsewhere upon the beet, the first having been found in Iowa and the second is prevalent in California; so far as known these have not occurred on sugar beet leaves in Ohio.

The reader is referred to the statements published in Bulletin 99 (1899) concerning the serious losses of beets in 1898 from the broad-striped flea-beetle, a small insect resembling in color-marking, the striped cucumber beetle; the smaller size and fleeing habit will enable one to recognize them. These insects are especially to be feared during dry periods in May and June. Care is required to guard against this pest. Bordeaux mixture should be used freely as a deterrent upon the first appearance of the beetles. Treatment may also be needed a second time if dry weather periods are prolonged.

Bordeaux mixture with arsenites is worthy of trial for the blister beetle; air slaked lime and Paris green proved an effective remedy on sugar beets at Wooster in 1900. Popular opinion to the contrary, the blister beetles were destroyed by eating leaves dusted with that mixture, one part Paris green to sixteen parts air-slaked lime. Repetition becomes necessary after showers. Flour may be used instead of the air-slaked lime, with which to mix the Paris green or London purple.

SUMMARY.

This bulletin recounts the distribution of about 1,050 pounds of sugar beet seed to 203 persons, situated in 60 counties of Ohio in the Spring of 1900.

It further gives, in Tables IV and V, the results of analyses made at the Station of 303 samples of beets received from 109 persons; of these samples 226 were from the northern section, 57 from the middle and 20 from the southern. See pages 140 to 154.

In Table VI the average results of 1900 are compared with those of 1897, 1898 and 1899; Table VII gives a comparison of varieties tested. See page 154.

Seasonal influences upon the sugar content and purity of the beets grown are considered in Tables II and III and in Figure I. See pages 135, 136, 138.

It is found that periods of comparative drouth and sunshine, having a duration of twenty-five to forty days, are highly favorable to high sugar and good purity when these periods occur between August first and freezing weather: pages 136–8.

It is further discovered that the seasons of 1897 and 1899 were highly favorable, compared with those of 1898 and 1900 in Ohio.

The beet sugar industry is discussed by a brief description of a modern factory and by a consideration of this matter from the grower's side. Illustrations are here introduced.

The sugar beet diseases thus far noted in Ohio are root-blight, or root-rot, heart or dry-rot, scab, crown gall, and bacteriosis, attacking the roots, and leaf-spot attacking the leaves.

Liming the soil intended for beets, preferably in the fall, the application of acid phosphate and Thomas slag with the seed, and the treatment of the beet seed itself with fungicidal substances, are suggested for root-blight and heart-rot.

For scab and bacteriosis it is suggested to avoid infected lands; the same may apply with respect to crown gall.

For leaf-spot it is recommended to use Bordeaux mixture as per the spray calendar, Bulletin No. 102 or No. 121, and to add arsenites for the commoner insect troubles.

PUBLICATIONS OF THE OHIO AGRICULTURAL EXPERIMENT STATION.

Bulletin 120 contains the annual report of the Station for the year ended June 30, 1900, and a list of previous publications. Following are the titles of subsequent issues:

Bulletin 121. A condensed handbook of the diseases of cultivated plants in Ohio.

Bulletin 122. Onion Smut. Preliminary experiments.

Bulletin 123. I, Grape rots in Ohio. II, Experiments in the prevention of grape rot.

Bulletin 124. The maintenance of fertility: Field experiments with fertilizers on corn, oats and wheat, 1899 and 1900.

Bulletin 125 The maintenance of fertility: Field experiments with fertilizers on potatoes, 1894 to 1900.

Bulletin 126. Sugar beet investigations in Ohio in 1900.