

DUPLICATE

[5000.]

Bulletin No. 59.

December, 1899.

CHEMICAL DEPARTMENT,

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

Sugar Beet Experiments of 1898

AND

Final Conclusions.

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"These data, in connection with those of former years, show that Oregon is one of the most promising localities in the country for successful beet culture."—
H. W. WILEY, Chief Chemist, U. S. Department of Agriculture, in "Progress of the Beet Sugar Industry in the United States, 1898."

By G. W. Shaw, Chemist.

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1899.

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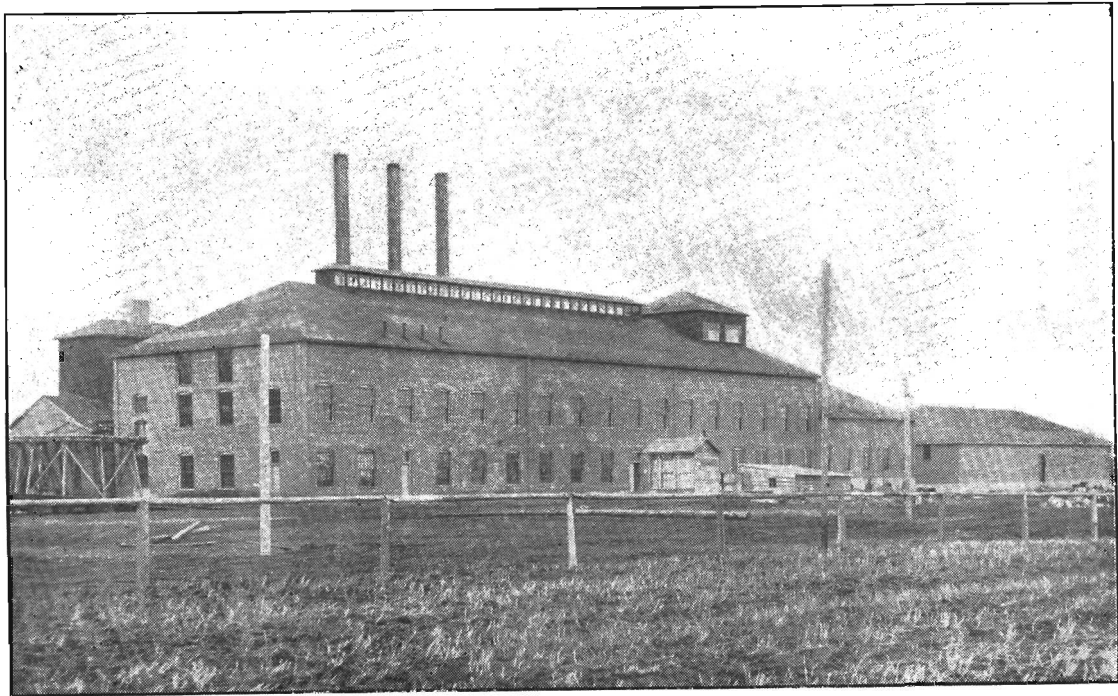
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EXTERIOR OF SUGAR BEET FACTORY, LA GRANDE, OREGON.

LIST OF BULLETINS

(In print) published by the Oregon Agricultural Experiment Station to December, 1899.

Circular No. 1—Dairying in Oregon	Shaw, French and Kent
No. 6, 1890—Chemistry, Zoology	Washburn
No. 7, 1890—Small Fruits and Vegetables	Coote
No. 8, 1891—Varieties of Wheat and Flax	French
No. 10, 1891—Entomology	Washburn
No. 28, 1894—Pig Feeding, continued	French
No. 29, 1894—Horticulture, Pruning, etc.	Coote
No. 30, 1894—Potatoes and Roots, continued ..	French
No. 31, 1894—Codlin Moth, Hop Louse	Washburn
No. 32, 1894—Five Farmers' Foes	Craig
No. 33, 1894—Tent Caterpillar	Washburn
No. 34, 1895—Fruits and Vegetables	Coote
No. 35, 1895—Pig Feeding, continued	French
No. 36, 1895—Composition and Use of Fertilizers ..	Shaw
No. 37, 1895—Experiments in Cattle Feeding ..	French
No. 38, 1895—Fruit Pests	Washburn
No. 39, 1895—Grasses, Chemistry	Shaw
No. 40, 1896—Prunes, Apples and Pears	Hedrick
No. 42, 1896—Feeding Sheaf Wheat	French
No. 43, 1897—Flax Culture	French
No. 44, 1897—Review of Oregon Sugar Beets ..	Shaw
No. 47, 1897—Cheat and Clover	Shaw and French
N.J. 43, 1898—Spraying	Cordley
No. 50, 1898—The Fertility of Oregon Soils ..	Shaw
No. 51, 1898—Marketing Fruit	Craig
No. 52, 1898—Nut Culture	Coote
No. 53, 1898—Sugar Beets	Shaw
No. 54, 1898—Flax, Hemp, Dairy, etc.	French and Kent
No. 55, 1898—Chemistry of Cherries	Shaw
No. 56, 1899—Notes on Prune Dipping and Strength of Concentrated Lyes ..	Shaw
No. 57, 1899—Brown Rot	Cordley
No. 58, 1899—Rose Culture in Oregon	Coote
No. 59, 1899—Sugar Beet Experiments of 1898 ..	Shaw

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Address THOS. M. GATCH,
Director of Experiment Station, Corvallis, Oregon.

INTRODUCTION.

"A Review of Oregon Sugar Beets" giving the results of investigations (1891-1896), having for their object a determination of the adaptability of Oregon soil, climate and other economic conditions to the production of sugar beets on a commercial scale, was published in March, 1897. In 1898 were published results of continued experiments along the same line.

The present publication sets forth not only the results obtained in the experiments of 1898, but also some observations on the industry now established at La Grande. It presents also the conclusions reached after five years of investigation concerning beet sugar production in Oregon.

Up to 1897 it had been conclusively shown that certain sections of the state possessed all the requisite conditions for beet culture on a commercial scale, and as a result of this work a factory of 350 tons capacity per day was erected and operated successfully last season at La Grande, Union county. The frontispiece shows the exterior of this factory, and on page 9 is given a description of the factory.

EXPERIMENTS IN SUGAR BEET CULTURE=1898.

IN addition to the experiments mentioned in the Introduction it seemed desirable to obtain still further results concerning certain other sections of the state. It was thought best, therefore, to continue the experiments through the season of 1898.

Practically all the seed issued in the experiments of 1898 was furnished by the United States Department of Agriculture and was of the Improved Elite Kleinwanzlebener variety. Concerning this seed the following was said:

“This is one of the best varieties of beets grown for use in the production of sugar. Under favorable conditions of soil and climate this seed should produce from 15 to 16 tons of very rich roots per acre. It is best adapted to soils containing moderate proportions of vegetable matters rather than to black soils.”

The U. S. Department of Agriculture also furnished a very limited quantity of five varieties of seed for special test. The varieties were as follows:

- Vilmorin's Improved (Russian grown.)
- Vilmorin's French, very rich.
- Kleinwanzlebener (grown by Vilmorin.)
- Schreiber's Elite.
- Pitzschke's Elite.
- Zeringen (grown by Strandes.)

Concerning this seed the following was stated in the accompanying letter:

“The Russian seed was grown for the firm of Vilmorin-Andrieux & Cie. This seed is from the crop of 1896; therefore it is probably of low vitality. I advise planting this seed at the rate of 36 lbs. per acre in order to insure a good stand.

The Zeringen seed was grown by Ad. Strandes, Rittergut, Zeringen, bei Cöthen, Anhalt, Germany, who requests that a copy of the station report of the analyses of beets from this seed be sent to him when published.

It is my desire to obtain a few beets from each lot of seed for use in seed production. At the proper time please send me a few of the beets, according to shipping directions that I will give you, transportation at the expense of the Department.”



PLATE I. TYPICAL SUGAR BEET FIELD, LA GRANDE, OREGON.

Early in the spring notices were sent out, by circular letters and through the papers published in the localities where it seemed desirable to conduct further experiments, offering to furnish seed to such parties as desired to enter upon this co-operative work. As we had sufficient seed, no one who applied for it was refused, even though the locality was not within the area selected for special work.

The character of cultivation was the same as that of preceding seasons, details of which have already appeared in former publications.

In response to requests, seed was sent to 170 farmers who agreed to cultivate experimental plats and forward samples for analysis. Of this number there were 55 who reported entire failure from one cause and another, and 27 who failed to report at all, leaving 52 per cent of those who engaged to do the work from whom results were finally obtained.

For consideration of results it has been the custom in former publications to divide the state into three divisions, Eastern, Western and Southern Oregon on account of the wide difference in climatic and soil conditions, and the same plan will be followed in this case.

Details and individual analyses are omitted from this publication, averages only being given.

The beets were harvested in accordance with the following directions which were furnished by the United States Dep't of Agriculture:

THE STATE AGRICULTURAL EXPERIMENT STATION.

DIRECTIONS FOR SECURING SAMPLES OF SUGAR BEETS FOR ANALYSIS.

Prepared by H. W. WILEY, Chief of Division of Chemistry, U. S. Department of Agriculture.

When the beets appear to be mature (September 15 to November 15, according to latitude and time of planting), and *before any second growth can take place*, select an average row (or rows), and gather every plant along a distance which would vary as follows, according to the width between the rows:

From rows 16 inches apart, length 75 feet.				
“ “ 18 “ “ “	66	“		
“ “ 20 “ “ “	59	“		
“ “ 22 “ “ “	54	and four-fifths feet.		
“ “ 24 “ “ “	50	“ “ “		
“ “ 28 “ “ “	42	“ “ “		

The beets grown in a row, of the length above mentioned, are counted. The tops are removed, leaving about an inch of the stems, the beets carefully washed free from all dirt and wiped. Where the row is not long enough to meet the conditions, take enough from the adjacent row or rows to make up the required length. Rows of average excellence must be selected; avoid the best or poorest. Throw the beets promiscuously in a pile and then select the largest or smallest.

From all of the rest of the beets, save these two, the necks are removed with a sharp knife at the point indicated by the dotted line in the figure. The beets, including the two saved as a sample, are then weighed.

The number of beets harvested multiplied by 435.6 gives the total number per acre. The total weight of beets harvested multiplied by 435.6 gives the yield per acre.

Wrap the two sample beets carefully in soft paper, and write your name legibly thereon. The beets must be perfectly dry. Fill out the descriptive blank, inclose it in the envelope, and sew it up in a cotton bag with the beets, attach the inclosed shipping tag, and send the package by mail.

No beets will be analyzed by the Station which are not packed as described above and properly identified. In all cases a copy of the descriptive blank supplied by the Station must accompany each sample.

Miscellaneous analyses of samples without accurate description are of no value.

Blanks are sent to each one for two sets of samples. From two to four weeks should elapse between the times of sending the two sets of samples.

If additional analyses are desired other blanks will be sent on application, but not more than four analyses can be made for any one person, except in special cases.

A model, showing how blanks should be filled out, is inclosed.

Samples were forwarded by mail, franking tags for this purpose being sent to the grower, and were accompanied by the following report, filled out by the grower:

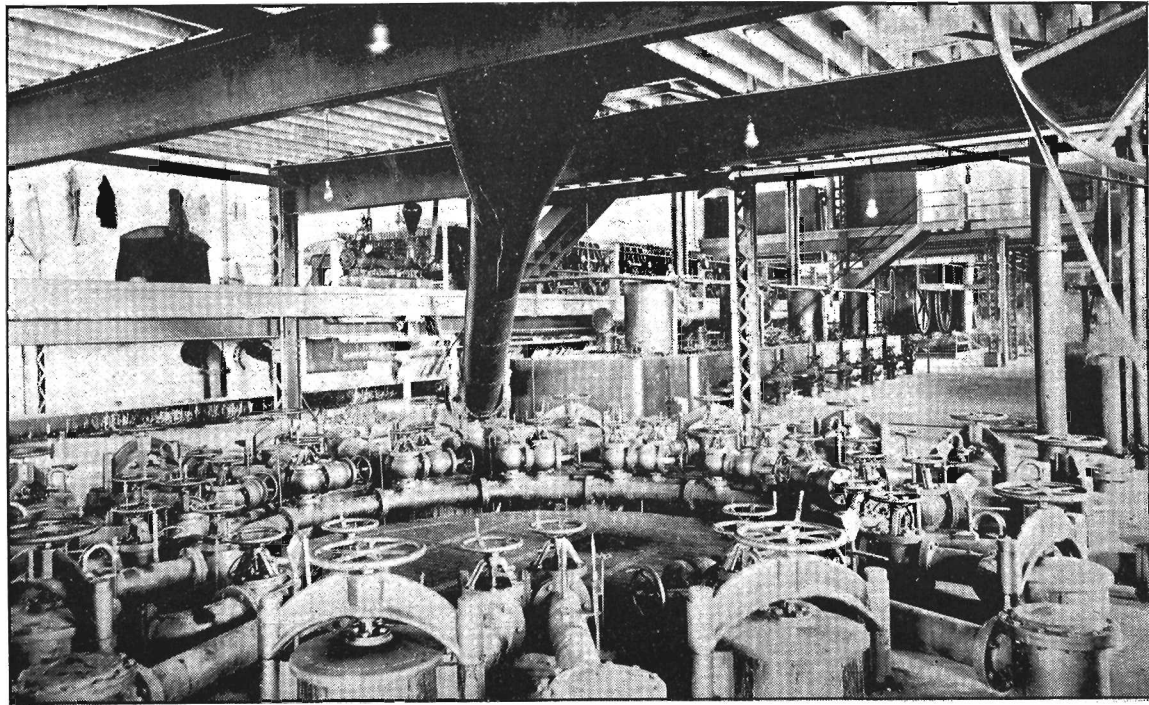


PLATE II. INTERIOR OF BEET SUGAR FACTORY, LA GRANDE, OREGON.

Experiments in Eastern Oregon.

UNION COUNTY.

No extensive experiments in the growth of beets were conducted in this county inasmuch as previous results had conclusively demonstrated the Grand Ronde valley to be particularly well adapted to the production of beets for sugar, as a result of which there had already been erected the first sugar factory in the state.

In this connection a few words will not be out of place relative to the industry in that locality. The factory, an exterior view of which is shown in the frontispiece, was erected in the summer of 1898 at a cost of about \$400,000. It is a stable structure of brick and steel, the main building being 288 feet long and 66 feet wide. The sugar storehouse adjoining is 160x66 feet. The sheds for receiving and storing beets are four in number, each being 500x25 feet. Silos for storing beet pulp to be used as cattle food aggregate 500 by 100 feet. Six furnaces and a bank of engines furnishing 1200 horsepower occupy a separate brick and steel structure 150x40 feet. These several buildings with their approaches, side tracks, etc., occupy 80 acres of land. The capacity of the factory is 350 tons of beets per 24 hours, which is equivalent to 35 tons of refined sugar. A test of the capacity of this factory, however, made last season showed that it surpassed this by considerable as it actually handled 450 tons of beets in the 24 hours. In its operation it requires 100 skilled men and uses about 8000 cords of wood and 2000 tons of lime during the season.

It is to be regretted that the first season of this new industry was confronted by so many unfavorable conditions. Many of the experiences of the first year were incident to the starting of the industry and would have occurred anywhere in the United States, hence they are not to be looked upon as any drawback to final success.

The writer in company with Mr. Alfred Holman of the Oregonian staff made a tour of the factory and some of the fields soon after the opening of the campaign, and the conditions which brought about the apparently poor results to the farmers were so aptly discussed by Mr. Holman in a series of articles published in the Oregonian that I take the liberty of quoting:

“The first mishap was in connection with the time of planting. There was serious miscalculation as to time, which carried the seeding season, which should have ended in May, into the early days of July. The planting too was

upon stubble and in many cases upon foul land, where no plowing had ever gone deeper than four inches. Under these conditions weeds at once took the soil and owing to their extraordinary thrift and to the tardiness of inexperienced labor the work of weeding and the subsequent work of thinning were carried into midsummer or long past the usual and favorable time. Even under all these disadvantages there would have been a fair crop, for everything promised well till August, when there came the extraordinary spell of hot weather which did so much harm to all crops east of the mountains. It found the beet fields freshly loosened from the operations of the weeders and thinners and in the worst possible condition to withstand a season of drought and heat. For a period of 20 days the temperature held from 90 to 105 degrees and before the hot spell was half through it became clear that the jig was up so far as the beet crop was concerned. Upon the return of cooler weather the fields revived somewhat but the injury had been too serious for complete recovery."

To the above described difficulties there may also be added that of spring plowing instead of fall plowing. This became necessary in the first season of the industry because the contract for the building of the factory was not made till very late in the season preceeding, and contracts were not signed by farmers for the growing of beets till the winter. These contracts when they were signed were in the main for a large acreage. Beets should be grown in small areas by a large number of farmers instead of in large areas by a small number of farmers as is now the case.

The people of LaGrande, and indeed the entire state, have much to congratulate themselves for as the industry is one of the most important in the northwest and is bound to be successful. The percentages obtained the first season were exceptionally high both in sugar content and purity. The factory books show the percentage of sugar to have been 15.6 for the entire crop and the purity 84.6 which is, so far as I am able to ascertain higher than any first year results obtained elsewhere. The present season the tonnage was more nearly normal, although not so high in general as I think it will finally be for that region; the cultivation cost less than in the first season, because the farmers understood the habits of the beet better; and the sugar content and purity were both excellent. The average results of beets delivered to the factory to October 25 were 15 percent. sugar and 82 percent. purity.

A small number of beets from Union county were analyzed during the season of 1898. The five varieties previously mentioned on page 5 as having been sent to the Station by the U. S. Department of Agriculture were placed in the hands of Mr. L. Oldenburg of

LaGrande. Samples of these were received at the Station laboratory for analysis at stated intervals with the following results:

Lab. No.	Date.	VARIETY.	No. of beets in sample.	Av. weight of beets.	Sugar in juice	Purity.
1402	Sept. 7, '98	1. Vilmorin's Improved (Russian grown)....	3	251		
1403	"	2. Kleinwanzlebener (grown by Vilmorin)...	3	238	16.9	88
1404	"	3. Zerigen (grown by Strandes).....	3	292	19.8	89
1405	"	4. Vilmorin's Freuch, very rich.....	3	351	17.1	87
1406	"	5. Pitzschke's Elite.....	3	266		
1407	"	6. Original Kleiwanzlebener (factory seed)	3	402	19.3	87
1408	"	7. Schreiber's Elite.....	3	402	19.1	87
		Average.....	21	315	18.4	88
1421	Sept. 14...	1.	3	512	15.1	83
1419	"	2.	3	243	16.0	86
1417	"	3.	3	502	14.0	84
1423	"	4.	3	326	15.1	85
2418	"	5.	3	432	15.2	86
1422	"	6.	3	368	15.0	77
1420	"	7.	3	215	16.7	88
		Average.....	21	371	15.3	83
1433	Sept. 20...	1.	3	340	16.6	90.
1434	"	2.	3	332	16.5	33
1432	"	3.	3	320	15.6	80
1435	"	4.	3	473	15.0	83
1431	"	5.	3	432	16.5	87
1436	"	6.	3	568	18.7	86
1430	"	7.	3	326	16.8	85
		Average.....	21	356	16.5	85
1615	Sept. 30...	1.	3	442	15.5	84
1609	"	2.	3	287	17.7	87
1612	"	3.	3	252	18.0	90
1613	"	4.	3	332	16.2	84
1614	"	5.	3	308	16.2	81
1610	"	6.	3	497	19.6	84
1611	"	7.	3	267	17.5	87
		Average.....	21	371	17.3	85

The following table shows the results of analyses expressed by varieties. These varieties were from the seed furnished for special trial by the U. S. Department of Agriculture except where indicated, and all are comparable since grown under the same conditions of soil, climate and cultivation. The seed furnished by the factory made considerably the best showing for the season's work:

RESULTS OF VARIETY TESTS.

VARIETY.	Total number of beets in sample.	Average weight.	Sugar in Juice.	Purity.
Vilmorin Improved (Russian growu)	9	431	15.7	86
Klein Wanzlebener (grown by Vilmorin)	12	275	16.7	86
Zeringer (grown by Strandes)	12	363	16.8	86
Vilmorin French, very rich	12	370	15.8	85
Pitzschke's Elite	9	359	15.9	84
Seed from Factory (Original Kleinwanzlebener)	12	459	18.1	86
Schreiber's Elite	12	303	17.5	87

Of the varieties experimented with in this county none have done so well as the original Klein Wanzlebener. I learn, however, that a variety of which we have not made a sufficient number of analyses to base an opinion, Knauer's Mangold, has also been satisfactorily grown there on a commercial scale.

An examination of the table shows that the beets made no improvement after September 7, except in a slight growth which was more than counterbalanced by loss occurring both in sugar content and purity, for the beets showed a loss of one percent. in sugar and three percent. in purity. The moisture and cooler weather of September immediately showed its effects on the beets by lessening the sugar content and purity, but increasing the weight. This loss of sugar content was never regained. I very much doubt whether it is best to delay beet harvest later than the first week in September provided the seed was planted in proper time in the spring. This is particularly true provided they have to withstand a long dry spell as in the season of 1898, which practically matures the beets before they have reached their full growth. There might, perhaps, be years when such delay would be best, but in my opinion the chances of loss more than counterbalance those of gain in weight.

It was the intention to forward samples of these beets to Washington, D. C., to be used in experiments in seed production but sampling and shipping directions were not received from the Department of Agriculture till it was too late to secure the samples.

Results of other analyses made from this county are stated below:

	GROWER.	POSTOFFICE.	Av.	Av.		Solids	Purity
			weight.	Sugar.			
			Grams.	In juice	In beet		
1416	Turner Oliver	La Grande.....	563	14.5	13.8	19.1	75.9
1442	H. Cordes	"	244	17.6	16.7	20.7	85.0
1443	"	"	340	16.2	15.2	18.6	87.0
1447	Turner Oliver	"	553	10.4	9.9	15.0	69.7
1448	"	"	358	11.7	11.0	15.9	78.4
1449	"	"	292	12.9	12.3	15.7	82.1
1600	"	"	411	15.6	14.8	19.8	75.8
1601	"	"	840	14.0	13.3	17.2	81.4
1602	"	"	497	14.5	13.8	20.2	71.7
1607	W. G. Hunter	"	278	20.5	19.4	23.5	87.0
1608	H. Cordes	"	363	18.4	17.5	21.8	84.4
1645	Turner Oliver	"	433	16.8	16.0	18.8	89.8
1649	"	"	475	13.7	13.0	16.0	85.5
1651	"	"	475	13.7	13.0	16.0	85.5
1680	H. J. Baker	Pine	400	16.0	15.2	17.7	90.4
1699	"	"	400	17.3	16.4	19.2	89.3
1728	J. B. Weaver	Union	275	18.3	17.3	21.0	86.9
1729	"	"	406	21.3	20.2	23.6	90.0
Average			* 446	15.8	14.9	18.3	83.2

Reviewing the results expressed above, the analyses ranged from 10.4 per cent sugar in the juice, purity 69.7 per cent, in a beet weighing 553 grams (19.4 oz.) to a maximum of 21.3 per cent sugar in the juice, purity 90, in a beet weighting 406 grams (12.2 oz.) The average for the county was sugar in juice 15.8 per cent, purity 83.2, weight 446 grams (13.4 oz.).

EFFECT ON THE SOIL.

There is probably no place in this country where the natural fertility of the soil will surpass that of the Grande Ronde valley. One dislikes to take positive issue with a man of so broad experience as the gentlemanly superintendent of the factory for 1898, but I can not refrain from saying that he gave the farmers entirely wrong advice as to the advisability of planting beets successively on the same soil. It has been so conclusively proven as to be beyond question that beets are a very exhausting crop unless the greatest care is taken to conserve the fertility of the soil. It is true that the sugar beet impoverishes the soil but little if care is taken to plow the tops under in the field and return the pulp in the shape of stable manure. Under these conditions there is practically no loss of fertility, for sugar contains no element of fertility—it may be considered condensed sunshine. If, however, the entire crop is removed from the field there is a very great loss of fertility. It is a serious mistake to underestimate the benefit of beet tops as a fertilizer. They are of great value and every farmer who restores them to the soil realizes

a double profit in the chemical and physical improvement of his land.

It is doubtless true that several crops of beets may be taken from the same soil before ill effects will be perceived, yet such effects are sure to follow. This will be the more noticeable if the pulp is not fed and returned to the land as manure. If the tops are not returned to the land the rate of exhaustion will be about four times as great as if they are turned under. Can the land stand the drain is a pertinent question for each farmer. Nor is it the best practice to feed the tops, for say what we will, it is very likely that the manure thus produced will not go back to the place which most needs it.

It is certainly bad policy to produce beets on the same soil successively for many years. The best results may be obtained by rotation with cereals and occasionally a leguminous crop as a nitrogen gatherer, by which practice both crops will be much benefited.

BET PULP AS A CATTLE FOOD.

There is one side of the beet sugar industry which observation and inquiry show is not receiving the attention which it deserves in the Grande Ronde valley. I refer to the feeding of beet pulp to cattle and sheep. Located as the valley is in the midst of the best stock regions of the Pacific coast, in a region where such excellent crops of alfalfa can be grown, there seems to be no reasonable excuse for neglecting this side of the industry, both for fattening stock and the manufacture of dairy products. The fullest fruits of the industry will never be realized till attention is given to this phase of the subject. Nothing has been more conclusively demonstrated than that beet pulp is a most excellent cattle, sheep and hog food when properly balanced with nitrogenous material, as alfalfa, clover or grain. While the leaves and tops are good food, pulp is much better. A chemical analysis of the pulp produced at La Grande shows the following composition:

Water-----	89.01.	Dry Matter-----	10.99.
		Fat-----	.58.
		Fibre-----	2.40.
		Protein-----	.88.
		Ash-----	.70.
		Carbohydrates---	6.43.
		Total-----	10.99.

No analysis was made of the siloed pulp but there is not a very great change in the chemical composition as will be shown by the following analysis given in the "Revue Universelle des Progres de la Fabrication du Sucre," 1, 428:

	Maercker.		Kuhn.	
	Before Ensilage.	After Ensilage.	Before Ensilage.	After Ensilage.
Water	89.77	88.52	88.9	87.5
Dry Matter	10.23	11.48	11.1	12.5
Ash .....	.38	1.09	.9	.9
Fat .....	.05	.11	.1	.1
Crude Fibre	2.39	2.80	2.5	3.0
Crude Protein .....	.59	1.07	.9	1.2
Nitrogen-free Extract	6.32	6.41	6.7	7.3

Beet pulp is not a balanced ration and the best results can not be expected from feeding it alone, though it is a healthful and nutritious food. Its chief components are the carbohydrates and proteids. It is essentially a fattening food. Experience has shown that it is relished by dairy cattle and produces an excellent flow of milk when balanced with nitrogenous foods. The pulp is valuable not only as cattle food but also as food for hogs and sheep. In Utah it is largely used as hog food.

It is one of the cheapest foods that farmers can use for it can be purchased at a very nominal figure. Each team as it delivers its load of beets should take home a load of beet pulp. This pulp should be placed in a silo where it is much more easily kept than any other silage material. It is very heavy and sinks down to a very solid, cheesy mass. When properly preserved it does not tend to ferment and can be kept a very long time. Mr. Allen of the Standard Cattle Company is authority for the statement that even in very cold weather, a large pile can be left out of doors and while a crust of 8 or 10 inches will freeze on the outside the inside will remain in good condition.

MALHEUR COUNTY.

In Bulletin 53 it was stated that a few analyses had been made of beets grown at Ontario, and that the sugar content and purity had been most excellent. Seed was distributed in this locality in 1898 and arrangements made with Mr. T. T. Danielson, of Arcadia, to grow an experimental plat of beets and to forward samples regularly for analysis.

Twelve samples were analyzed during the season with the following results:

Beets showing 14-15 per cent sugar in juice	1
“ “ 15-16 “ “ “	3
“ “ 16-17 “ “ “	2
“ “ 17-18 “ “ “	2
“ “ 18-20 “ “ “	4

The average results obtained other years as well as 1898-1899 are:

TIME OF ANALYSIS.	Number of Analyses	Average weight. oz.	Average Sugar in Juice.	Average Purity.
1891-1892	1		20.20	84.9
1897-1898 by Station	12	13	17.70	90.8
1897-1898 by Utah Sugar Company	15	20	16.10	84.1
1898-1899 by Station	12	17	16.9	87.1

These results certainly show that this section of the state is capable of producing very high grade beets. The tonnage on a plat of 5 acres this year was 50, showing that nothing need be feared in the matter of yield. Again the conditions of growth in this region are much the same as in Utah, in that all operations are conducted under the irrigation system, which practically insures a crop when the system is properly understood.

There is plenty of land suitable for beet culture in this region, and were it not for the fact of a sparse population it would be a most excellent point for the location of a factory. Unless a larger population can be brought beet culture would be out of the question. If this difficulty could be overcome there would be no better place in the state for a factory. There is abundance of water and land, it is near excellent lime curries, and fuel can be readily obtained.

OTHER LOCALITIES.

The following analyses were made of beets from other localities in the eastern part of the state:

	GROWER.	POSTOFFICE.	Average Weight.		Sugar.			Solids not Sugar.	Total Solids.	Date of Planting.	Date of Harvest.
			Grams.	Ounces.	In Juice.	In Beet.	Purity.				
1438	Shinn, R. A.	Joseph	495	18.8	17.8	85.0	3.4	22.2	May 2	Sept. 10	
1709	Maxwell, J. S.	Enterprise	320	17.6	16.7	82.5	3.7	21.3	May 15	Oct. 7	
1710	McAllister, J. W.	Enterprise	403	11.1	10.5	70.2	4.7	15.8	May 15	Oct. 20	
1764	Maxwell, J. S.	Enterprise	935	18.2	17.2	83.8	3.5	21.7	May 15	Nov. 3	
	Average		538	16.4	15.5	80.4	3.8	20.2			

Western Oregon.

Many beets were also analyzed from western Oregon, mainly from the Willamette valley, the results of which are printed below. These are classified by counties and show the average for each county.

NAME OF COUNTY.	No. of Analyses.	Average Weight in Grams.	Sugar in Juice.	Purity.
Benton	3	691	13.0	82.9
Clackamas	9	390	17.0	86.8
Coos	1	545	13.3	85.3
Douglas	15	852	14.8	85.2
Lane	12	474	14.9	85.1
Lincoln	7	604	14.6	85.2
Linn	21	534	14.5	85.2
Marion	6	703	14.0	82.2
Multnomah	10	556	14.8	86.6
Polk	2	595	11.8	84.3
Tillamook	3	377	17.3	90.6
Washington	4	413	15.3	87.6
Yamhill	12	564	14.3	82.2

Of the 105 analyses reported, western Oregon, 97 show above 12 per cent sugar in the juice; 74 above 14 per cent, and 35 above 16 per cent. The average of all analyses for the season for western Oregon was 14.8 per cent sugar in juice, purity 85, weight of beets 425 grams (14.87 oz.) Results obtained other years are:

YEAR.	No. of Analyses.	Sugar in Juice.	Purity.
Season of 1891	81	13.7	77.9
Season of 1892	41	14.7	81.7
Season of 1897	115	15.1	85.6
Season of 1898	105	14.8	85.0

This shows that western Oregon can certainly grow beets satisfactory both as to sugar content and purity. Other things than the ability to grow good beets, however, have to be taken into consideration in locating a sugar factory. There are certain other factors which are of as great importance as the ability to produce beets. For a full discussion of these the reader is referred to Bulletins 44 and 53 of this Station.

The Willamette valley is much handicapped by having a soil which is generally too clay-like for beet production for sugar purposes. Rains also are very likely to occur just about the time beets mature thus rendering a successful harvest very uncertain. Beets grown in the soils of Willamette valley have a great tendency to throw out many root hairs and branching roots even with good cultivation. This, in addition to the sticky nature of the soil, would render it almost impossible to properly wash beets delivered at the factory. These facts taken together with that of lack of a cheap lime supply enforce the conviction on one that it is not wise to advocate the establishing of sugar factories in this portion of the state.

Southern Oregon.

JACKSON COUNTY.

As a result of experiments and data secured in 1898 I stated in Bulletin 53 that I believed Jackson county possessed all the requirements for a sugar factory. To gain more extended data many analyses of beets grown in that country were made in 1898. These results are summarized as follows:

Forty-six samples were analyzed from the county. The results ranged from 10.9 per cent sugar in the juice, purity 69.4 per cent to 20.2 per cent sugar in juice purity 86. The weight of beets ranged from 9.5 oz. to 54 oz. The beet giving the lowest results, however, could not be considered mature. Of the 46 analyses made 40 showed over 12 per cent sugar in juice, 23 showed over 15 per cent, 21 showed over 16 per cent, and 14 over 17 per cent. The average for the county was 15.8 per cent sugar in juice, purity 83.8, weight 547 grams (19.1 oz.).

The average results obtained in this county in other years are:

YEAR.	No. of Samples.	Average weight. Grams.	Sugar in Juice.	Purity.
Results of 1891.....	3	275	18.9	80.99
Results of 1892.....	1	783	15.0	84.74
Results of 1897.....	60	437	15.4	81.00
Results of 1898.....	46	546	15.8	83.80

The time of planting ranged from April 1st to June 1st. The latter time is considered altogether too late for this section of the state. The time of harvest extended from August 28th to November 4th. The earliest beets and the latest beets came from the same field and were purposely thus harvested to note the effect of late harvest on the beets in this section.

EFFECT OF LATE HARVEST.

	Average of 16 beets harvested before October 1.	Average of 12 beets harvested after October 10
Weight in grams	487	550
Sugar in juice	18.0	14.7
Purity	84.9	84.6

The above is a most excellent illustration of the deterioration of beets, after becoming once mature, by the starting of a second growth.

INFLUENCE OF TIME OF PLANTING.

Of the analyses made of beets from Jackson county the reports show as follows:

	Planted before May 1. Av. of 48 Analyses.	Planted after May 1. Av. of 14 Analyses.
Average weight of beets	504	566
Per cent sugar in juice	15.19	16.58
Purity	82. 1	83. 4

From the above it appears that there is plenty of time in this county for beets to mature if planted by May 1st. I believe the yield, however, would be better by earlier planting. The reports sent in by the growers are too unreliable and irregular to base definite conclusions upon so far as this factor is concerned. It requires about 100 to 110 days for beets to mature and if in the ground by May 1st they would be ready to harvest by September 1st and are not likely to be injured by rain if they should be delivered at once to a factory.

When these results are considered in connection with the fact that all the conditions for maintaining a factory exist in the immediate vicinity, as shown in Bulletin 53, I feel confident that there is

no better location for a factory to be found than exists in Jackson county. The people of that section of the state should recognize the importance of this great industry and take steps towards securing the location of a sugar factory in their midst.

CONCLUSIONS.

These results complete a series of experiments to determine the adaptability of the state in its several sections to the sugar beet. The conclusions reached after a most careful investigation not only of the ability of the various sections to produce beets of a high grade, but also of the other economic conditions essential for the industry are as follows:

First. That three sections of the state are exceptionally well adapted to the industry, viz., Union county in the vicinity of La Grande; Malheur county in the vicinity of Ontario and Arcadia; Jackson county in the vicinity of Medford, possessing as it does a large area capable of producing a very large supply of beets. Water, fuel and limestone are easily and cheaply obtainable in each locality.

Second. That the most serious obstacle in any of these localities is the limited number of people available for field help at short notice, especially would this be true in Malheur county.

Third. That western Oregon is not well adapted to the industry on account of the early fall rains and a soil which is very heavy and sticky, and tenacious to the beet when wet, and it also lacks a cheap lime supply.

Fourth. Beet growing in Malheur county would have to be under a system of irrigation similar to that in Utah.

Fifth. If beets are planted by the middle of April either in eastern or southern Oregon nothing is gained by delaying harvest later than the first week in September.

Sixth. That the Original Klein Wanzlebener and the Elite Klein Wanzlebener have proven themselves well adapted to the conditions in the Grande Ronde valley, and both have given good results in Jackson county. The former has given the better results in the latter place. Each has given better results in each place than the Vilmorin.

Seventh. That in eastern Oregon beets may be left in the ground quite late without serious loss from second growth.

Eighth. That beets for sugar production should not be planted on alkali soils.

Ninth. That beets may be allowed to grow much larger here than in Germany and still hold an excellent per cent of sugar.

Tenth. That the hill lands of Jackson county are not well adapted to the industry.

Eleventh. That the establishment of a sugar factory makes possible a most excellent opportunity for a high development of the dairy industry. This is of no mean consequence when it is remembered that all three of the localities which present favorable conditions for the industry produce immense quantities of alfalfa, and yet ship in dairy products in large amounts. Why not produce them at home and supply the neighboring sections?

Twelfth. That the establishment of a sugar factory means also the development of a large fuel and lime industry.

ACKNOWLEDGEMENTS.

In closing this series of experiments I desire to thank those who co-operated in the work by growing beets and reporting results. It is only by such co-operation between the Station and the farmer that the best results can be obtained in such an investigation, and a satisfactory answer obtained to the question at stake. I desire also to extend thanks to Mr. C. M. McKellips, assistant in this department, for the faithfulness with which he attended to the routine work of analysis in the season of 1898.

FERRATA.

Through an oversight the last three lines on page 8 were left in the copy when they should have been expunged.