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CHEMICAL DEPARTMENT.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

Miscellaneous Investigations.

By G. W. SHAW, Chemist.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

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Miscellaneous Investigations.

This bulletin collects the results of numerous analyses more or less relating to agriculture which have been made in this laboratory during the incumbency of the writer as chemist. These analyses have accumulated in three ways:--

(1) During the course of regular investigation of more extended character;

(2) From isolated analyses of materials which at the time were deemed of *sufficient public importance* to be undertaken;

(3) In the course of work for the State Dairy and Food Commissioner.

It has not been the policy of this department to make a large number of miscellaneous analyses, but to limit the work to matters of public importance rather than private interest, always reserving the right to publish the results of work in as much detail as the Station desired.

Sorghum for Syrup.

On the completion of the work with sugar beets (1898) plans were laid to investigate the possibilities of growing sorghum for syrup-making in certain parts of the state. The work was begun in the spring of 1899 during which season a quantity of seed was distributed in the state, especially in Jackson and Umatilla counties, where it was thought the conditions would be most suitable for the crop. In each of these counties sorghum had been grown on a very limited scale for a number of years and a crude syrup had been made for home use. No attempt had ever been made, so far as known to the writer, to ascertain the real quality of the cane as compared with that produced elsewhere. The seed employed in these experiments consisted of Minnesota Early Amber cane, purchased of Mr. Seth Kinney, Morristown, Minn., and the following varieties of pedigreed southern grown seed furnished by the U. S. Department of Agriculture: Early Amber, Brown Colman, and Folger's Early.

None of the southern grown varieties matured, but the Minnesota seed seemed quite well adapted to the Oregon conditions. The season was altogether unfavorable for the experiment and for one reason and another of the 79 to whom seed was sent, 51 failed to forward samples. In most of these cases the cane was killed by a quite general frost which occurred on or about October 2d in both eastern and southern Oregon, which is quite an unusual occurrence so early in the season, especially in Jackson county. The results of the analyses of the canes are presented below.

ANALYSES OF SORGHUM. SEASON OF 1899.

Laboratory No.	Grower	Postoffice	Planted	Cut	Longest Stalk Feet	Shortest Stalk Feet	Was Season Favorable?	Analyses of Juice.				
								Sucrose	Glucose	Total Sugar	Purity	Total Solids
1801	LeeWatkins	Central Point	April 25	September 30				16.8	8.7	25.5	66.9	25.1
1803	S.L.Bennett	Medford	April 25	October 3	8	5½	No	15.4	4.6	20.0	73.0	21.0
1804	I.A.Merriman	Medford	April 19	October 3	7½	4½	No	9.0	3.9	12.9	41.0	19.4
1805	T.B.Johns	Galevill						13.4	4.2	17.6	63.0	18.1
1806	E.H.Davis	Table Rock	April 15	October 3	9½	5½	Yes	12.2	4.6	16.8	50.0	19.5
1808	Isaac Wolf	Medford	April 15	October 4	6	4	No	11.0	6.2	17.2	46.0	23.9
1809	J.W.Smith	Eagle Point	May 10	October 6	8⅞	5	No	13.0	5.5	18.5	63.4	20.5
1810	E.H.Lenox	Brockway	May 1	October 6	8½	6	Yes	13.7	4.6	18.3	67.0	21.0
1814	Thos.McAndrews	Medford	May 15	October 9			Fair	14.6	4.2	18.8	71.5	19.7
1815	E.A.Hendricks	Talent	May 16	October 9	7¾	5¾	No	13.0	5.2	18.2	64.1	20.3
1815½	W.W.Estes	Talent	May 10	October 9	7	5	No	12.5	4.5	17.0	67.0	18.3
1816	E.P.Bennett	Medford	April 15	October 10	10¾	6½		11.7	3.8	15.5	55.0	21.4
1817½	M.E.Dixon	Applegate	May 15	October 11			No	12.5	2.9	15.4	67.0	18.6
1824	I.A.Merriman	Medford	April 19	October 15	7½	4½	No	11.5	3.6	16.1	63.0	18.0
1825	A.A.Porter	Grave						13.2	3.6	16.8	67.0	19.5
1826	J.W.Smith	Eagle Point	May 10	October 20	9	5	No	10.5	4.1	14.6	65.0	16.2
1827	Noah Cornutt	Riddle	May 10	October 21	10	6	No	14.7	3.0	17.7	75.0	19.5
1828	E.A.Hendricks	Talent	May 16	October 21			No	15.2	3.2	18.4	74.0	20.5
1829	M.H.Tower	Oakland	May 9	October 27			No	7.8	4.7	12.5	60.0	13.0
1831	John Hall	Myrtle Creek						13.2			71.0	18.5
1816½	L.Oldenburg	LaGrande	May 12	October 18			No	10.9	5.3	16.2	61.5	17.7
1830	H.A.Kerns	The Dalles	May 12	October 26	7	3	No	12.7	5.2	17.7	69.0	18.5
1811	K.J.Stackland	Cove	June 7	October 7	9	4	No	6.7	6.1	12.8	40.4	14.1
1818	Robt.Jamieson	Milton	May 15	October 10	10	8	Yes	14.2	4.7	18.9	73.0	19.3
1819	G.DeGraw	Milton	May 15	October 10	8½		Yes	13.2	4.1	17.3	65.0	20.1
1807	L.B.Zell	Milton	Late	October 4	11	6	No	8.0	5.5	13.5	48.4	16.5
1320	G.Carmichael	Weston	April 20	October 9			Yes	14.9	4.5	19.4	72.0	20.5
1828	J.R.King	Weston	May 10	October	10	7	Fair	10.3	3.7	14.0	60.2	17.1

The results show that a fair quality of sorghum for the purpose of syrup manufacture can be produced in Jackson county and probably in certain parts of Umatilla county. Experience of growers in the former shows that in ordinary seasons the early varieties of sorghum will well mature, but in the latter locality there will be much uncertainty as to the maturing of the crop. Under the present condition it is impossible to estimate the cost of the crop and the profit realized from it, but the most reliable estimates show that the cost of the syrup, ready for market, does not exceed 30 cents per gallon. Mr. E. H. Davis of Table Rock, Jackson county, reports that from a little less than one-half an acre he obtained 56 gallons of syrup. W. W. Estes states that from one-fourth of an acre he obtained 22 gallons of syrup. I believe the field is worthy of further investigation.

Strawberries.

There is but little literature touching upon the chemical side of strawberries. So far as I have been able to ascertain there has been published but one bulletin treating of the composition of strawberries, and in the annual reports of the Stations there is but one reference to this subject.* A few annalyses of this fruit have been made at this Station and the results are here stated.

ANALYSES OF STRAWBERRIES.

Laboratory No.	Variety.	Average Weight. Grams.	Flesh. Per cent.	Waste (hulls).	Sugar. Per cent.			Acid as Malic.	Nitrogen.	Albumenoids. N. x 6.25.	Proximate Composition.			
					Grape.	Cane.	Total.				Water.	Organic Matter.	Ash.	Total.
844	Michael's Early (1898)	2 39	94.47	5.53	3.07	1.59	4.66	1.08	.10	.62	91.52	8.15	.33	100
845	Vick's (1898)	10.66	97.27	2.73	3.21	.93	4.14	.95	.18	1.12	81.70	17.91	.39	100
846	Warfield (1898)	6.66	96.80	3.20	3.94	1.08	5.02	.89	.11	.69	90.45	9.18	.37	100
847	Glendale (1898)	11.30	97.00	3.00	3.27	.88	4.15	1.01	.18	1.12	88.23	11.45	.32	100
1343	Sharpless (1899)	5.55	97.54	2.46	----	----	6.18	.72	.18	1.12	88.22	11.42	.36	100
1344	Wilson (1899)	4.86	97.59	2.41	----	----	5.90	.80	.12	.72	88.14	11.20	.66	100
1345	Oregon Everb'ring ('99)	6.96	96.56	3.44	----	----	10.00	.40	.10	.62	87.30	12.12	.58	100
1346	Magoon (1899)	18.33	97.38	2.62	----	----	6.18	.19	----	----	88.72	10.79	.49	100
1350	Clark's Seedling (1899)	8.43	95.36	4.64	5.44	.62	6.06	----	----	----	89.02	10.69	.25	100
		8.39	96.66	3.34	3.79	----	5.80	.75	.17	.86	88.57	11.43	.41	100

*Bulletin No. 4, Vol. II, Part 2, Tenn. Exp. Station, 1889, W. E. Stone, and 6th An. Report Ohio Station.

For the sake of comparison the following averages obtained by other workers are here stated:

	Water.	Dry Matter.	Protein.	Total Sugar.	Acid.	Fibre.	Ash.
*European (J. König)	87.66	12.34	.57	6.28	.93	2.32	.81
†Tennessee (W. E. Stone)	90.52	9.48	.99	5.36	1.37	1.55	.62
‡Ohio (H. A. Webber)				4.50	1.00		
Oregon	88.57	11.43	.86	5.80	.75		.41

From this it appears that the European strawberry is probably sweeter than the American berry, yet this would be governed much by the variety used in analysis, but they do not appear so rich in protein and probably carry more fibre. Comparing the mean of the averages of the American analyses with the European as to the relation of acid to sugar, it appears that in the latter the ratio appears as 1 to 7, while in the former it stands as 1 to 5. If this be compared with the ratio for wild strawberries, as stated by Fresenius, 1 to 2, it is seen there has been quite an improvement brought about by selection and cultivation.

From the above analyses it is seen that the strawberry can not be considered as a very nutritious food, carrying but little over 10 per cent dry matter. Strawberries have even less food value than the flesh of stone fruits. In a general way they may be stated to approximate vegetables in their nutritious properties which may be seen from the following table:

	Water.	Dry Matter.	Protein.	Nitrogen free Extract. Including fat and fibre.	Ash.	Acid as SO_3
Fresh Prunes (Oregon; all prunes)	77.37	23.46	1.14	21.14	.83	.35
Fresh Prunes (Oregon; Petites)	72.26	27.74	1.14	25.49	.76	.35
Fresh Prunes (Oregon, Italians)	77.07	22.93	1.09	20.56	.86	.42
California (all prunes)	80.20	19.80	.80	18.50	.50	.40
Plums (California)	78.40	21.60	1.00	20.10	.50	.40
Cherries (Oregon)	81.30	18.70	.90	17.30	.50	.....
Cherries (California)	79.40	20.60	1.20	19.00	.40	.....
Potatoes	78.30	21.70	2.20	17.50	1.00	.....
String Beans	89.20	10.80	2.30	7.70	.80	.....
Turnips	90.46	9.54	1.14	8.63	.80	.....
Strawberries (Oregon)	88.57	11.43	.86	9.41	.41	‖.75

*Chemie d. Mensch Nahrungs u. Genussmittel, 1 Baud (30 Ed.) p. 777.

†Tenn. Bul. Vol. 11, No. 4, 1889.

‡6th An. Rept. Ohio Ext. Station, 1881.

‖As Malic.

A limited number of dietary studies have been made in this country to ascertain the effect of a liberal use of fruits and vegetables on the cost of living and in this connection the results are interesting. The results of these experiments show the liberal use of either fresh fruits or vegetables increases the cost of living out of proportion to the nutrients furnished.

However, it should be remembered that the value of an article of diet should not be measured entirely by the nutrients, as some foods undoubtedly have a certain medical and mechanical effect in stimulating the appetite and counteracting any tendency to constipation by introducing into the system beneficial vegetable acids in a pleasant and agreeable combination with water and sugar. No fruit equals the strawberry in this particular. Though containing a relatively small amount of nutriment strawberries offer in this a very valuable article of diet and have a deserved wide use in the American household.

Composition of Strawberry Ash.

A composite sample of the ash from strawberries was analyzed which is of interest inasmuch as it represents the draught on the soil. Only those ingredients were determined which are of importance from a fertilizing standpoint. The results, together with those from a few other fruits are expressed below:

Table showing Plant Food Extracted from the Soil by Certain Fruits.

FRUITS.	Per cent. in Total Ash.					Pounds Removed in 1000 Lbs. of Fruit.				
	Total Ash.	Potash.	Phosphoric acid	Lime.	Nitrogen. Per cent.	Total Ash.	Potash.	Phosphoric acid	Lime.	Nitrogen.
PRUNES:										
Oregon	.83	58.61	15.60	.....	.220	8.3	4.45	1.30	.....	2.20
California	.49	63.83	14.08	4.66	.162	4.9	3.10	.68	.....	1.62
European	.63	59.19	10.79	.....	.122	6.3	3.73	.95	.....	1.22
CHERRIES:										
Oregon	.50	40.37	11.06	1.08	.169	5.0	2.01	.55	.05	1.69
European	.58	34.83	10.34	.....	.180	5.8	2.00	.60	.....	1.80
STRAWBERRIES:										
Oregon	.42	39.86	13.99	4.20	.190	4.2	1.67	.59	.18	1.90
Other Localities	.60	50.00	23.31	.....	.150	6.0	3.00	1.10	.....	1.50
Apples (average)	.39	48.72	2.56	.....	.130	3.9	1.90	.10	.....	1.30

Strawberries draw heavily on the side of potash and nitrogen, the former constituting about two-fifths of the entire ash. Any fertilizers used on strawberry plants should be relatively rich in both potash and nitrogen and I would suggest the following combination and amount per acre:

Nitrate of soda	200 pounds
Muriate of potash	250 pounds
Dissolved bone	200 pounds

It should be borne in mind that no scientific rule can be laid down in this matter of fertilizers, as conditions are so variable, but the farmer must keep in mind the general principles and use his intelligence in applying them to his conditions.

Cost and Composition of Bread in Oregon.

During the year 1899 analyses were made and data collected under the direction of the writer, to ascertain the cost and composition of bread in Oregon.* The study was made for the purpose of gaining some data for making comparisons with similar experiments conducted elsewhere, as well as to ascertain the relative cost per pound of the various nutrients contained in the bread.

The samples were collected from different parts of the state, including both eastern and western Oregon. In each case inquiry was made as to the claimed weight of the loaf, but in many instances no definite weight was claimed. In most cases the actual weight, as found in the laboratory, approximated very closely with the claimed weight. In a few instances the actual weight was found a little greater than the claimed weight.

The samples represented the bread as actually sold to the consumer, as in no instance did the merchant know for what purpose the bread was purchased. The moisture determination was made as soon as the bread reached the laboratory, and much care was taken to protect the loaves from loss of moisture after purchasing. In all 25 samples were examined. The samples after being air-dried were analyzed according to official methods. The results obtained are shown in the following table:

*Credit is due Miss Idella McBride for a portion of the work under this head, she having presented it in a thesis.

TABLE SHOWING COST AND COMPOSITION OF BREAD IN OREGON.

No.	Place of Purchase.	Trade Name.	Claimed Weight of Loaf.		Actual Weight of Loaf.		Cost of Loaf	Cost per lb.		Composition of Fresh Bread						Calculated to Dry Matter			
			Pounds	Grams	Pounds	Grams	Cts.	Claimed Weight Cts.	Actual Weight Cts.	Water	Dry Matter	Protein	Fat	Carbohydrates	Ash	Protein	Fat	Carbohydrates	Ash
1	Salem	French Roll	None		.88	400	2½		3.1	31.51	68.49	7.68	1.43	58.56	.80	11.21	2.08	85.54	1.17
2	Salem	None	None		.71	320	2½		3.5	35.07	64.93	7.10	1.04	55.60	1.19	10.93	1.61	85.63	1.83
3	Salem	None	.75	340	.77	348	2½	3.3	3.2	38.77	61.23	6.51	.63	52.96	1.13	10.63	1.03	86.49	1.85
4	Salem	None	.75	340	.70	319	2½	3.3	3.5	36.75	63.25	6.84	1.05	54.17	1.19	10.81	1.67	85.64	1.88
5	LaGrande	Cream	1.19	539	1.00	453	4¼	3.5	4.3	29.83	70.17	7.09	1.39	60.33	1.36	10.11	1.93	85.98	1.93
6	LaGrande	Baker	1.25	567	1.17	531	4¼	3.3	3.5	35.05	64.95	6.96	.69	56.01	1.27	10.73	1.07	86.24	1.96
7	LaGrande	City	1.06	482	.97	438	4¼	4.0	4.4	32.11	67.89	7.35	.82	58.34	1.37	10.84	1.21	85.93	2.02
8	The Dalles	French	None		.91	415	5		5.5	29.66	70.94	7.70	.88	60.92	1.44	10.85	1.24	85.88	2.03
9	The Dalles	None	1.00	454	.85	385	5	5.0	5.8	37.38	68.62	7.78	.41	59.02	1.41	11.34	.60	86.01	2.05
10	The Dalles	Pioneer	1.00	454	.91	415	5	5.0	5.5	34.51	65.49	7.75	.73	55.66	1.35	11.83	1.10	84.25	1.82
11	Milton	None	1.00	454	1.08	489	5	5.0	4.6	32.54	67.46	8.10	.69	57.80	1.54	10.74	.00	87.22	2.04
12	Portland	None	1.06	482	.96	445	5	4.7	5.2	37.05	62.95	7.16	.81	53.35	1.63	11.36	1.29	84.75	2.60
13	Portland	None	None		.67	383	3½		4.9	35.99	64.01	7.78	1.13	53.83	1.27	12.15	1.77	84.09	1.99
14	Portland	Creamery	.75	340	.77	348	2½	3.3	3.2	38.63	61.37	5.78		*53.90	1.69	9.40		*87.87	2.73
15	Portland	None	None		1.28	579	5		3.9	33.28	66.72	6.31	.83	58.12	1.46	9.45	1.25	87.11	2.19
16	Portland	Steam	1.00	453	.97	445	3⅓	3.3	3.4	35.28	64.72	5.88	.28	56.94	1.62	9.09	.44	87.98	2.49
17	Portland	None	None		1.03	467	5		4.8	34.22	65.78	5.65	.52	58.35	1.26	8.59	.80	88.70	1.91
18	Portland	None	None		.86	390	3⅓		3.8	38.06	61.94	7.93	1.09	50.44	2.43	10.95	1.76	83.88	3.41
19	Portland	Pullman	2.00	907	1.87	846	10	5.0	5.7	35.81	64.19		1.73		1.54		2.73		2.41
20	Albany	None	.75	340	.75	348	2½	3.3	3.3	39.80	60.20	5.80	2.11	51.15	1.14	9.64	3.51	84.95	1.90
21	Albany	None	1.50	696	1.44	651	5	3.3	3.4	39.26	60.74	5.47	.04	53.94	1.29	9.00	.06	88.16	1.78
22	Albany	None	None		.64	292	2½		3.9	39.05	60.95	5.54	.00	52.62	1.79	9.08	.00	87.98	2.94
23	Albany	None	None		1.34	608	5		3.7	38.51	62.49	5.38		*55.76	1.35	8.75		*89.06	2.19
24	Albany	None	.56	255	.72	327	2½	4.4	3.4	38.73	61.27	5.85		*54.28	1.14	9.54		*88.60	1.86
25	Albany	None	1.13	510	1.37	622	5	4.4	3.6	39.05	60.95	5.66	.00	54.41	.98	9.28	.00	89.12	1.60

*Not included in the average.

Discussion of Results.

"The variations in the composition of bread are chiefly due to two causes, (1) the variation in the composition of the flour used which may cause changes in two directions, (a) in the amount of water that may be absorbed by the bread and (b) in the proportion of protein, fats and carbohydrates; (2) the different methods used by bakers in making the bread. In some cases only flour, yeast and salt are used, while in others, milk, butter, sugar and lard, either alone or in combination are added.* The average composition of the bread as purchased and found by analysis is stated below:

Water	35.81
Protein	6.75
Fat	.80
Carbohydrates	55.26
Ash	1.38
Total	100

The widest range is seen to be in the fat, which varied from "trace" to 1.73 per cent. This variation in the fat of bread is considered to be due partially to certain changes which it undergoes in the process of baking, rendering the fat non-extractible, perhaps in some cases, destroying it. The results obtained for 11, 21, 22 and 25 are too low to be due to any brand of flour. The water content varied from 29.06 in sample 8 to 39.80 in sample 20. The difference in the moisture content is probably due to the different absorbing power of bread made in different ways.

In the case of protein there is not so wide a range, and the difference in this respect is probably due less to the method of making than to the difference in the composition of the flour. It is interesting to note that the breads made from eastern Oregon flour have a higher per cent of protein than do those analyzed from western Oregon. This is of greater interest since it tends to confirm the results that have been obtained in analysis of flour from these regions by Mr. E. J. Lea of this department. Mr. Lea's results, which have not yet been published, show as follows:

* Bulletin 35, U. S. Department of Agriculture.

AVERAGE COMPOSITION OF OREGON FLOUR.

	No. of Analyses.	Ash.	Moisture.	Fat.	Protein.	Gluten.				Protein.	
						Wet.	Dry.	Ratio.	Aleurometer.	Highest.	Lowest.
Eastern Oregon (white flour)	11	48	10.16	1.14	10.09	30.1	12.1	2.5	36	12.48	8.69
Western " " "	19	.43	11.94	1.41	6.82	12.3	5.0	2.5	25—	7.68	5.93
Eastern " (whole wheet flour)	2	.95	9.50	2.38	14.01	32.2	12.8	2.6	27	18.04	9.97
Western " " " "	3	.71	11.06	1.95	7.79	13.8	5.9	2.4	25—	8.68	7.21

Cost of Bread.

It is interesting also to note the difference in the cost of bread at the different points. It is the cheapest at Salem, averaging 3.3 cents per pound; and the highest at The Dalles, averaging 5.6 per pound —a difierence of 2.3 per pound or 41 per cent. Portland stands about midway between these two, bread being purchased there at an average price of 4.3 per pound. If it be assumed that the average family of five persons consume 1000 pounds of bread per year there would be a difference of $23.00 in the cost whether purchased at The Dalles or at Salem. Comparing the cost of bread per pound in Oregon and the East the following table is of interest:

New Brunswick, N. J.	4.3	
Trenton, N. J.	4.9	
Newark, N. J.	3.8	
Camben, N. J.	4.6	
Average		**4.4 cts**
Salem	3.3	
La Grande	4.0	
The Dalles	5.6	
Portland	4.3	
Albany	3.6	
Average		**4.1 cts**

From this it will be seen that bread appears to be very slightly cheaper here than in New Jersey which may probably be taken as typical of the North Atlantic States. There appears, however, to be a greater uniformity in prices in New Jersey than in Oregon. The difference in price would indicate that there is a lack of uniformity on the part of bakers in fixing the price of the loaf. *Bread should be sold by the pound* and not by the very indefinite term "loaf," and then the purchaser would be able to know just what he is purchasing and pay for just the amount obtained.

Cattle Foods.

The following analyses of cattle foods have been made to date. It will be noted that analyses of a number of native clovers are presented. These clovers are all found in the vicinity and in some cases might prove useful plants if brought under cultivation:

TABLE SHOWING COMPOSITION OF SOME OREGON CATTLE FOODS.

SUBSTANCE.	Composition of Original Substance.							Calculated to Dry Matter.				
	Moisture.	Dry Matter.	Ash.	Protein—N x 6.25.	Fibre.	Nitrogen Free Extract.	Ether Extract.	Ash.	Protein—N x 6.25.	Fibre.	Nitrogen Free Extract.	Ether Extract.
1. Red Clover [Trifolium pratense]	9.39	90.61	7.77	8.26	28.45	43.70	2.43	8.51	9.11	31.40	48.29	2.69
2. Trifolium tridentum	9.51	90.49	7.28	7.00	27.20	47.21	1.80	8.45	7.75	30.05	51.87	1.98
3. Trifolium eriocephalum	8.58	91.42	9.20	7.03	21.55	51.26	2.38	10.06	7.68	23.57	56.07	2.60
4. Meadow Foxtail [Abopecurus pratensis]	8.40	91.60	10.65	6.00	21.31	51.70	1.94	11.62	6.55	24.35	55.36	2.12
5. English Rye Grass [Lolium perenne]	6.93	93.02	7.00	3.50	23.20	56.72	4.60	7.52	3.76	24.94	53.83	4.95
6. Cheat [Bromus secalinus]	8.56	91.44	9.19	3.61	31.90	44.99	1.75	10.05	3.94	33 79	50.30	1.92
7. Vetch [Vicia sativa]	9.19	90.81	9.37	7.05	25.64	47.15	1.60	10.31	7.76	28.23	51.94	1.76
8. Alsicke Clover [Trifolium hypridun]	8.96	91.04	8.40	7.73	32.19	40.55	2.17	9.22	8.49	35.35	44.56	2.38
9. Sweet Vernal [A .odoratum]	10.81	89.19	8.10	8.20	23.38	46.49	3.02	9.08	9.19	26.21	52.13	3.39
10. Spurry [S. maxima]	8.58	91.42	8.62	4.81	14.70	59.09	4.20	9.42	5.26	16.08	64.63	4.59
11. Trifolium ciliatum	10.29	89.71	9.58	10.06	22.20	45.93	1.94	10.92	11.47	25.31	50.09	2.21
12. Trifolium incarnatum	11.51	88.49	7.43	10.92	29.09	37.89	3.16	8.31	12.34	32.87	42.91	3.57
13. Trifolium grandentum	10.05	89.95	9.16	10.66	12.07	55.02	3.04	10.18	11.85	13.41	50.05	3.38
14. Orchard Grass [Dactylis glomerata]	11.80	88.20	5.90	8.17	38.33	33.54	2.26	6.60	9.26	43.44	38.12	2.56
15. Tall Oat Grass [Arrheuathenum avenaceum]	14.30	85.70	7.23	10.88	24.36	42.82	2.41	8.43	12.69	28.42	52.34	2.80
16. Meadow Fescue [Festuca pratensis]	8.03	91.97	7.52	6.69	31.83	44.29	1.64	8.17	7.16	34.60	48.29	1.78
17. Timothy [Phleum pratense]	11.19	88.81	3.98	6.02	30.35	46.26	2.20	4.48	6.77	34.15	52.13	2.47
18. Oat Straw	9.62	90.38	5.20	3.51	43.37	36.02	2.21	5.62	3.78	46.94	41.63	2.39
19. Wild Barley [Hordeum maritinum]	7.51	92.49	12.20	6.50	25.00	46.79	2.20	13.18	7.02	27.03	50.39	2.38
20. Red Clover [Trifolium pratense]	4.27	95.73	8.50	14.84	28.83	40.11	3.35	8.88	15.50	29.90	42.23	3.49
21. Cheat [Bromus secalinus]	7.00	93.00	9.09	7.67	31.80	42.49	1.95	9.77	8.24	34.19	45.70	2.10
22. English Fescue	7.68	92.32	8.64	3.94	24.17	53.17	2.00	9.35	4.26	26.18	58.05	2.16
23. Native Grasses [mixture]	8.75	91.25	10.12	11.25	30.86	36.79	2.23	11.08	12.21	33.82	40.45	2.44
24. Sacalin	68.31	31.69	2.14	8.96	4.33	14.46	1.80	6.75	28.27	13.66	45.96	5.36
25. Sugar Beet Pulp	89.01	10.99	.70	.88	2.40	6.43	.58	6.37	8.00	22.02	58.33	5.28
26. Salsify	77.07	22.93	.40	3.21	____	*17.82	1.50	1.76	13.93	____	*77.89	6.37
27. Wheat Shorts	9.61	90.39	4.24	5.62	2.84	76.31	1.38	4.67	6.22	3.14	84.44	1.53
28. Wheat, Oats and Bran Mixture [equal parts]	9.59	90.41	7.63	7.39	4.68	67.51	1.15	8.42	8.17	5.17	76.96	1.28
29. Oat Chop	9.40	90.60	7.65	7.44	3.27	73.98	1.26	8.44	8.20	3.61	78.37	1.38
30. Wheat Chop	9.76	90.24	7.93	7.59	4.31	69.17	1 27	8.79	8.41	4.77	76.62	1.41

*Includes fibre.

Notes.

1. Sample taken from Station plat; was in full bloom; grown on drained "whiteland."

2, 3, 11, 12, 13 are samples of native clovers which grew on heavy soil; plants rather small except the last two. Cut when in full bloom.

4. Sample cut when in full bloom, June 8, 1893; cured in the laboratory and became somewhat bleached before analysis. The same remarks apply to samples 5, 7, 9, 10, 14, 15, 16, 17.

6. Sample sent by Wm. Bogue, Corvallis; a fair sample as cured by the farmer of the vicinity; slightly over-ripe at base of leaves.

20. Received March 3, 1896. Used in Cheat vs. Clover experiment (see Bulletin 47). Excellent sample; cut in full bloom.

21. Received March 3, 1896. Used in Cheat vs. Clover experiment (see Bulletin 47). Most excellent sample; cut in full bloom.

23. Sample of hay from a mixture of native grasses which grew in Union county near La Grande; considered by the stockmen very nutritious, which is borne out by analysis.

24. The sample was somewhat withered when received at the laboratory, hence the moisture is probably a little too low for a fair sample. The plant is remarkable for a high protein content, a fact also pointed out by the California Station.

25. Silage of sugar beet pulp from sugar factory at La Grande (see Bulletin 59). An excellent cattle food. 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.

GYPSUM.

There is probably no place in the United States where gypsum could be used to greater advantage with a liberal hand than on the soils of Oregon, provided the material could be obtained at anything like a reasonable figure. At present, however, the prices are so high as to render it almost prohibitive except in in certain special cases. This seems the more to be regretted, since within the state can be found as fine a quality of this material as at any other point in the country. So far as the writer has been able to ascertain, the only deposit of this material of any considerable extent occurs in eastern Oregon, principally near Huntington, although lesser deposits

have been reported from other localities. The only samples that have reached this laboratory have been from the point mentioned above. Analyses of several samples of this rock are presented below, as well as analyses made of a few samples from other sources:

TABLE SHOWING COMPOSITION OF OREGON GYPSUM.

	1289.	1290.	1291.	1369.	1370.	1495.	1496.	1503.	1514.	1580.	1581.	1582
Insoluble Matter	3.82	1.42	.18	.....	.....	10.44	11.24	5.76	.19	2.13	8.45	3.55
Pure Crystallized Gypsum	84.71	93.30	88.04	85.82	95.93	84.32	86.00	84.76	93.84	95.98	73.86	94.22
Moisture, Carbon dioxid, etc.	11.47	5.28	11.78	.....	.....	5.24	2.76	9.48	5.97	1.89	12.69	2.33

Notes.

1289 and 1291. Huntington gypsum. A sample of average quality.

1290. Huntington gypsum. This is an extra quality of gypsum, and ranks well with the very finest found in the country.

1369 and 1370. Samples sent by Buell Lamberson, Portland Said to be Japanese gypsum. The former was pulverized; the latter is of very high grade.

1495 and 1496. Samples of Ashpatu (Cal.) gypsum; the so-called "California gypsum" found in the Portland markets. The samples carry about the average amount of sulfate, but a larger amount of insoluble matter than is desirable. The former was of very dark color which is somewhat against it.

1504. Huntington gypsum of average quality, probably from same ledge as 1289.

1514. Huntington gypsum of superfine quality. It was from the interior of the ledge below 1504 and had a very fine crystalline structure much resembling granular sugar.

1580 and 1582. Huntington gypsum of excellent quality. The former was of a grey color; the latter very white.

1581. Huntington gypsum of low grade, about 10 per cent below the average quality.

Gypsum, or land plaster, has been used as a fertilizer from the time of the Greeks and Romans. Its action on soils as relates to plant growth has been the subject of exhaustive study by many experimenters, with the result of showing that its beneficial effects are not due to a direct fertilizing action but rather to indirect effects, and in this respect is not comparable with such fundamental plant foods as nitrates, phosphates and potash. Its most important function is its action on the double silicate of aluminum and potash.

an insoluble compound which exists in greater or less quantities in nearly all soils—especially in clays—converting them into a silicate of aluminum and lime, while the accompanying product, sulfate of potash, goes into solution and thus becomes available for plants. Thus the principal effect seems to be its power to set free potash from its insoluble compounds, making them available. Storer, an authority, says: "It is often of great use in regions where wheat is grown in alternation with clover, since by encouraging the growth of clover it acts as a manure for wheat."

On the soils of western Oregon it could be used to much advantage on account of the tendency of this soil to be weak in available potash. It would also serve to improve their physical condition by the particles thus making the soils more porous. In eastern Oregon it would be of high utility as a corrective for the hated black alkali. In western Oregon it should be sown in the very early spring at the rate of 100 to 150 pounds to the acre, preferably to encourage the growth of clover, the yield of which it not unfrequently increases fifty per cent. As a corrective for the black alkali in eastern Oregon it would have to be used in much larger quantities, probably not less than one ton per acre, this depending somewhat upon the amount of alkali present.

LIMESTONES.

Lab. No.	Locality	Insoluble Matter	Calcium oxid (Lime)	Iron and Alumina	Magnesia	Carbondioxid, etc.
592	Near Baker City	.....	16.11	.....	11.06	.....
593	" "	.....	44.57	.....	9.44	.....
594	" "	.....	47.84	.....	.76	.....
595	" "	.....	52.59	.....	.98	.....
596	" "	.....	52.65	.....	.87	.....
948	Near LaGrande	9.81	50.43	1.58	.....	38.08
949	" "	trace	30.66	7.54	.....	.....
1296	Southern Oregon	3.93	48.68	trace	5.75	41.64
1297	" "	83.31	5.91	.00	3.32	7.46
1298	" "	2.79	23.30	19.78	2.79	61.34
1299	" "	4.98	47.01	.....	trace	48.01
1300	" "	5.49	54.24	1.08	.00	39.19
1528	Near Huntington	1.36	55.32	trace	1.37	41.95
1529	" "	.96	55.63	trace	.16	43.25
1530	" "	1.31	55.64	trace	.18	42.87
1550	" "	.90	53.50	trace	trace	46.55
1551	" "	18.94	32.10	3.45	15.62	30.89
1552	" "	1.43	31.30	.60	trace	.....
1537	Near Baker City	4.00	53.42	.....	.....	42.58

Notes.

Samples 592–597, inclusive, were sent by Hon. W. P. Keady, of Portland. Nos. 595 and 596 are high grade samples and would make a fair rock for sugar work. or burn to an excellent lime. They have a purity of 93.85 and 93.95 per cent respectively.

Samples 948 and 949 were sent by Mr. E. W. Kammers, of La Grande, who desired only partial analyses. Samples are not of good grade.

Samples 1296–1310, inclusive, were sent by Mr. H. C. Perkins, of Grant's Pass, who desired particularly to know the magnesia content.

Samples 1528–1530 and 1550–1552, inclusive, are from different ledges near Huntington (Lime Spur). Nos. 1528 and 1529 are high grade blue limestones, and burn to an excellent white lime. No. 1550 is also a high grade rock from near the same ledge as 1528. These samples are of good quality for beet sugar work. No 1551 is a low grade lime rock, and would produce a dark and very inferior lime. No. 1552 is a "calcareous tuff," and would yield a very poor lime. The last two are worthless for sugar work.

A Dietary Study.

A writer recently stated that "although the cost of food makes so large a part of the whole cost of living, and although the health and strength of all are so intimately connected with and dependent upon their diet, yet even the most intelligent people know less of the actual uses and values of their food in fullfiling its purposes than of almost any other of the necessities of life."

The studies of dietaries so far made are not sufficient for reliable inference regarding the eating habits of the people at large. The total number is but a little over one hundred and these are confined mostly to New England. So far the results confirm the opinion of hygienists that our diet is one-sided in that we eat too much. It is one-sided in that we eat to little protein and too much fat, starch and sugar. There is also found to exist great waste in the purchase of food, and especially is this true among the classes who can least afford a waste, if such is allowable at all. This is not altogether due to kitchen waste since often it is due to the delusion that high priced articles are more nutritious than cheaper ones. A sirloin steak contains no more nutritive matter than a round and there is much more waste. It is also found that there is altogether too much carelessness in the kitchen in the saving of waste matter.

The following data were obtained from a dietary study conducted under the direction of the writer by a class in the "Chemistry of Foods" from the Household Science department of the college. The methods followed were those outlined by Prof. Atwater and explained in Methods and Results of Investigations on the Chemistry and Economy of Foods (Bul. No. 21, Office of Experiment Stations.) The general plan was to take an inventory of the amounts of all

material on hand at the time of beginning the experiment, to keep an accurate record of amounts of all material purchased during its progress, and at the end of the experiment to to take another inventory of material on hand and to calculate the amount used from this data. Material used was assumed to have the average composition of American food material as published by Atwater.*

The kitchen waste and refuse, however, was brought to the laboratory from time to time, where they were prepared for and subjected to analysis according to the methods employed by Atwater and Woods, as published in the reports of the Storrs (Conn.) Experiment Station. The work was undertaken primarily to familiarize the class with methods of conducting such experiments in a study of dietaries. Inasmuch as the results are of interest at this time the data is here presented.

Cost of Food Used in Dietary Study.

In the following table is given as near as possible the usual cost of the materials used in this study when purchased in the Corvallis markets. The range of price is also given:

TABLE SHOWING USUAL PRICE OF FOODS USED IN DIETARY STUDY.

Food Materials.	Range in price.	Usual price.	Food Materials.	Range in price.	Usual price.
ANIMAL FOOD.	*Cents.*	*Cents*	VEGETABLE FOOD.	*Cents.*	*Cents*
Beef, shoulder ..... per lb.	8 @ 10	8	Sugar, granuloted..... per lb.	5¾ @ 7	6½
Beef, steak, round..... "	.....	10	Cabbage ..... "	1 @ 1½	1½
Pork, bacon..... "	7 @ 13	9	Celery..... per bunch.	.....	5
Pork, lard..... "	7 @ 10	10	Onions ..... per lb.	1½ @ 2	2
Fish, smelt..... "	4 @ 8	6	Potatoes..... per bu.	20 @ 35	25
Eggs ..... per doz.	8 @ 30	15	Tomatoes, canned....per qt.	.....	10
Butter..... per lb.	15 @ 25	20	Apples..... per bu.	25 @ 40	25
Milk ..... per qt.	.....	5	Parsuips .. .. per lb.	.....	1½
Sour milk..... "	.....	2	Honey ..... "	.....	10
Buttermilk ..... "	.....	2½	Canned strawberries..per qt.	.....	10
VEGETABLE FOOD.			Canned blackberries.. "	.....	10
Corn meal..... per lb.	.....	2½	Canned prunes ..... "	.....	10
Wheat flour..... "	1¼ @ 2	2	Jelly, prune.....per ½ pt.	.....	10
Graham flour..... "	.....	2	Preserves..... "	.....	10
Rice..... "	.....	7	Cocoa ..... per lb.	.....	30
Crackers, soda..... "	8⅓ @ 10	10	Salsify ..... "	.....	1

This study covered a period from Jan. 15 to Jan. 22, 1898, in a private family consisting of five members; two men, one 20 and the other 60 years of age; three women, aged 18, 25 and 45. All members of the family were in good health. The family was of the middle class and while in no sense penurious or close, yet has the reputation of "looking after the corners." One hundred and eighteen meals were eaten in the seven days—equivalent to one man 39⅓ days.

The tables giving the details of weights and percents from which the results given below are not published, inasmuch as they would not be of sufficient interest to people in general. The table given below gives the nutrients and fuel values of the food used, in the

* Bulletin 28, Office of Experiment Station.

table and kitchen wastes, and in the portion actually eaten. In estimating the fuel values of the nutritive ingredients the protein and carbohydrates are assumed to contain 4.1 and the fats 9.3 calories of potential energy per gram, which factors have been demonstrated to be practically correct.

NUTRIENTS AND POTENTIAL ENERGY IN FOOD PURCHASED, REJECTED AND EATEN.

Kinds of food material.	Cost.	Nutrients.			Fuel value.
		Protein.	Fat.	Carbohydrates.	
Food purchased:		*Grams.*	*Grams.*	*Grams.*	*Calories.*
Animal	$2.17	1,105	2,324	685	28,270
Vegetable	3.29	2,201	445	16,421	91,784
Total	5.46	3,306	2,769	17,106	120,054
Waste:					
Animal		12	18		166
Vegetable		30	46	204	1,421
Total		42	64	204	1,587
Food actually eaten:					
Animal		1,093	2,306	685	28,104
Vegetable		2,171	399	16,217	90,363
Total		3,264	2,705	16,902	118,467
PER MAN PER DAY.					
Food purchased:					
Animal	$ .07	36	75	22	909
Vegetable	.10½	71	14	528	2,951
Total	.17½	107	89	550	3,860
Waste:					
Animal		38	58		5.3
Vegetable		96	148	655	46.0
Total		134	206	655	51.3
Food actually eaten:					
Animal		35	74	22	903.6
Vegetable		70	13	521	2,905.2
Total		105	87	543	3,808.8
PERCENTAGES OF TOTAL FOOD PURCHASED.					
Food purchased:	*Per cent*	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*
Animal	39.7	33.4	83.9	4	23.6
Vegetable	60.3	66.6	16.1	96	76.4
Total	100.0	100.0	100.0	100	100.0
Waste:					
Animal		.36	.65		.14
Vegetable		.91	1.78	1.19	1.18
Total		1.27	2.43	1.19	1.32
Food actually eaten:					
Animal		33.1	83.2	4.0	23.41
Vegetable		65.7	14.3	94.8	75.27
Total		98.8	97.6	98.8	98.68

Notes.

Of the entire cost, $5.46, for the seven days for the food for the family, which price takes account of everything eaten, whether purchased in the market or raised in the garden, reckoning the latter at market rates as per previous table, about 40 per cent was for animal food and 60 per cent for vegetable. A dietary experiment conducted in Connecticut showed an expense of 57 per cent of the total for animal food. About two-thirds of the protein was obtained from vegetable food; four-fifths of the fat came from animal food. Practically all the carbohydrates were obtained from vegetable food. Nearly two-thirds of the fuel value came from vegetable food. The total protein, or muscle-forming material purchased per man per day was 3.75 oz., fat 3.13 oz., carbohydrates 19.39 oz. Of this amount there was a waste of only 1.3 per cent in protein, 2.5 per cent in fat, and 1.2 per cent in carbohydrates, which is, indeed, remarkably small. There was no special attempt at saving during the time of this experiment, the family living as they ordinarily do. In this experiment the ratio of protein to fuel ingredients is as 1 to 5.9, which is about the same as the maximum of well nourished families in Europe. The average ratio in America is much wider than this. On this ration it cost per man per day seventeen and one-half cents.

NOTE.—For the routine work under "A Dietary Study" credit is due Misses Edna Groves, Hulda Holden, and Georgia Hartless, of the class of 1897.