

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF CHEMISTRY.

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ANALYSES OF CEREALS

COLLECTED AT THE

WORLD'S COLUMBIAN EXPOSITION,

AND

COMPARISONS WITH OTHER DATA.

BY

HARVEY W. WILEY,
CHIEF OF THE DIVISION OF CHEMISTRY.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1895.

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BULLETIN No. 45.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., April 17, 1895.

SIR: I submit for your inspection a compilation of analyses of typical cereals exhibited at the World's Columbian Exposition, and request that it be published as Bulletin 45 of the Division of Chemistry.

Respectfully,

H. W. WILEY,
Chemist.

Hon. J. STERLING MORTON,
Secretary.

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TYPICAL CEREALS.

COMPOSITION OF CEREALS EXAMINED FOR THE JUDGES OF AWARDS AT THE WORLD'S COLUMBIAN EXPOSITION.

By direction of the Secretary of Agriculture, the Division of Chemistry placed at the disposal of the authorities of the World's Columbian Exposition the laboratory at Jackson Park, Chicago, for the purpose of assisting in the determination of the value of food products in competition for awards.

Early in July of 1893 the author was directed to take charge in person of this work, and to assist the judges in their labors in every possible way. For some reason the committee of jurors on cereal products did not get to their work as promptly as was expected. Instead of having the samples ready for analysis the latter part of July, it was not until September that the analytical work could be begun. The number of samples, therefore, which could be examined was very much less than had been expected. In addition to the regular force of the Division of Chemistry detailed for the work, the valuable assistance of one of the jurors, Mr. Frank T. Shutt, chemist of the experimental farms at Ottawa, Canada, was secured in the laboratory.

On account of the late date at which the analytical work was commenced, it was found impracticable to do the whole of it at the Chicago laboratory. An arrangement was therefore made with the jurors to use only certain data of the analyses in giving the awards. By this arrangement the analyses were to be finished in the laboratory at Washington. The data which were submitted to the jurors, and which were determined in the laboratory at Chicago, were the weight of 100 kernels, the percentage of moisture, the percentage of albuminoids, and the percentage of ash; while the data which were obtained at the Washington laboratory subsequently were the percentages of dry and wet gluten in the wheat and wheat flours and the percentages of ether extract and the fiber. The starches and other carbohydrates were calculated in the usual way by difference.

The methods of analysis pursued were, with one or two minor changes not affecting the results except in the way of securing more

rapid work, those adopted by the Association of Official Agricultural Chemists. Inasmuch as many who will receive this bulletin do not have access to these methods, they are given below:

PREPARATION OF THE SAMPLES.

Samples of cereals are ground in a small mill until they pass a sieve with a half-millimeter mesh.

DETERMINATION OF MOISTURE.

Two grams of the substance in a flat-bottomed aluminum dish are dried for five hours at the temperature of boiling water. Experience has shown that after this time no further loss of weight takes place.

DETERMINATION OF ASH.

Char from 2 to 3 grams of the substance and burn to whiteness at the lowest possible red heat. If a white ash can not be obtained in this manner, exhaust the charred mass with water; collect the insoluble residue on a filter, burn, add this ash to the residue from the evaporation of the above aqueous extract, and heat the whole to a low redness till the ash is white.

DETERMINATION OF ETHER EXTRACT.

Extract from 2 to 3 grams of the substance dried as for the determination of the moisture, with anhydrous and alcohol-free ether, for sixteen hours. Dry the extract, by exposure to the full heat of boiling water, to constant weight.

ALTERNATE METHOD FOR ETHER EXTRACT.

In determining hygroscopic water, as above, continue the drying until the loss of weight in thirty minutes is reduced to 1 milligram or less; extract the dried substance for sixteen hours as directed, dry again, and give loss of weight as ether extract.

Anhydrous ether.—To prepare the anhydrous alcohol-free ether required for estimation of fat, take any of the commercial brands of ether, wash with two or three successive portions of distilled water, add sticks of solid caustic soda or potash until most of the water has been abstracted from the ether. Carefully cleaned metallic sodium, cut into small pieces, is now added until there is no further evolution of hydrogen gas. The ether thus dehydrated must be kept over metallic sodium, and should be only lightly stoppered in order to allow any accumulating hydrogen gas to escape; and it may be drawn off with a pipette as required.

ESTIMATION OF NITROGEN.

REAGENTS.

(1) *Acid.*—(a) Standard hydrochloric acid, the absolute strength of which has been determined by precipitating with silver nitrate and weighing the silver chloride, as follows:

To any convenient quantity of the acid to be standardized add a solution of silver nitrate in slight excess and then 2 c. c. of pure nitric acid of 1.2 sp. gr.; heat to the boiling point, and keep at this temperature for some minutes, but without violent ebullition, and with constant stirring, until the precipitate assumes the granular form. Allow to cool somewhat, and then pass the fluid through the asbestos. Wash the precipitate by decantation, with 200 c. c. of very hot water, to which have been added 8 c. c. nitric acid and 2 c. c. dilute solution of silver nitrate containing 1

gram of the salt in 100 c. c. of water. The washing by decantation is performed by adding the hot mixture in small quantities at a time, and beating up the precipitate well with a thin glass rod after each addition. The pump is kept in action all the time, but to keep out dust during the washing the cover is only removed from the crucible when the fluid is to be added.

Put the capsule and precipitate aside, return the washings once through the asbestos so as to obtain them quite clear, remove them from the filter and set aside to recover excess of silver. Rinse the receiver and complete the washing of the precipitate with about 200 c. c. of cold water. Half of this is used to wash by decantation, and the remainder to transfer the precipitate to the crucible with the aid of a trimmed feather. Finish washing in the crucible, the lumps of silver chlorid being broken down with the glass rod. Remove the second filtrate from the receiver and pass about 20 c. c. of 98 per cent alcohol through the precipitate. Dry at 140 to 150°. Exposure for half an hour is found more than sufficient, at this temperature, to dry the precipitate thoroughly.

Or (b) standard sulphuric acid the absolute strength of which has been determined by precipitation with barium chlorid and weighing the resulting barium sulphate.

For ordinary work half normal acid is recommended, i. e., acid containing 18.2285 grams of hydrochloric acid or 24.5185 grams sulphuric acid to the liter; for work in determining very small amounts of nitrogen, one-tenth normal acid is recommended. In titrating mineral acids against ammonia solutions, use cochineal as indicator.

(2) *Standard alkali*, the strength of which, relative to the acid, has been accurately determined. One-tenth normal ammonia solution, i. e., containing 1.7051 grams of ammonia to the liter, is recommended for accurate work.

(3) *Sulphuric acid*, specific gravity 1.81, free from nitrates and also from ammonium sulphate, which is sometimes added in the process of manufacture to destroy oxids of nitrogen.

(4) *Metallic mercury* or mercuric oxid, prepared in the wet way. That prepared from mercuric nitrate can not be safely used.

(5) *Potassium permanganate* finely pulverized.

(6) *Granulated zinc*, pumice stone, or 0.5 gram of zinc dust is to be added to the contents of the flasks in distillation, when found necessary, in order to prevent bumping.

(7) *Potassium sulphid*.—A solution of 40 grams of commercial potassium sulphid in 1 liter of water.

(8) *Soda*.—A saturated solution of sodium hydrate free from nitrates.

(9) *Indicator*.—Solution of cochineal prepared as follows: Tincture of cochineal is prepared by digesting and frequently agitating 3 grams of pulverized cochineal in a mixture of 50 c. c. of strong alcohol with 200 c. c. of distilled water, at ordinary temperatures, for a day or two. The solution is decanted or filtered through Swedish paper.

APPARATUS.

(1) *Kjeldahl digestion flasks* of hard, moderately thick, well-annealed glass. These flasks are about 22 cm. long, with a round, pear-shaped bottom, having a maximum diameter of 6 cm., and tapering out gradually in a long neck, which is 2 cm. in diameter at the narrowest part, and flared a little at the edge. The total capacity is 225 to 250 c. c.

(2) *Distillation flasks* of ordinary shape, of 550 c. c. capacity, or preferably flasks of the same capacity of well-annealed glass and of pear-shaped bottom, for both digestion and distillation, fitted with a rubber stopper and a bulb tube above to prevent the possibility of sodium hydrate being carried over mechanically during distillation. The bulbs are about 3 cm. in diameter, the tubes being of the same diameter as the condenser and cut off obliquely at the lower end. The bulb tube is adjusted to the condenser by a rubber connection.

MANIPULATION.

(1) *The digestion.*—From 0.7 to 3.5 grams of the substance to be analyzed, according to its proportion of nitrogen, are brought into a digestion flask with approximately 0.7 gram of mercuric oxid or its equivalent in metallic mercury and 20 c. c. of sulphuric acid. The flask is placed in an inclined position, and heated below the boiling point of the acid for from five to fifteen minutes or until frothing has ceased. If the mixture froth badly, a small piece of paraffin may be added to prevent it. The heat is then raised until the acid boils briskly. No further attention is required till the contents of the flask have become a clear liquid, which is colorless, or at least has only a very pale straw color. The flask is then removed from the frame, held upright, and, while still hot, potassium permanganate is dropped in carefully and in small quantities at a time till, after shaking, the liquid remains of a green or purple color.

(2) *The distillation.*—After cooling, the contents of the flask are transferred to the distilling flask with about 200 c. c. of water, with a few pieces of granulated zinc, pumice stone, or 0.5 gram of zinc dust when found necessary to keep the contents of the flask from bumping, and 25 c. c. of potassium-sulphid solution are added, shaking the flask to mix its contents. Next add 50 c. c. of the soda solution, or sufficient to make the reaction strongly alkaline, pouring it down the side of the flask so that it does not mix at once with acid solution. Connect the flask with the condenser, mix the contents by shaking, and distil until all ammonia has passed over into the standard acid. The first 150 c. c. of the distillate will generally contain all the ammonia. This operation usually requires from forty minutes to one hour and a half. The distillate is then titrated with standard alkali.

The use of mercuric oxid in this operation greatly shortens the time necessary for digestion, which is rarely over an hour and a half in case of substances most difficult to oxidize, and is more commonly less than an hour. In most cases the use of potassium permanganate is quite unnecessary, but it is believed that in exceptional cases it is required for complete oxidation, and in view of the uncertainty it is always used. The potassium sulphid removes all the mercury from the solution, and so prevents the formation of mercur-ammonium compounds which are not completely decomposed by soda solution. The addition of zinc gives rise to an evolution of hydrogen and prevents violent bumping. Previous to use the reagents should be tested by a blank experiment with sugar, which will partially reduce any nitrates that are present, which might otherwise escape notice.

MOIST GLUTEN.

Place 10 grams of the sample in a porcelain dish and moisten with from 6 to 7 c. c. of cold water, knead, and allow to stand for an hour. Work into a ball, being careful that none of the material adheres to the dish. Holding the mass in the hand knead it in a slow stream of cold water until the starch and all soluble matter are washed out. Place the ball of gluten thus formed in cold water and allow to stand for one hour; remove from the water, press as dry as possible between the hands, roll into a ball, and weigh in a flat-bottomed dish.

DRY GLUTEN.

After weighing place the ball of moist gluten in the drying oven at a temperature of boiling water for twenty-one hours; cool and weigh.

CRUDE FIBER.

The residue from the ether extract may be used for this determination. To this residue in a half liter flask or beaker add 200 c. c. of boiling 1.25 per cent sulphuric acid. Continue the boiling for thirty minutes,

filter, wash thoroughly with boiling water till the washings are no longer acid; remove the substance from the filter into the same beaker with 200 c. c. of hot 1.25 per cent solution of sodium hydrate, free of sodium carbonate; boil for thirty minutes, filter through a gooch and wash with boiling water till the washings are neutral; dry to constant weight and incinerate after weighing. The loss in weight by incineration will give the quantity of crude or indigestible fiber. The most convenient filtering material for the first filtration is fine linen, although any other method which secures a clear filtrate and rapid work may be used. The strength of the solutions of acid and alkali should be accurately determined by titration.

NOTES ON METHODS OF ANALYSIS.

The total albuminoids are obtained by multiplying the percentage of nitrogen found by 6.25. The starch and soluble carbohydrates, including all bodies soluble in the reagents employed, are obtained by difference—that is, the sum of the moisture, ash, ether extract, albuminoids, and crude fiber subtracted from 100. The percentage of starch in this material varies largely with different cereals and even with different samples of the same cereal, but inasmuch as all these carbohydrate bodies are supposed to have almost the same food value no attempt has been made to separate them.

In regard to the slight variations from standard methods which are mentioned above, the only one of importance is that referring to the determination of fiber. It is found in our experience here that heating in beakers covered with watch glasses is quite as efficient as the method prescribed by the association, and where so many samples are to be examined the greater speed which is secured by doing away with the process of directing a current of air on the foaming mass while boiling is a matter of considerable importance.

Another variation from the official method was in the determination of moisture. At Chicago no facilities were afforded for the determination of moisture in a current of hydrogen. Experience has shown that there is practically no difference in the analytical data secured on samples dried in the open air, in a partial vacuum and in a current of hydrogen, and for this reason the drying in the air, which is so much more easily accomplished, has been followed.

The methods used for moist and dry gluten have not been adopted by the Association of Official Agricultural Chemists. They are the processes which are used in this laboratory and which have given us satisfactory results. The determination of moist and dry gluten can not in any sense be regarded as an exact analytical process. For millers' purposes, however, the numbers have considerable value, showing the comparative percentage of glutinous matter in the different samples. For obvious reasons the determination of dry and moist gluten was confined to samples of wheat and wheaten flour.

The data which were used by the judges in determining the value of a given sample were the percentage of moisture, the percentage of ash, and the percentage of albuminoids. Inasmuch as it was not possible to determine the ether extract and indigestible fiber in the time at our disposal the average content of these constituents in the several cereals under examination was assumed to be that found in previous work of the division, and these average data were also considered in the determination of awards. For food values for comparative purposes, it was assumed that the albuminoids and fats were two and one-half times as valuable as the carbohydrates and the total comparative value of each sample for food purposes was determined by multiplying the percentage of carbohydrates by one and the percentages of albuminoids and fats each by 2.5 and taking the sum of their products. It was considered that these were sufficient data for the purposes of the jury of awards.

In the following tables will be found the analytical data obtained. The albuminoids were determined by Messrs. T. C. Trescot and F. T. Shutt. The moisture and ash were determined by other assistants in Chicago. The ether extract was determined by Mr. J. S. Carman, the insoluble fiber by Messrs. Krug and Trescot, and the moist and dry glutens by Mr. T. C. Trescot.

For convenience of reference the means of the analytical data obtained are compared with those secured in the previous work of this Division and which were published in Bulletins Nos. 1, 4, and 9. These bulletins are now out of print and this tabulation of the mean data will be of especial use to workers who are unable to consult the original data.

Comparisons are also made with the mean data of cereal analyses contained in the Bulletin No. 11 of the Office of Experiment Stations compiled by Jenkins and Winton. To complete as far as possible a tabular view of our present knowledge of the composition of cereals the mean data given by König and Dietrich in their compilation of the analyses of foods have been used.

In the data from König and Dietrich given in the tables of means, the percentages of moisture in each case are as found by weighing. For purposes of comparison, however, the other data are calculated to the water content of the general mean given in the first number of the series.

Description and analyses of barley.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moist- ure.	Albumi- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
12181	47	CALIFORNIA, Nublas Coebner, Los Angeles.	Commercial barley.	Bushels. 55	Pounds. 49	Grains. 4,679	Per ct. 10.35	Per ct. 8.58	Per ct. 2.22	Per ct. 5.15	Per ct. 2.47	Per ct. 71.23
17796	2	ILLINOIS, Robert Shetden, Pingree Grove.	Golden melon.	48	57	4,628	11.77	9.89	2.03	3.87	2.49	69.95
17797	3		Beardless white.	43	54	5,157	11.31	8.67	2.32	4.07	2.34	71.49
17798	4		Prolific barley.	52	50	4,899	11.72	8.32	2.07	4.22	2.20	71.47
		Means				4,895	11.60	8.96	2.14	4.05	2.34	70.97
8629	42	INDIANA, Willard Smith, Belemore.	Spring barley.	42	56	3,403	11.47	10.33	2.05	5.62	2.52	68.01
112	1	KANSAS, S. H. Williams, Abilene.	White barley.	42		3,190	11.57	11.73	1.93	5.07	2.95	66.75
20463	59	MICHIGAN, E. A. Parks, Waterloo.	Purple barley.		58.50	4,873	9.35	13.83	2.19	1.85	2.44	70.34
2481	13	MINNESOTA, H. Winslow, Lehtramio.	White barley.			4,445	9.24	12.78	2.42	4.55	2.64	68.37
4176	33	NEW YORK, A. T. Leach, Lyons.	Barley, two-rowed.	55	54	3,987	11.57	9.98	2.09	3.75	2.43	71.18
4182	34		do	52	51.50	3,852	11.92	11.20	2.18	4.25	2.42	68.03
4183	35		do	47	51.25	3,972	12.96	10.68	1.89	3.85	2.45	68.17
4192	36		do	50	52	4,760	10.78	11.20	2.17	3.67	2.46	69.72
4193	37		do	53	51.50	4,030	12.68	11.20	2.11	4	2.28	67.73
4206	38		do	55	54.75	4,009	11.66	11.20	2.12	4.50	2.42	68.10
4207	39		do	55	52.25	3,860	11.14	11.20	2.11	3.70	2.75	69.10
4209	40		do	50	50.75	4,064	11.11	11.20	2.05	4	2.89	68.75
4210	41		do	48	52.25	4,182	11.07	10.33	2.12	4.10	2.57	69.81
		Means				4,079	11.65	10.91	2.09	3.98	2.52	68.84

Description and analyses of barley—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbo-hydrates.
			Bushels.	Pounds.	Grams.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
		OHIO.										
11125	44	Whipps Bros., Marion.....	Barley, two-rowed.....	42	51	3,245	11.12	12.08	2.08	4.40	1.71	68.61
11126	45	.....do.....	Barley, four-rowed.....	Good.	.....	3,316	11	10.33	2.09	5	2.59	68.99
		Means.....	.....	.....	.....	3,280	11.06	11.20	2.09	4.70	2.15	68.80
		PENNSYLVANIA.										
2892	14	Samuel Wilson, Mechanicsville.....	California Prolific.....	42	48	3,897	8.92	12.95	2.41	4.47	2.83	68.42
		UTAH.										
16185	53	Utah Agricultural College, Logan.....	Lamp Blue barley.....	.....	.....	4,315	9.98	10.50	1.89	4.57	2.42	70.64
16186	54	.....do.....	Black barley.....	66	.....	4,050	10.24	11.90	2.01	1.57	2.26	72.02
16190	55	.....do.....	New Zealand barley.....	.....	.....	3,276	10.03	10.85	2.22	3.50	2.80	70.60
16192	56	.....do.....	Standard barley.....	54	.....	4,765	9.75	8.93	2.15	4	1.70	73.47
16193	57	.....do.....	Solzers's California Prolific.....	.....	.....	4,357	8.95	10.68	2.35	3.50	2.59	71.93
16194	58	.....do.....	Common barley.....	.....	.....	4,810	9.66	9.63	2.14	4	1.65	72.92
		Means.....	.....	.....	.....	4,262	9.77	10.42	2.11	3.52	2.24	71.93
		WASHINGTON.										
12772	46	State of Washington, Olympia.....	White brewing barley.....	50	49.50	4,250	10.60	9.63	2.05	4.40	2.50	70.82
13900	48	W. O. Bush, Olympia.....	Northumberland.....	43	53	4,218	10.91	9.63	2.09	4.72	2.58	70.07
13901	49	.....do.....	Provooster barley.....	48	53	5,078	10.60	8.63	2.19	4	2.54	71.74
13903	50	.....do.....	Highland Chief.....	.....	.....	5,249	10.32	9.63	2.16	4	2.24	71.65
		Means.....	.....	.....	.....	4,699	10.61	9.46	2.14	4.28	2.47	71.07
		WISCONSIN.										
15553	29	Adam Graver, Waukesha.....	Barley.....	40	52	3,240	11.72	10.85	2.27	5.17	2.75	67.24
		WYOMING.										
14118	51	A. A. Lambrigger, Big Horn.....	New black or purple.....	54	50	4,090	10.32	12.08	2.23	2	2.24	71.13
		Total means, United States.....	.....	.....	.....	4,192	10.80	10.69	2.13	4.05	2.44	69.89

ARGENTINE REPUBLIC.											
23172	Benj. Brunt, Chubut.....	62.5	58	4.354	12.07	8.58	2.21	4.10	2.91	70.13	
23454	P. and A. Lanusse, Buenos Ayres.....	62.5	55	4.016	13.25	11.90	1.65	3.77	2.61	67.42	
	Means.....	.....	.....	4.185	12.66	10.24	1.63	3.94	2.76	68.78
CANADA.											
7897	Ontario Agricultural College, Guelph, Ontario.....	.....	.....	4.300	9.15	11.03	2.17	4.07	2.55	71.03
7901	do.....	.....	.....	3.856	11.52	10.59	2.24	5	2.66	67.99
7902	do.....	.....	.....	3.882	10.75	9.89	2.25	4.35	2.68	70.08
7905	do.....	.....	.....	5.368	10.68	10.68	2.22	4.35	2.56	69.51
18416	B. P. Wilson, Trafalgar, Ontario.....	.....	.....	5.718	11.48	10.24	2.36	3.77	2.43	69.72
18420	do.....	.....	.....	5.507	12.65	10.24	2.38	3.82	2.36	68.55
18421	do.....	46	.....	5.897	12.10	10.68	2.32	4.65	2.39	68.46
18422	do.....	.....	.....	4.809	12.10	10.85	2.11	4.60	1.88	68.46
18423	George Baker, Woodhouse.....	.....	.....	4.995	11.89	11.20	2.14	4.37	2.44	67.90
18424	Gaylord Greenman, Charlottetville.....	.....	.....	5.608	11.38	11.03	2.19	3.90	2.13	69.37
18428	Thomas Puzer, Woodhouse.....	.....	.....	5.398	11.41	11.20	2.06	3.60	2.32	69.41
18432	Ralph Brewels, White Church, Ontario.....	54	.....	5.768	12.74	10.68	2.05	4.07	2.43	68.03
18478	Andrew Clifford, St. Josephus Island.....	.....	.....	5.520	12.38	9.28	2.28	4.50	2.25	69.31
18479	do.....	.....	.....	5.820	12.07	10.68	2.44	3.87	2.31	68.63
18484	Major Thos. Walker, Ancaster, Ontario.....	50	52	5.783	13.61	11.03	2.29	3.75	2.42	67.64	
18488	Wm. Tuck, Nelson, Ontario.....	50	52	5.797	13.55	10.50	1.24	4	2.43	68.80	
27756	Wm. Tuck, Watertown, Ontario.....	46	.....	5.547	12.47	11.03	2.38	4.12	2.36	67.42
27757	Richard P. Wilson, Trafalgar, Ontario.....	.....	.....	5.547	12.47	11.03	2.38	4.12	2.36	67.42
27758	Ralph Brewels, White Church, Ontario.....	54	(a)	5.547	12.47	11.03	2.38	4.12	2.36	67.42	
27760	T. Pyke, Markham, Ontario.....	40	(b)	5.351	13.40	9.28	1.26	3.95	2.32	69.79	
	Means.....	.....	.....	5.262	11.96	10.57	2.06	4.10	2.41	68.90
SPAIN.											
30498	Girardo Cerespo (Eusebia), Medina del Campo.....	.....	.....	5.731	11.67	9.45	1.75	4.50	2.40	70.23
	Total means, foreign barleys.....	.....	.....	5.007	12.01	10.49	2.01	4.11	2.43	68.97
	Total means, all barleys.....	.....	.....	4.533	11.31	10.61	2.09	4.07	2.44	69.47

b Heavy weight.

a Over standard.

NOTES ON ANALYSES OF BARLEY.

The total number of samples examined, grown in the United States, was 32. The mean composition of all the samples was as follows:

The weight of 100 kernels, 4.192 grams; moisture, 10.80 per cent; albuminoids, 10.69; fat or ether extract, 2.13 per cent; indigestible or crude fiber, 4.05 per cent; ash, 2.44 per cent; starch, sugar, and other digestible carbohydrates, by difference, 69.89 per cent.

A tabular comparison of these averages with those obtained in previous examinations by the Department (Bulletin No. 9, Div. of Chemistry) and compiled by Jenkins and Winton (Exp. Sta. Bull. No. 11), will be of interest.

	World's Columbian Exposition samples (32).	Samples previously analyzed in Division of Chemistry (60).	Samples collected by Jenkins and Winton (10).
Weight of 100 kernels.....grams..	4.192	3.482	.....
Moisture.....per cent..	10.80	6.53	10.90
Albuminoids.....do..	10.69	11.33	12.40
Ether extract.....do..	2.13	2.68	1.80
Indigestible fiber.....do..	4.05	3.80	2.70
Ash.....do..	2.44	2.89	2.40
Carbohydrates, by difference.....do..	69.89	72.77	69.80
Total.....do..	100	100	100

The greatest point of difference between these analyses and those made in former years is found in the percentage of moisture. It is difficult now to reconcile the discrepancy, but it appears that the difference makes a marked contrast, as would naturally be expected, in the other data, raising as a rule all of the other constituents in proportion as the water diminishes. The difference in the weight of the kernels is also marked, and this is due to the fact that naturally the finest and plumpest kernels would be sent to the Exposition. This and the diminished amount of water in the former samples examined are sufficient to account for the larger average weight of 100 kernels as exhibited at the Columbian Exposition.

In a barley the two most important characteristics for brewing purposes, aside from the diastatic action of malt, are the percentages of carbohydrates, principally starch, and of the albuminoids. In the three classes of barleys examined, as indicated in the above table, the carbohydrates reduced to water-free basis are 78.26 per cent, 77.85 per cent, and 78.34 per cent, respectively; and the albuminoids 11.97 per cent, 12.12 per cent, and 13.92 per cent, respectively. It is seen, therefore, that there is not a very great difference in the averages of the three different classes when reduced to a water-free basis, save in the higher percentage of albuminoids in class three.

The weight per bushel and the yield per acre in all cases were given by the exhibitors, and the evidence substantiating the statements made was not communicated to this division by the judges of awards. In respect of extremes of variation, the following data will be of interest:

In the United States the largest grains of barley were grown in Washington and the smallest in Kansas. In moisture the largest percentage was found in a New York sample, viz, 12.96, and the smallest in a sample from Pennsylvania, viz, 8.92. In Canada the maximum and minimum percentages found were 13.61 and 9.15, respectively. Among foreign exhibits the highest percentage of moisture, viz, 13.25, was found in a sample from the Argentine Republic, and the lowest, viz, 11.67, in a sample from Spain. The comparisons of the other constituents of the barley in regard to maxima and minima and means can be seen with sufficient detail in the following table:

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albami- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
	<i>Grams.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Domestic:							
Maxima	<i>a</i> 5.249	<i>b</i> 12.96	<i>c</i> 13.83	<i>d</i> 2.42	<i>e</i> 5.62	<i>f</i> 2.95	<i>g</i> 73.47
Minima	<i>f</i> 3.190	<i>h</i> 8.92	<i>i</i> 8.32	<i>b</i> 1.89	<i>g</i> 1.57	<i>g</i> 1.65	<i>f</i> 66.75
Means.....	4.192	10.80	10.69	2.13	4.05	2.44	69.89
Canada:							
Maxima	5.897	13.61	11.20	2.44	5	2.68	71.03
Minima	3.856	9.15	9.28	.56	3.60	1.88	67.42
Means.....	5.262	11.96	10.57	2.06	4.10	2.41	68.90
Foreign:							
Maxima	<i>j</i> 5.731	<i>k</i> 13.25	<i>k</i> 11.90	<i>k</i> 2.21	<i>j</i> 4.50	<i>k</i> 2.91	<i>j</i> 70.23
Minima	<i>k</i> 4.016	<i>j</i> 11.67	<i>k</i> 8.58	<i>k</i> 1.05	<i>k</i> 3.77	<i>j</i> 2.40	<i>k</i> 67.42
Means.....	5.007	12.01	10.49	2.01	4.11	2.43	68.97

a Washington.
b New York.
c Michigan.

d Minnesota.
e Indiana.
f Kansas.

g Utah.
h Pennsylvania.
i Illinois.

j Spain.
k Argentine Republic.

For a more detailed description of the composition of barley the results of some former work in the Division of Chemistry may be cited (Bulletin No. 9, p. 77):

Number of analyses.....	14
Water.....	per cent.. 6.47
Ash	do... 2.87
Oil.....	do... 2.67
Sugar	do... 7.02
Dextrin and soluble starch.....	do... 3.55
Starch	do... 62.09
Albuminoids soluble in 80 per cent alcohol.....	do... 3.66
Albuminoids insoluble in 80 per cent alcohol.....	do... 7.86
Indigestible fiber.....	do... 3.81

The following means are given by König-Dietrich for barleys from different countries:

	Number of analyses.	Water.	Albuminoids.	Oil.	Carbohydrates.	Indigestible fiber.	Ash.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per ct.</i>	<i>Per cent.</i>	<i>Per ct.</i>	<i>Pr ct.</i>
Miscellaneous.....	263	14.05	9.71	1.89	65.75	5.76	2.84
Middle and north Germany.....	120	14.92	9.88	1.80	66.75	4.77	2.75
Southern and western Germany.....	185	15.84	9.62	2.30	64.84	6.70	2.49
Austria.....	105	14.38	9.02	1.87	67.13	5.53	2.40
Hungary.....	45	14.70	9.39	2.48	67.77	3.95	2.36
North Russia.....	9	13.83	10.40	-----	-----	-----	2.24
South Russia.....	12	13.81	12.71	-----	-----	-----	2.36
England and Scotland.....	51	16.01	9.80	2.17	64.45	6.84	2.69
France.....	62	14.97	9.08	1.64	65.43	7.31	2.49
Sweden and Norway.....	23	14.71	9.35	-----	-----	-----	2.20
Denmark.....	3	15.66	8.98	-----	-----	-----	2.36
Turkey.....	25	12.40	8.78	1.82	71.19	2.16	2
Africa.....	15	12.76	8.98	1.74	71.12	1.96	2.15
North America.....	101	7.01	10.48	2.42	66.94	3.47	2.64
Hulled barleys grown in United States (Bull. 9, p. 75).....	15	6.26	11.77	2.66	75.53	1.60	2.18

* In this and the following numbers the mean percentages of water found are given, but the other data are calculated to the basis of the percentage of water in the first instance, viz. 14.05.

A typical unhulled American barley should have approximately the following composition:

	Per cent.
Moisture.....	10.85
Albuminoids.....	11.00
Oil.....	2.25
Indigestible fiber.....	3.85
Ash.....	2.50
Digestible carbohydrates.....	69.45

In a general comparison of the samples exhibited at the World's Columbian Exposition it is seen that the average data obtained represent very nearly the mean composition of barleys the world over. They show decidedly more moisture than those formerly examined by the Division of Chemistry, but less than the majority of foreign barleys as quoted by König. Representing as they do the presumably typical barleys and the best of their classes their composition, as revealed by the analyses given, may be taken as a standard of comparison for barleys in general.

No attempt was made in the analyses to determine the comparative value of the samples for brewing purposes, and this can not be well determined by chemical analysis alone. Some authorities object to barleys rich in albuminoids for brewing purposes, but, inasmuch as the nutritive value of a beer depends largely upon its percentage of albuminoid matter, it is not readily seen how the objection can hold from a dietetic point of view. On the other hand, beers which have a high content of proteid matter are more difficult to preserve in a bright, sparkling condition than those whose nitrogenous content is low. The choice therefore of a barley for brewing purposes must depend largely on the judgment of the brewer as to the purposes for which the beer is to be used. There is no reason to suppose that the barleys grown in

the United States would prove inferior to those of other countries, provided the varieties best suited to beer manufacture were cultivated and properly developed. Climatic and soil conditions, as well as methods of fertilization, would undoubtedly have a tendency to vary the composition of the crop, but by judicious choice among the barleys rich or poor in albuminoids or other constituents the scientific brewer can undoubtedly secure a mixture which will satisfactorily meet the demands of his customers.

BUCKWHEAT.

But few samples of this cereal were offered for analysis, and these were wholly of American origin. The whole number embraced 7 samples from the United States and 3 samples from Canada. The composition of the samples and the mean composition of all are shown in the table on the following page.

Description and analyses of buckwheat.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbo-hydrates.
		INDIANA.		<i>Bushels.</i>	<i>Pounds.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>
8635	6	Chas. Dribler, Patriot.....	Japanese buckwheat.....	.....	.....	3,383	11.90	11.38	2.20	9.70	1.99	62.83
8636	7	Ed. Shoemaker, Columbia City.....	Silver hulled buckwheat.....	.....	.....	3,380	11.80	11.55	2.33	11.15	1.91	61.26
8637	8	Frank Woods, Princeton.....	Japanese buckwheat.....	.....	.....	3,312	12.29	11.90	1.92	11.02	1.86	61.01
8638	9	Henry Thomas, La Fontaine.....	do.....	.....	.....	3,303	11.80	10.50	2.43	12.45	1.63	61.12
		Means.....	.....	.....	.....	3,345	11.95	11.33	2.22	11.08	1.85	61.56
		MICHIGAN.		.....	.....	.....	.....	.....	.....	.....	.....	.....
20372	5	J. Elder, Pearson.....	Silver hulled buckwheat.....	.....	.....	2,350	11.75	11.55	2.08	9.57	1.90	63.15
		MINNESOTA.		.....	.....	.....	.....	.....	.....	.....	.....	.....
2362	1	Cosgrove Live Stock Company, Le Sueur.....	Japanese buckwheat.....	50	56	3,100	13.	9.19	1.74	10.19	1.74	64.14
2484	2	James Walsh, Little Falls.....	do.....	40	56	3,008	12.52	9.19	2.06	11.17	2.23	62.83
		Means.....	.....	.....	.....	3,054	12.76	9.19	1.90	10.68	1.99	63.49
		Total means, United States.....	.....	.....	.....	3,119	12.15	10.75	2.11	10.75	1.89	62.33
		CANADA.		.....	.....	.....	.....	.....	.....	.....	.....	.....
18618	3	George N. Harris, Beverly, Ontario.....	Buckwheat.....	35	.....	2,203	12.82	10.94	2.62	9.09	1.57	62.96
18622	4	W. H. R. Talbot, London.....	do.....	.....	.....	3,400	13.14	11.03	1.31	10.77	1.69	62.06
27596	10	do.....	Japanese buckwheat.....	27	.....	3,250	12.12	11.38	1.87	10.62	1.94	62.07
		Means.....	.....	.....	.....	2,951	12.69	11.12	1.93	10.16	1.73	62.36
		Total means, all buckwheats.....	.....	.....	.....	3,069	12.31	10.86	2.06	10.57	1.85	62.34

NOTES ON ANALYSES OF BUCKWHEAT.

The samples containing the largest and smallest grains were both from Canada, 100 kernels weighing 3.400 and 2.203 grams, respectively. In regard to size the samples from Indiana were the most uniform, each of the individual samples being very near the mean in weight. The percentage of moisture is remarkably uniform in all the samples, the maximum being 13.14 per cent in a Canada sample and the minimum 11.75 per cent in a sample from Michigan. In respect of albuminoids the highest percentage, 11.90, was found in an Indiana, and the lowest, 9.19, in a Minnesota sample. In oil content the highest was a Canada sample with 2.62 per cent, and the lowest, also from Canada, with 1.31 per cent. The extremes in regard to the other constituents will be found by inspecting the table given below. In regard to the indigestible fiber, it should not be forgotten that the hull of the kernel was ground with the flour, and this fact explains why the indigestible fiber of the buckwheat flour is so much higher than that of ordinary cereals.

In the table which follows are found the maxima, minima, and means for domestic samples and those from Canada from the World's Fair exhibits compared with the mean data as given in Jenkins and Winton's compilation of American feeding stuffs and in König and Dietrich's tables of the constitution of foods:

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albumi- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
	<i>Grams.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Domestic:							
Maxima	a 3.383	b 13.00	a 11.90	a 2.43	a 12.45	b 2.23	b 64.14
Minima	c 2.350	c 11.75	b 9.19	b 1.74	c 9.57	a 1.63	a 61.01
Means	3.119	12.15	10.75	2.11	10.75	1.89	62.33
Canada:							
Maxima	3.400	13.14	11.38	2.62	10.77	1.94	62.96
Minima	2.203	12.12	10.94	1.31	9.09	1.57	62.06
Means	2.951	12.69	11.12	1.93	10.16	1.73	62.36
Jenkins and Winton (10 anal- yses):							
Means		12.60	10	2.20	8.70	2	64.50
König:							
Means of 14 analyses		14.12	11.32	2.61	14.32	2.77	54.86
Columbian Exposition sam- ples:							
Means of 10 analyses	3.069	12.31	10.86	2.06	10.57	1.85	62.34

a Indiana.

b Minnesota.

c Michigan.

Comparing the analyses made with those given by König and Dietrich we find again that in the foreign samples the percentage of water is very much higher than in those of domestic origin. The indigestible fiber is also markedly higher and, as a consequence of the high percentages of moisture and indigestible fiber, the digestible carbohydrates are remarkably low. Buckwheat is a cereal which has received little attention from analysts, and the data at hand for comparison are therefore limited.

A typical American buckwheat should have approximately the following composition: Weight of a hundred kernels, 3 grams; moisture, 12

per cent; albuminoids, 10.75 per cent; oil, 2 per cent; indigestible fiber, 10.75 per cent; ash, 1.75 per cent; digestible carbohydrates, 62.75 per cent.

MAIZE (INDIAN CORN).

For some reason the number of samples of maize offered for analysis by the judges of awards was very small, and the great maize-producing States of Illinois, Iowa, and Missouri, as well as many others, are not represented at all in the samples analyzed. The few samples which were received, however, were of very fine quality and may be taken as fairly representative of the best maize products of the localities represented. The former work of the Department in the analysis of samples of maize is very comprehensive. The bulletins in which the results of these analyses were printed—viz, Nos. 1, 4, and 9—have had a wide circulation, and have been taken as containing the data necessary to form an estimate of the character of the maize products of this country. The deficiency, therefore, in the samples offered for analysis at the World's Columbian Exposition can be supplied by referring to the analyses made at a former period. This deficiency is not due to any lack of samples which were on exhibition, but simply to the failure of the judges to deliver the samples for examination. By reason of the fact that it was impossible to make an analysis of all the samples examined by the judges, it was deemed best by them to select only those which were peculiarly typical. While this was practiced with other cereals with reasonable success, for some reason they failed to apply this rule in the case of the samples of maize, and therefore the largest maize-producing regions of the United States are unrepresented. The detailed analyses of the samples delivered to the chemical laboratory follow.

Description and analyses of maize.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moist- ure.	Albami- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
				Bushels.	Pounds.	Grams.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
335	1	NEW HAMPSHIRE. Warren Brown, Hampton Falls.....	Angel of Midnight.....	75	60	40.040	12.27	11.12	3.88	1.00	1.51	70.22
444	2	INDIANA. James Riley, Thorntown.....	Riley's Favorite.....	60	59	33.045	12.32	8.84	3.80	1.62	1.32	72.10
446	10	.....do.....	Ivory bent white corn.....	90	61	44.584	10.35	9.98	4.28	1.75	1.34	72.30
8599	23	J. A. Evert, Indianapolis.....	Capitol corn.....	70	57	37.855	10.08	8.58	2.94	1.42	1.41	75.07
8021	11	Indiana Experiment Station, La Fayette.....	Big Buckeye.....	62.36		36.250	9.80	9.80	3.99	2	1.31	73.10
8622	12	.....do.....	Mastodon Hunt.....	67		38.048	10.15	9.45	4.32	1.67	1.55	72.86
8623	13	.....do.....	Piaso Queen.....	74.49		42.192	10.60	9.80	4.21	2	1.32	72.97
8625	14	.....do.....	Learning corn.....	61.70		33.170	9.58	10.33	4.32	2	1.31	72.46
		Means.....	.....			37.963	10.41	9.54	3.98	1.85	1.36	72.85
1263	3	KENTUCKY. W. F. Knight, Nicholasville.....	White Dent.....	60		46.360	12.19	9.69	4.01	1.82	1.19	71.10
1266	4	M. V. Dulin, Crofton.....	Extra Sweet Bread.....	50		35.789	11.45	11.55	5.06	1.75	1.22	68.97
1275	5	Wm. F. Snelzer, Bellardsville.....	Yellow corn.....	50		48.312	11.41	9.80	4.11	2	1.32	71.36
		Means.....	.....			42.820	11.68	10.35	4.39	1.86	1.24	70.45
a 15780	7	WISCONSIN. Nashold Bros., Rio.....	Red Popcorn.....	80	63	10.608	9.83	10.33	4.59	1.97	1.53	71.75
15808	8	S. D. Owen, Danford.....	Yellow Flint corn.....	b 100	55	37.220	10.50	10.33	4.63	1.50	1.48	71.56
15814	9	H. Pansie, Princeton.....	King Chief Red Winter.....	b 100	57.50	38.803	10.17	9.28	4.74	1.57	1.32	72.96
15882	22	Geo. S. Robertson, Weyanunga.....	White Flint.....	b 100	61	37.753	11.12	10.37	4.39	1.50	1.45	72.37
15967	17	John Specker, Burlington.....	Smutted Flint.....	b 100	61	43.106	11.11	10.50	4.26	1.60	1.34	71.10
15972	16	Andrew Stobbins, Melrose.....	Yellow Dent.....	b 150	56.50	34.981	11.74	10.85	3.93	1.75	1.38	70.35
16064	18	W. H. Welcome, Hancock.....	Squaw Dent.....	b 75	58.25	39.540	11.05	8.75	4.03	1.57	1.34	73.25
		Means.....	.....			37.734	10.94	9.85	4.33	1.58	1.38	71.93
		Total means, United States.....	.....			38.979	10.93	9.88	4.17	1.71	1.36	71.95

b Ears.

a This sample excluded from the averages.

Description and analyses of maize—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		ARGENTINE REPUBLIC.										
23120	21	I. Bataglia, Buenos Ayres.....	Corn.....	Bushels, 83	Pounds, 57	Grams, 25,250	Per ct. 11.36	Per ct. 11.55	Per ct. 4.78	Per ct. 1.92	Per ct. 1.61	Per ct. 68.78
23126	20	Exequiel Belando, Buenos Ayres.....	do.....	88	61	24,046	12.45	11.55	4.38	1.80	1.80	68.02
		Means				24,618	11.91	11.55	4.58	1.86	1.71	68.40
		BULGARIA.										
30569	19	Penkoe M. Vassiltchen, Denagominos....	Corn.....	40	56.61	18,428	12.60	9.98	4.02	2.20	1.26	69.94
		NEW SOUTH WALES.										
5600	6	New South Wales commissioners, Sydney ..	Trophy maize.....	(a)	(a)	46,487	10.43	9.80	4.85	1.57	1.50	71.85
		Total means, foreign corn.....				28,553	11.71	10.72	4.51	1.87	1.54	69.65
		Total means, all corn.....				36,993	11.08	10.04	4.23	1.74	1.39	71.51

a No reliable data.

NOTES ON ANALYSES OF MAIZE.

In regard to the more important constituents, the chief variations noted in the domestic products are as follows: In regard to moisture, both the largest and smallest content were found in samples from Indiana. In regard to the size and weight of the kernels, the finest sample was from Kentucky, in which each grain weighed nearly half a gram. The smallest reported was a Wisconsin sample, but this being one of pop corn could not be compared with the others. The next smallest sample was from Indiana, 100 kernels weighing only 33.045 grams.

In albuminoids Kentucky furnished the sample having the largest quantity and Indiana the smallest. A sample from Kentucky contained the highest percentage of oil and one from Indiana the lowest. The extreme variations in other constituents can be seen from the table below.

Of the foreign exhibits, the sample containing the heaviest and largest kernels was from New South Wales, and the one containing the smallest and lightest from Bulgaria. In moisture the Bulgarian sample occupied first position and one from New South Wales the last. A sample from the Argentine Republic contained the largest percentage of albuminoids and one from New South Wales the smallest. A sample from New South Wales had the highest and one from Bulgaria the lowest content of oil. Following is the table of comparisons of maxima, minima, and means of the samples analyzed from the Columbian Exhibition.

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
	Grams.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Domestic corn:							
Maxima	<i>a</i> 48.312	<i>b</i> 12.32	<i>a</i> 11.55	<i>a</i> 5.06	<i>b</i> 2	<i>b</i> 1.55	<i>b</i> 75.07
Minima	<i>c</i> 10.608	<i>b</i> 9.58	<i>b</i> 8.58	<i>b</i> 2.94	<i>d</i> 1	<i>a</i> 1.19	<i>a</i> 68.97
Means	38.979	10.93	9.88	4.17	1.71	1.36	71.95
Foreign corn:							
Maxima	<i>e</i> 46.487	<i>f</i> 12.60	<i>g</i> 11.55	<i>e</i> 4.85	<i>f</i> 2.20	<i>g</i> 1.80	<i>e</i> 71.85
Minima	<i>f</i> 18.428	<i>e</i> 10.43	<i>e</i> 9.80	<i>f</i> 4.02	<i>e</i> 1.57	<i>f</i> 1.26	<i>g</i> 68.02
Means	28.553	11.71	10.72	4.51	1.87	1.54	69.65
Means of samples from the United States exhibited at the Columbian Exposition (18 analyses)	38.979	10.93	9.88	4.17	1.71	1.36	71.95
Means of foreign samples exhibited at the Columbian Exposition (2 analyses)	28.553	11.71	10.72	4.51	1.87	1.54	69.65
Means of former analyses of the Department of Agriculture:							
United States	(<i>h</i>) 36.474	(<i>j</i>) 10.04	(<i>i</i>) 10.39	(<i>j</i>) 5.20	(<i>j</i>) 2.09	(<i>i</i>) 1.55	(<i>j</i>) 70.69
Northern States	37.320	9.98	10.64	5.11	1.41	1.54	71.32
Southern States	40.659	8.96	10.95	4.94	1.72	1.37	72.06
Middle West	32.457	12.33	10.89	4.97	2.22	1.43	68.16
Far West	37.528	9.50	10.43	5.30	2.47	1.55	70.75
Pacific Slope	27.900	9.78	8.14	6.40	2.07	1.48	72.13
Jenkins and Winton (208 analyses)		10.90	10.50	5.40	2.10	1.50	69.60
König—Mean composition of samples from various localities:							
Miscellaneous origin (137)		13.35	9.45	4.29	2.29	1.29	69.33
Italian samples (24)		13.13	10.26	3.84	2.88	1.95	67.72
American samples (80)		10.02	10.17	4.78	1.67	1.40	68.63
Dent corn (149)		10.14	9.36	4.96	2.21	1.47	68.65
Sugar corn (27)		8.70	11.43	7.79	2.86	1.81	62.76
Southeastern Europe (19)		14.53	9.42	4.13	2.34	1.39	69.37
Southwestern Europe (8)		12.47	8.84	5.80	4.16	2.06	65.79

a Kentucky.
b Indiana.
c Wisconsin

d New Hampshire.
e New South Wales.
Bulgaria.
j 114 analyses,

g Argentine Republic.
h 1211 analyses.
i 202 analyses.

Comparing the means of the analyses of American samples with those of foreign origin, we are again struck with the excess of moisture in the foreign samples. In those from southwestern Europe are found 4 per cent more moisture than in samples of domestic origin. Among the samples grown in the United States, those in the Middle West, viz, Iowa, Missouri, Nebraska, etc., contain the largest amount of moisture, while those grown in the arid region have the smallest amount. Of the domestic samples exhibited at the World's Fair it was found that the mean content of water was 10.93 per cent, nearly 1 per cent higher than the mean of former analyses of the Department. The weight of 100 kernels was a little more than that before found, and this is not a surprising fact, inasmuch as it would be natural for exhibitors to send not only the largest ears but also the largest grains to the Exposition. The percentage of albuminoids in the domestic World's Fair samples was surprisingly low, being about 0.75 per cent less than was found in the work done a few years ago. On the other hand, the percentage of digestible carbohydrates was about one point higher than that obtained in the former work. In the above table will be found a convenient comparison of the means of maize analyses from all parts of the world.

The typical American maize should have approximately the following composition: Weight of 100 kernels, 38 grams; moisture, 10.75 per cent; albuminoids, 10 per cent; oil, 4.25 per cent; fiber, 1.75 per cent; ash, 1.50 per cent; digestible carbohydrates, 71.75 per cent.

OATS.

In the United States, oats are used chiefly for cattle food, and the amount devoted to the manufacture of oatmeal is small compared to the total production. For this reason it seemed advisable to make the analyses on the unhulled samples. The high percentage of crude fiber and ash, therefore, which is found in the analytical tables is due to the fact that the hull was ground with the grain. Former investigations of the Department, recorded in Bulletin No. 9, show that the proportion of kernel to the husk for the United States is as 7 to 3. In the Western States the proportion of kernel is relatively higher and in the Southern States relatively lower. One hundred samples of the hulls of oats, representing all parts of the United States, were found to have the following composition:

	Per cent.
Water	5.22
Ash.....	5.59
Soluble carbohydrates and undetermined.....	68.83
Indigestible fiber	17.88
Albuminoids	2.48

Taking this average composition of the hulls and the proportion of kernel to husk as the basis of computation, it will be possible to calculate the average results for each locality in terms of the kernel alone.

In the following table are contained the results of the analyses of the World's Fair samples arranged by States and foreign countries:

Description and analyses of oats.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per bushel.	Weight of 100 kernels.	Moist- ure.	Albumi- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
				Bushels.	Pounds.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
		COLORADO.									
1969	16	I. S. McClelland, Fort Collins	Black Tartarian	40	2,586	8.23	12.08	4.22	12.19	4.08	59.20
1973	17	D. C. Travis, San Isabel	World's Wonder	136	3,462	8	12.43	4.24	13.73	4.11	55.49
		Means			3,024	8.12	12.26	4.23	13.96	4.09	57.34
		ILLINOIS.									
9666	39	T. P. Chester, Champaign	Russian oats	73.5	2,448	11.01	11.90	3.29	12.75	3.62	57.43
9668	40	do	White Chief	67	2,570	10.93	11.20	3.67	12	3.80	58.40
9669	41	do	White Bonanza	71	2,433	9.58	10.68	3.46	15.85	3.36	57.07
9670	42	do	Black Tartarian	70	38.50	9.19	12.78	3.48	13.90	4.20	56.45
9706	9	University of Illinois, Champaign	Wide Awake oats	44	2,950	9.26	14.53	3.78	12.96	3.92	56.55
9713	10	do	Pride of Grant County	61	2,722	8.14	12.78	4.10	11.86	3.67	59.85
1787	11	Robert Shedd, Pingree Grove	Black Highlands	64	2,722	8.95	9.63	4.02	12.83	3.73	60.74
1788	12	do	Race Horse White	53	2,993	9.60	14.18	3.94	12.26	2.87	57.15
1789	13	do	Prize Chester	56	3,302	9.54	10.15	5.09	11.06	2.72	61.44
17792	14	do	Black Tartarian	48	38.50	9.75	9.10	4.03	13.03	3.77	60.32
		Means			2,684	9.59	11.69	3.89	12.82	3.47	58.54
		INDIANA.									
8570	34	F. C. Huntington, Indianapolis	W. Scotch Superior	70	2,751	9.33	12.43	4.10	13.75	3	57.39
8571	35	John Marvel, Indianapolis	White Belgian	60	2,526	9.07	12.78	4.44	13.75	2.92	57.04
8573	36	Ellis Parke, Crawfordsville	Prize Cluster	50	2,829	8.69	12.78	4.28	13.97	3.01	57.27
8723	37	Indiana Experiment Station, Lafayette	White Bonanza	38	2,780	9.05	13.30	4.19	14.62	2.99	55.85
8729	38	do	American Banner	43	2,475	10.04	12.25	3.27	14.15	3.85	56.44
		Means			2,672	9.24	12.71	4.06	14.05	3.15	56.79
		IOWA.									
3770	8	L. G. Clute & Sons, Credeley	Badger Queen	67	3,255	8.30	10.68	4.44	15.23	3.81	57.54
		KANSAS.									
88	44	H. W. Hoffman, Salina	Black oats	62	2,789	11.46	11.55	5.57	8.62	2.91	59.89
89	43	A. C. Rait, Junction City	Red oats	54	3,415	9.61	13.48	4.82	8.57	3.71	59.81
90	45	N. J. Dalton, Topeka	do	58	3,707	11	10.85	4.95	12.10	3.99	57.11
91	46	Thos. Anderson, Salina	Black oats	35	2,323	10.84	11.90	6	8.82	3.72	58.72
94	47	W. S. Lower, Halton	Red oats		3,810	9.12	12.17	4.72	11.30	4	58.69

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield Bushels per acre.	Weight per bushel Pounds.	Weight of 100 kernels Grams.	Moist- ure Per cent.	Albumi- noids Per cent.	Ether extract Per cent.	Crude fiber Per cent.	Ash Per cent.	Carbo- hydrates Per cent.
KANSAS—continued.												
95	48	F. Fry, Salina.....	Red oats.....	.....	.....	3.194	10.61	12.69	5.08	10.07	4.03	57.52
96	1	James Sullivan.....	Black oats.....	50	39	2.985	9.80	13.13	5.66	8.71	3.60	50.10
97	2	J. E. Knox, Manhattan.....	Red oats.....	60	39	2.877	9.11	12.08	4.10	13.78	3.67	57.26
98	3	W. G. Swift, Clay Center.....	Black oats.....	55	40	2.075	9.15	13.48	6.14	8.90	3.70	58.63
99	4	L. Landren, Russell.....	White oats.....	48	39	3.075	9.68	13.05	4.07	10.20	3.62	57.38
100	49	Erick Urburg, Clay Center.....	Red oats.....	60	38	3.054	11.70	11.73	5.28	9	3.97	58.32
		Means.....	.....	.....	.....	2.920	10.19	12.55	5.12	10.01	3.72	58.40
KENTUCKY.												
1250	27	C. B. Eaton, Winchester.....	White.....	.....	.....	2.927	10.83	11.38	4.03	11.97	4.20	57.59
1190	26	Kentucky Agricultural Experiment Station, Lexington.....	Badger Queen.....	.....	.....	2.095	10.96	11.64	4.66	11.52	3.80	57.42
1194	5	.....do.....	Golden Giant.....	42	.....	2.116	8.77	13.48	4.13	13.32	3.18	57.12
1195	6	.....do.....	Welcomer oats.....	.....	.....	2.479	8.85	11.73	4.60	12.57	3.24	59.01
		Means.....	.....	.....	.....	2.254	9.85	12.06	4.35	12.35	3.60	57.78
MICHIGAN.												
21247	66	David Woodman, Paw Paw.....	White Russian.....	45	40	3.294	11.63	12.25	4.15	12.35	2.86	56.76
21250	60	.....do.....	Common White oats.....	54	40	3.410	11.42	12.78	4.07	12.32	2.77	56.64
21273	57	.....do.....	Dakota oats.....	50	40	3.306	11.13	12.78	4.06	12	2.89	57.14
21287	69	.....do.....	Potato oats.....	60	33.50	2.516	12.15	14	3.66	12.45	3.14	53.70
21291	62	.....do.....	Common White oats.....	60	42	3.352	10.20	12.95	4.76	11.65	2.86	57.58
		Means.....	.....	.....	.....	3.176	11.43	12.95	4.14	12.25	2.90	56.36
OHIO.												
11111	67	Eli Cubertson, Grand Rapids.....	Monarch.....	58	.....	2.620	11.17	12.25	4.15	13.50	3.24	55.69
11117	64	Thos. Crofts, Toledo.....	Early Prize Cluster.....	60	34	2.197	7.87	13.65	4.10	12.50	3.06	58.82
		Means.....	.....	.....	.....	2.405	9.52	12.95	4.13	13	3.15	57.26
PENNSYLVANIA.												
2890	28	Samuel Wilson, Mechanicsville.....	White Bonanza.....	68.5	40	2.613	10.75	14.36	3.88	13.64	3.46	53.91
6468	29	Michael Gibson, Mansfield.....	Oats.....	.....	.....	2.530	11.17	11.90	3.38	12.82	3.03	57.70
6470	30	W. H. Harnish, Waterstreet.....	.....do.....	40	37	2.606	11.05	12.25	3.77	12.17	3.42	57.34

6471	31	Peter Hoffmann, Scalpnel.....do	40	40	2,249	10.33	11.90	4.35	11.25	2.94	59.23
6479	7	M. M. Nagney, Milroy.....do	50	41	2,564	8.15	12.08	3.65	13.43	2.94	59.75
6480	32	W. H. Nesbit, Milton.....do	50	41	2,974	9.51	12.25	4.51	12.80	2.47	58.46
		Means			2,589	10.16	12.46	3.92	12.68	3.04	57.73
		WASHINGTON.									
13925	54	W. O. Bush, Olympia.....do	50 to 100	35 to 45	3,891	13.02	11.03		(9)	3.18	
13928	59	.....do	50 to 100	35 to 45	3,811	10.82	11.03		.93	16.65	57.79
		WISCONSIN.									
15536	70	A. Guster, Beaver Dam			2,843	11.65	10.68	4.27	11.17	3.15	59.08
		WYOMING.									
14066	56	Wyoming Experiment Farm, Lander.....	46		3,435	11.05	10.15	4.94	10.75	4.37	58.74
14068	68	W. A. Sonnesberger, Buffalo.....do	68	38, 50	2,359	10.97	10.33	4.91	9.37	3.92	60.50
14069	52	.....do	96	43, 50	3,526	10.59	11.90	4.50	12.75	3.91	56.26
14072	50	Wyoming Experiment Farm, Laramie.....	26	41	2,938	11.57	10.77	4.39	9.37	3.75	59.55
14074	63	A. A. Lambrieger, Big Horn.....do	100	42	3,231	9.82	12.60	5.01	9.87	4.	58.70
14082	61	.....do	80	45	3,742	10.86	11.55		(9)	3.53	
14086	55	Wyoming Experiment Farm, Lander.....	65	41	3,282	11.23	10.50	5.66	9.07	3.83	59.71
14088	53	A. A. Lambrieger, Big Horn.....	60	45	3,470	10.50	12.60	4.29	11.17	3.65	57.79
		Means			3,248	10.82	11.26	4.91	10.33	3.92	58.75
		Total means, United States.....			2,918	10.06	12.15	4.33	12.07	3.46	57.93
		CANADA.									
7802	15	Ontario Agricultural College, Guelph, Ontario.			3,871	9.27	11.73	4.09	13.48	2.95	58.48
8423	18	I. E. Richardson, Blenheim.....	50		3,390	9.43	11.47	4.36	13	2.86	58.88
8431	19	Gaylord Greenman, Charlotteville.....	50		2,791	9.21	10.73	5.56	8.60	2.92	61.98
8433	20	J. E. Richardson, Blenheim.....	60		3,750	9.20	10.63	4.29	13.80	3.29	58.65
8434	21	Richard J. Wilson, Trafalgar.....	70		3,076	8.87	11.55	5.49	8.52	3.16	61.35
8437	22	George Baker, Woodhouse.....	65		3,278	8.83	11.38	3.93	14.25	3.15	58.45
8445	23	A. G. Meisner, Gainsborough, Ontario.....	55		2,912	8.55	12.08	4.07	13.36	2.99	59.04
8446	24	George Baker, Woodhouse.....	60		3,092	8.52	11.20	3.79	15.65	3.23	57.61
8452	25	George Padget, Markham, Ontario.....	50		4,253	9.21	12.25	4.80	11.62	2.71	59.31
8471	33	D. Alton, McDonald.....do	50		3,698	10.16	12.78	4.27	12.27	2.87	57.65
12250	71	L. Wilson, Fergus, Ontario.....				9.65	14.18	6.63	1.12	1.94	66.48
30136	51	W. W. Wainan, Souris, Manitoba.....	55		2,895	11.63	11.03	4.96	11	2.97	58.41
		Means			3,364	9.46	11.83	4.73	11.39	2.92	59.69
		GREAT BRITAIN.									
26583	65	Kean, Robinson & Belleville, London.....			3,242	10.29	10.68	6.21	9.40	2.75	60.67
		Total means, foreign oats.....			3,254	9.52	11.75	4.84	11.24	2.91	59.76
		Total means, all oats.....			2,995	9.96	12.07	4.42	11.92	3.35	58.28

a Nos. 13925 and 14082 excluded from the means. *b* Sample lost.

NOTES ON ANALYSES OF OATS.

For comparing the results of these analyses with those heretofore made by this Department and in other places the table of maxima, minima, and means is inserted below.

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbo-hydrates.
	Grams.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Domestic oats:							
Maxima	a 3.891	a 13.02	b 15.95	b 6.14	a 16.65	c 4.37	d 61.44
Minima	d 2.038	e 7.87	d 9.10	a .93	b 8.57	f 2.47	g 53.70
Means	2.918	10.06	12.15	4.33	12.07	3.46	58.75
Canada:							
Maxima	4.253	11.63	12.78	5.56	15.65	3.29	61.98
Minima	2.791	8.52	10.68	3.79	8.52	2.71	57.61
Means	3.364	9.46	11.83	4.73	11.39	2.92	59.69
Means of World's Fair samples (72 analyses)	2.995	9.96	12.07	4.42	11.92	3.35	58.28
Means of samples previously analyzed by Department of Agriculture—hulled—(179 analyses)	h 2.507	6.93	14.31	8.14	1.38	2.15	67.09
Means of Jenkins and Winton (30 analyses)		11	11.80	5	9.50	3	59.70
König—mean composition of samples from various localities:							
Miscellaneous (377)		12.11	10.66	4.99	10.58	3.29	58.37
Middle and north Germany (31)		12.45	10.82	5.30	10.25	3.29	58.23
Southern and southwestern Germany (16)		13.39	11.36	5.30	9.93	3.18	58.12
Austro-Hungary (14)		11.85	11.41	5.84	11.01	3.23	56.40
France (196)		13.50	9.52	3.46	9.18	3.26	62.47
United States (22)		12.11	10.11	6.24	9.33	2.99	68.61
a Washington.	c Wyoming.	e Ohio.	g Michigan.				
b Kansas.	d Illinois.	f Pennsylvania.	h Unhulled.				

In discussing the comparative results contained in the above table, it will be noticed at once that the samples examined at the World's Fair contained much less water than those reported by König. These samples were almost wholly of domestic origin, and thus show that the oats follow the other cereals which have been mentioned in having a less quantity of moisture when grown in the United States. The percentage of indigestible fiber also appears to be somewhat larger than of other sets of samples. This may be due to the fact that naturally the largest and finest looking kernels would be selected for exhibition and the hulls of these kernels would be correspondingly developed. In the samples formerly examined by the Department of Agriculture we find the same striking deficit in moisture that has been noticed in the other cereals and the consequent increase in the percentage of other constituents, notably albuminoids and oil. It must not be forgotten, however, that these samples can not be compared with the other sets in the series, because the hulls of the kernels were removed before the analyses were made. Taking into consideration all the data at hand, it may be said that the typical oats of the United States may be described as follows: One hundred kernels of the unhulled oats will weigh 3 grams and will consist of 2.1 grams kernels and 0.9 gram hulls. The sample would contain in its normal state 10 per cent of water, 12 per cent of albumi-

noid matters, 4.5 per cent of fat, 12 per cent of indigestible fiber, 3.5 per cent of ash, and 58 per cent of starch and other soluble carbohydrates.

RICE.

It is rather difficult from the data accessible to draw any valuable conclusions in regard to the composition of rice. This cereal may reach the analyst in three different states, viz, unhulled, hulled, and polished. He may also have occasion to examine the broken fragments produced in polishing and hulling, the waste in manufacture, rice bran, and other products. The most important of these products are the unhulled and polished rice—in the one case the product as it comes from the thrasher and in the other as prepared for the kitchen.

The number of samples of all kinds delivered by the judges for analysis was only 28, of which only a few were domestic samples. The composition of these samples, arranged by classes and countries, is shown in the table on the following page.

Description and analyses of rice.

I. RICE IN THE HULL.

Bureau of awards No.	Lab- oratory No.	Grower.	Foreign or domestic.	Variety.	Yield per acre.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
					Bushels.	Grams.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
17825	24	Robert Sheddlen, Pingree Grove, Ill.	Domestic	Upland rice.	.....	2,782	11.48	6.83	1.48	9.82	4.02	66.37
22221	26	Antonio Lapollon, Santa Rosa, Suchitepequez, Guatemala.	Foreign	.....	.....	2,845	9.03	8.23	1.64	10.95	4.45	65.70
22232	25	Tarjados de Leon, Santa Isabella, Suchitepequez, Guatemala.	do	.....	.....	3,250	9.10	8.32	1.44	11.47	4.66	65.01
		Means	.....	.....	.....	3,048	9.07	8.28	1.54	11.21	4.56	65.35
29561A	23	Government of Johore, Johore.	Foreign	Galak cleaned rice in hulls.	.....	2,842	11.52	8.40	2.04	9.45	3.26	65.33
		Means of foreign rice.	.....	.....	.....	2,979	9.88	8.32	1.71	10.62	4.12	65.35
		Means of all rice.	.....	.....	.....	2,929	10.28	7.95	1.65	10.42	4.09	65.60

II. UNPOLISHED RICE.

9105	1	Issei Nagano, Kumamoto, Japan.	Foreign	.....	40 to 52	2,446	12.57	7.27	1.75	0.90	1.16	76.25
9107	2	Tsumaki Tsubinoye, Kumamoto, Japan.	do	.....	.....	2,826	12.22	7.35	1.62	.90	1.21	76.67
9108	3	Kan Gijokai, Kumamoto, Japan.	do	.....	.....	2,389	11.67	7.53	1.90	.92	1.22	76.76
9413	12	Taihei Watanabe, Ehime, Japan.	do	.....	.....	2,598	10.92	7.33	2.04	1	1.17	77.34
9416	13	J. Ishinari, Toyumaken, Japan.	do	.....	.....	2,277	12.02	7.92	2.18	.87	1.10	73.91
9479	14	Shosuko Sato, Hokkaido, Japan.	do	.....	38, 50	2,250	11.88	10.50	2.26	.97	1.04	73.35
		Means	.....	.....	.....	2,466	11.88	8.02	1.96	.93	1.15	76.05

NOTES ON ANALYSES OF RICE.

As in the case of the preceding cereals, it will be of interest here to compare the mean results of the analyses carried on with the World's Fair samples with those on record in other places. In the case of the World's Fair samples, the maxima and minima as well as the means are given as before, while in other cases only the means are recorded.

Table of maxima, minima, and means.

RICE.

	Weight of 100 kernels.	Moisture.	Albumi- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
I. Rice in the hull (foreign):	<i>Grams.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Maxima.....	a 3.250	b 11.52	b 8.40	b 2.04	b 11.47	a 4.66	a 65.70
Minima.....	b 2.842	a 9.03	a 8.23	a 1.44	b 9.45	b 3.26	a 65.01
Means.....	2.979	9.88	8.32	1.71	10.62	4.12	65.35
II. Unpolished rice (foreign):							
Maxima.....	c 2.826	c 12.57	c 10.50	c 2.26	c 1	c 1.22	c 77.34
Minima.....	c 2.260	c 10.92	c 7.27	c 1.62	c .87	c 1.04	c 73.35
Means.....	2.466	11.88	8.02	1.96	.93	1.15	76.05
III. Polished rice (foreign):							
Maxima.....	b 2.633	b 13.15	b 10.33	c .54	a .56	a .65	c 81.66
Minima.....	a 1.560	c 11.82	c 5.42	c .04	a .27	c .28	b 75.02
Means.....	2.132	12.34	7.18	.26	.40	.46	79.36
Mean composition of polished rice, etc., as given by Jen- kins and Winton:							
Polished rice (10 samples).....		12.40	7.40	.40	.20	.40	79.20
Rice bran (5 samples).....		9.70	12.10	10.90	9.50	10	49.90
Rice hulls (3 samples).....		8.20	3.60	.70	35.70	13.20	38.60
Rice polish (4 samples).....		10	11.70	7.30	6.30	6.70	58
Mean composition of rice, etc., as given by König:							
Unhulled rice (3 samples).....		11.99	6.48	1.65	6.48	3.33	70.07
Hulled rice (41 samples).....		12.58	6.73	1.88	1.53	.82	76.46
Polished rice (9 samples).....		12.52	7.52	.84	.48	.64	78
Means of World's Fair sam- ples:							
Unhulled rice (4 samples).....	2.929	10.28	7.95	1.65	10.42	4.09	65.60
Unpolished rice (6 sam- ples).....	2.466	11.88	8.02	1.96	.93	1.15	76.05
Polished rice (14 samples).....	2.132	12.34	7.18	.26	.40	.46	79.36

a Guatemala.

b Johore.

c Japan.

The mean composition of the different classes of rice as shown by the analyses of the World's Fair samples is almost the same as that shown by the work of other analysts collated as indicated above. A typical unhulled rice will have about the following composition:

Weight of 100 kernels.....	grams.:	3.00
Moisture.....	per cent..	10.50
Albuminoids.....	do.....	7.50
Fat.....	do.....	1.60
Fiber.....	do.....	9
Ash.....	do.....	4
Carbohydrates.....	do.....	67.40

A typical hulled rice, but unpolished, would have about the following composition:

Weight of 100 kernels.....	grams..	2.50
Moisture.....	per cent..	12
Albuminoids.....	do.....	8
Fat.....	do.....	2
Fiber.....	do.....	1
Ash.....	do.....	1
Carbohydrates.....	do.....	76

A typical polished rice would have a composition represented by the following numbers:

Weight of 100 kernels.....	grams..	2.20
Moisture	per cent..	12.40
Albuminoids	do....	7.50
Fat	do....	.40
Fiber	do....	.40
Ash	do....	.50
Carbohydrates.....	do....	78.80

RYE.

The number of samples of domestic rye offered for examination and analysis was 18, and of foreign ryes, 2. The samples offered were presumably the best that came into the hands of the judges as far as could be determined by external appearance. Their composition, as revealed by the chemical analysis, is given in the following table:

Description and analyses of rye.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moist- ure.	Albu- minoids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.
		ILLINOIS.		Bushels.	Pounds.	Grams.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
9671	20	T. P. Chester, Champaign.....	White rye.....	32	52	1,932	11.05	11.55	1.68	2.15	1.71	71.86
9672	21	do.....	Giant rye.....	32	52	2,408	10.80	11.55	1.44	2.45	1.80	71.87
17820	4	O. L. Campbell, Knoxville.....	White rye.....	.....	.....	1,932	12	11.90	1.59	1.77	1.88	70.86
17821	5	Robert Sheddon, Pingree Grove.....	Dusburg rye.....	.....	.....	3,000	11.19	18.99	2.15	1.65	2.41	63.61
17822	7	do.....	White Spring rye.....	30	58	4,201	9.54	17.77	1.16	2.12	1.99	67.42
17823	6	do.....	St. John's rye.....	27	58	2,472	11.42	13.13	1.42	2.17	1.93	69.90
		Means.....	.....	.....	.....	2,767	11.02	14.15	1.57	2.05	1.95	69.25
		MICHIGAN.										
20502	22	A. C. Titus, Fitchburg.....	.....	.....	.....	2,215	10.38	12.60	1.51	2.15	1.90	71.49
		MINNESOTA.										
2331	14	Peter Anderson, Toklad.....	White rye.....	30	56	2,224	10.13	13.13	1.79	2.27	1.90	70.78
2382	15	Francis Dick, Afton.....	Winter rye.....	30	.....	2,177	9.91	13.65	2.11	2.32	1.91	70.10
2446	16	Wm. Reuther, Red Wing.....	White Winter rye.....	56	57.50	2,289	10.35	13.65	1.56	2.25	1.81	70.38
2458	17	Thos. Sanders, Warren.....	do.....	.....	.....	2,234	10.25	13.30	1.61	2.42	1.99	70.43
		Means.....	.....	.....	.....	2,231	10.16	13.43	1.77	2.32	1.90	70.42
		NEW HAMPSHIRE.										
379	1	Edwin T. Evans, Rochester.....	Winter rye.....	26	(a)	2,442	10	11.03	1.58	2.50	2.09	72.80
380	23	Merrill Moore, Northfield.....	Rye.....	22	60	2,528	10.26	11.47	1.28	2	1.99	73
382	2	C. W. T. Spiller, Pittsfield.....	Winter rye.....	25	60	2,022	9.77	9.80	1.69	1.75	1.80	75.19
		Means.....	.....	.....	.....	2,331	10.01	10.77	1.52	2.08	1.96	73.66
		NEW YORK.										
4216	10	John W. Jones, Elmira.....	White Winter.....	28	62.25	2,841	11.05	9.98	1.50	1.65	1.88	73.94
4241	11	Alexander B. Stewart, Ballston Center.....	Black Winter.....	.....	.....	2,247	10.50	10.68	2.30	2.10	1.89	72.53
		Means.....	.....	.....	.....	2,544	10.78	10.33	1.90	1.88	1.89	73.24
		OREGON.										
3259	8	M. Wilkins, Coburg.....	White rye.....	.....	.....	2,829	10.81	8.40	1.65	1.97	1.81	75.36

2883	PENNSYLVANIA. 19 Samuel Wilson, Mechanicsville.....	Pennsylvania Mammoth White.....	38.50	60	2.332	11.10	11.20	1.65	1.97	1.96	73.12
	Total means, United States.....				2.493	10.62	12.43	1.65	2.09	1.92	71.37
28245	BRAZIL. 26 Comm. Mines, Ouro Preto.....	Rye.....			2.031	14.10	12.25	.37	2.25	1.95	69.08
30499	SPAIN. 25 Giraldo Cerespo (Eusebio), Medina del Campo.....	Rye.....			3.417	10.74	9.28	1.61	1.75	1.88	74.74
	Total means, foreign rye.....				2.724	12.42	10.77	.99	2	1.92	71.91
	Total means, all rye.....				2.516	10.77	12.26	1.58	2.08	1.92	71.42

a Over standard.

NOTES ON ANALYSES OF RYE.

For a comparison, the data collected by former analyses of the Department, and in the works already noted, follow:

Table of maxima, minima, and means.

RYE.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbo-hydrates.
Domestic:	<i>Grams.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Maxima.....	a 4.201	a 11.45	a 18.99	b 2.30	c 2.50	a 2.41	d 75.36
Minima.....	a 1.932	a 9.54	d 8.40	a 1.16	a 1.65	a 1.71	a 63.61
Means.....	2.493	10.62	12.43	1.65	2.09	1.92	71.37
Foreign:							
Maxima.....	e 3.417	f 14.10	f 12.25	e 1.61	f 2.25	f 1.95	e 74.74
Minima.....	f 2.031	e 10.74	e 9.28	f .37	e 1.75	e 1.88	f 69.08
Means.....	2.724	12.42	10.77	.99	2	1.92	71.91
Means of World's Fair samples:							
Domestic samples (18)....	2.493	10.62	12.43	1.65	2.09	1.92	71.37
All samples (20).....	2.516	10.77	12.26	1.58	2.08	1.92	71.42
Means of previous analyses by the Department (57 samples).....	2.070	8.67	11.32	1.94	1.46	2.09	74.52
Means given by Jenkins and Winton (6 samples).....		11.60	10.60	1.70	1.70	1.90	72.50
Means given by König:							
Miscellaneous (173).....		11.15	10.81	1.77	1.78	2.06	70.21
Spring rye (11).....		12	12.90	1.98	1.71	1.93	68.11
North Germany (27).....		14.84	11.01	1.70	2.17	1.97	69.78
South Germany (36).....		12.31	12.04	1.98	2.73	1.91	67.97
Sweden (3).....		14.29	8.50	2.29	1.47	2.11	71.34
All Germany (63).....		13.37	11.52	1.84	2.45	1.94	68.88

a Illinois. b New York. c New Hampshire. d Oregon. e Spain. f Brazil.

We see again, in the comparison of the means, the greater dryness of the United States ryes. This is, as has been the case heretofore in the cereals already mentioned, especially marked in the analyses made a few years ago by the Department. In the World's Fair samples the difference is less marked, the percentage of moisture being almost as high as in the foreign samples.

The United States ryes are also distinguished by their smaller kernels. Even the samples on exhibition in Chicago, which were presumably those of the finest and plumpest kernels, were not nearly so large as the kernels of the foreign samples. They were, however, distinctly larger and heavier than the kernels analyzed here a few years ago.

In the percentage of albuminoids the United States samples are fully equivalent to those of foreign origin and in their mean composition their other constituents do not differ greatly from those of standard varieties abroad. The cultivation of rye is not very extensively practiced in the United States and that which is grown is used chiefly for the manufacture of whisky and for cattle food, and not for bread making, as is the case in Europe.

A typical American rye would have approximately the following composition: Weight of 100 kernels, 2.5 grams; moisture, 10.50 per cent; albuminoids, 12.25 per cent; oil, 1.50 per cent; fiber, 2.10 per cent; ash, 1.90 per cent; digestible carbohydrates, 71.75 per cent.

WHEAT.

The number of samples of domestic wheat submitted for examination by the judges of awards was 166. These samples were distributed among the various States, as follows:

Colorado, 5 samples; Illinois, 22 samples; Indiana, 8 samples; Iowa, 1 sample; Kansas, 28 samples; Kentucky, 4 samples; Maine, 1 sample; Michigan, 6 samples; Missouri, 1 sample; Montana, 2 samples; Nebraska, 5 samples; New York, 8 samples; North Carolina, 2 samples; Ohio, 3 samples; Oregon, 11 samples; Pennsylvania, 12 samples; South Dakota, 8 samples; Washington, 11 samples; West Virginia, 5 samples; Wisconsin, 5 samples; Wyoming, 7 samples.

Of foreign wheats the total number of samples offered for examination was 62. These samples were distributed as follows:

Argentine Republic, 5 samples; Australia, 4 samples; Bulgaria, 1 sample; Canada, 49 samples; Costa Rica, 2 samples; Spain, 1 sample.

The results of the analyses are recorded in the following tables:

Description and analyses of wheat.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moist- ure.	Albumi- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.	Wet gluten.	Dry gluten.
COLORADO.														
1948	45	T. L. Tracey, Hygiene.....	Polish.....	35	60	3.419	10.15	15.23	1.67	2.62	1.97	68.36	33.04	12.95
1950	46	D. Leathenq, Lamar.....	Red Chaff.....	25	61	2.519	9.66	12.78	2.11	2.45	1.84	70.50	27.73	10.70
1953	48	L. S. McCalland, Fort Collins.....	Australian Club.....	22	60	5.100	9.67	12.08	1.93	2.67	1.87	71.80	27.01	10.53
1955	49	Sylvester & Son, Monte Vista.....	Ruby No. 16.....	30	60	5.103	9.71	14.35	1.73	2.72	1.94	69.55	31.92	12.17
1957	50	L. S. McClelland, Fort Collins.....	Saxon Flie.....	30	60	3.280	8.13	13.83	2.26	2.75	1.82	71.21	31.61	11.93
		Means.....	.....	.....	.....	4.302	9.46	13.65	1.94	2.74	1.92	70.28	30.26	11.66
ILLINOIS.														
9698	12	University of Illinois, Cham- paign.	Dietz Long Bearded Red..	30	55	3.048	11.84	13.65	1.66	2.67	2.03	68.15	31.67	12.45
13447	192	Robert Sheelton, Pingree Grove.	Champion White Winter, No. 1.	49	62	4.539	8.64	10.50	1.95	1.87	1.75	75.30	25.54	10.10
13448	189	.....	Imperial White Winter...	63	62.75	4.727	10.35	11.03	1.66	2.12	1.81	73.03	22.61	9.02
17669	13	.....	Prince Champion.....	43	63	5.537	12	11.03	1.59	2.19	1.62	71.57	24.33	9.57
17670	14	.....	Handcastle.....	42	64	4.680	11.53	10.50	1.85	2.25	1.72	72.15	22.40	8.88
17673	15	.....	Pride of the Market.....	56	64	4.195	12.22	10.85	1.79	2.80	1.67	70.69	23.41	9.32
17678	16	.....	Scottish Chief Red.....	55.50	64	3.958	12.72	10.68	1.80	2.92	1.78	70.70	23.45	9.32
17679	17	.....	Flour Ball.....	63.50	64	5.703	12.68	11.38	1.58	2.95	1.70	70.41	25.43	9.78
17691	151	.....	Ontario Red.....	57	65.50	4.969	9.93	11.03	1.39	2.05	1.71	73.78	22.26	8.63
17695	158	.....	Proflie.....	36	62	4.380	13	12.95	1.39	2.72	1.85	67.89	28.23	10.78
17703	152	.....	Pride of the Market.....	36	60	4.262	9.71	16.85	1.66	2.07	1.77	73.91	21.72	8.65
17704	153	.....	Jones Winter Flie.....	40	62	4.542	8.66	11.20	1.54	2.02	1.88	74.70	20.55	8.32
17705	154	.....	Holborn Wonder.....	53	60	4.113	8.47	11.73	1.24	2.05	1.71	74.80	21.80	10.61
17707	155	.....	Prize Champion.....	.....	.....	4.380	8.19	11.38	1.90	2.20	1.84	74.49	23.05	9.20
17708	156	.....	Red River Club.....	38	61	2.571	7.97	15.93	2.09	3.15	2.16	68.69	32.11	12.75
17718	157	.....	French Imperial.....	35	60	2.195	7.95	13.13	2.08	2.97	2.06	71.81	25.05	10.08
17718	41	.....	Kissinland Red.....	58	62.50	4.435	9.57	11.20	1.67	2.35	1.75	73.46	23.21	9.23
17727	42	.....	Japan Amber.....	33.50	63	3.717	9.60	11.90	1.70	2.50	1.43	72.87	27.77	10.39
17730	43	.....	March Bronze.....	32	63	4.404	9.18	13.30	1.65	3	2.02	70.85	27.55	10.51
10760	159	.....	Red Prize Spring.....	40	68	4.544	12.76	11.20	1.52	2.37	1.73	70.79	26.68	9.44
10765	160	.....	Redgreen S.....	43	65	4.467	12.85	11.20	1.59	2.37	1.79	70.20	16.68	6.55
10766	161	.....	Square Head.....	40	68	4.377	13.06	12.25	1.51	2.62	1.86	68.67	24.34	9.69
		Mean.....	.....	.....	.....	4.255	10.59	11.76	1.69	2.39	1.80	71.77	24.40	9.69

INDIANA.		Pool	60	3,450	11.25	10.85	1.97	2.17	1.87	71.92	22.80	8.75
8523	James Riley, Thorntown	.....	30	3,450	10.78	12.25	1.56	2.47	1.78	71.16	26.36	10.15
8525	J. N. Barker, Thorntown	.....	38	4,985	10.38	11.73	1.87	2.55	1.86	71.61	27.35	10.59
8532	James Riley, Thorntown	.....	40	3,402	10.90	11.90	1.52	2.25	1.85	71.58	27.18	10.61
8553	John Barry, Perr.	.....	25	3,628	10.74	12.43	1.83	2.10	1.83	71.07	27.30	10.47
8557	James Riley, Thorntown	.....	40	3,637	10.74	12.43	1.83	2.10	1.83	71.07	27.30	10.47
54	.....do	.....	40	4,186	13.10	14.18	1.44	2.37	1.76	67.15	27.51	10.85
8559	Dial Mediterranean	.....	40	3,844	10.17	12.08	1.68	2.45	1.81	71.81	24.06	9.47
8561	Mrs. S. Hodges, Rockport	.....	40	3,908	12.16	11.63	1.83	3.05	1.79	70.14	24.78	9.46
8077	James Riley, Thorntown	.....	36	3,908	12.16	11.63	1.83	3.05	1.79	70.14	24.78	9.46
Means		.....	.....	3,680	11.19	12.05	1.71	2.42	1.82	70.81	25.92	10.04
IOWA.		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3098	L. G. Clute, Greeley, Iowa	.....	32	3,874	11.90	16.01	1.77	2.20	1.45	66.67	33.44	13.80
KANSAS.		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1	A. Shrieve, Wamego, Kans.	.....	42.50	2,504	13.02	14.18	1.59	2.57	1.70	66.94	33.25	12.20
2	L. Landon, Kassel, Kans.	.....	18.50	2,965	7.75	13.30	1.84	2.25	1.81	73.05	30.98	11.55
3	N. J. Dalton, Topeka, Kans.	.....	30	3,472	8.96	12.95	1.52	2.87	1.94	71.96	30.80	11.28
5	Cyrus Wray, Salina, Kans.	.....	36	3,374	8.35	12.43	1.91	2.22	1.99	72.50	28.14	11.20
6	G. B. Donneyer, Cambria, Kans.	.....	42.75	3,821	9.49	12.43	1.84	2.32	1.91	72.01	30.40	11.34
7	H. W. Hoffman, Salina, Kans.	.....	36	3,127	10.09	11.55	1.87	2.07	1.69	72.73	27.20	9.87
8	W. S. Lower, Haltom, Kans.	.....	39.50	4,446	12.75	12.95	1.60	1.70	1.82	69.18	29.30	10.55
9	S. H. Cramer, Ottawa, Kans.	.....	45.70	3,308	9.23	12.25	1.62	2.62	2.10	72.78	28.25	11.01
10	I. H. Sayles, Norcut, Kans.	.....	45	3,252	10.86	10.50	1.82	2.12	2.02	72.68	22.36	8.45
11	G. V. Johnson, Willis, Kans.	.....	42.17	3,624	8.85	12.78	1.69	2.20	2.04	72.44	30.64	11.71
12	P. E. Butler, Glasco, Kans.	.....	34	4,408	8.81	11.75	1.80	2.55	1.96	73.66	30.80	11.15
13	B. D. Franch, Concordia, Kans.	.....	38	3,323	9.63	11.55	2.26	2.30	1.95	72.91	26.30	10.45
14	Wm. Rundell, Clay Centre, Kans.	.....	35	3,270*	8.51	14	1.81	3.12	1.95	70.61	32.82	12.35
16	W. W. Eddie, Marysville, Kans.	.....	33	3,565*	8.47	14.18	1.91	2.25	1.97	71.22	31.85	12.34
17	A. Anderson, Marysville, Kans.	.....	38	3,081	7.97	11.73	2.02	2.35	1.91	74.02	26.88	9.94
18	L. L. Johnson, Marysville, Kans.	.....	30	3,305	7.78	10.85	1.55	2.42	1.96	75.44	22.87	9.02
19	Godlieb Adam, Marysville, Kans.	.....	40	3,732	9.44	11.90	1.90	2.12	2	.....	29	11.36
20	Frank de Long, Belleville, Kans.	.....	(a)	3,649	9.38	11.55	1.70	2.20	1.84	73.33	23.17	8.34
21	A. C. Raft, Junction City, Kans.	.....	38	3,437	12.18	11.21	1.27	2.40	2.05	70.89	21.86	9.72
22	W. H. Smith, Topeka, Kans.	.....	38	3,311	.....	.....	.....	.....	.....	.....	.....	.....
23	Thos. Gillespie, Salina, Kans.	.....	39	3,046	12.58	11.29	1.54	2.25	1.63	70.50	23.45	9.11
24	S. T. Collins, Belleville, Kans.	.....	38	3,088	12.05	10.85	1.74	3.12	1.86	70.38	21.11	8.30
25	H. A. Houston, Junction City, Kans.	.....	40	3,245	12.12	12.50	1.69	2.67	1.77	69.25	29.61	11.11
26	John Luster, Lima, Kans.	.....	32.50	3,191	14.53	11.90	1.73	2.50	1.80	67.54	28.25	10.45
27	I. K. Edwards, Phillipsburg, Kans.	.....	43	3,383	11.59	11.20	1.61	2.32	1.91	71.37	22.63	8.58
28	I. D. Foster, Washington, Kans.	.....	33	3,238	12.06	11.55	1.52	2.62	1.61	70.66	24.20	9.54
29	S. B. Wilson, Clay Center, Kans.	.....	36.25	3,135	12.23	12.78	1.74	2.42	2	68.81	31.50	11.85
63	E. E. Ross, Menoken, Kans.	.....	.....	3,450	7.11	11.90	1.80	2.37	1.93	74.88	25.10	9.68
Means		.....	.....	3,381	10.21	12.15	1.64	2.41	1.91	71.68	27.51	10.46

a Average standard. b Up to standard.

Description and analyses of wheat—Continued.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel, kernels.	Moist- ure.	Albami- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.	Wet gluten.	Dry gluten.
				Bushels.	Pounds.	Grams.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
		KENTUCKY.											
1054	33	I. F. Garnett, Casky, Ky.	Lizzie Williams	30	62	4.085	10.97	1.90	2.33	1.82	70.93	27.54	11.37
1055	34	E. B. Lyle, Churchill, Ky.	Pineaster			3.913	10.71	1.48	2.44	1.69	69.15	23.98	8.59
1073	10	W. B. Rouf, Solora, Ky.	Improved Fultz	30	60	3.699	12.45	1.79	2.25	1.61	70.51	22.02	8.67
1078	11	B. S. Clarkson, Big Spring.	Longberry wheat			3.382	12.46	1.67	2.60	1.85	67.60	33.18	12.75
		Means				3.019	11.42	1.71	2.41	1.74	69.55	26.68	10.59
		MAINE.											
16639	103	B. F. Willey, Cherryfield, Me.	Defiance	25	65	3.592	9.45	1.85	2.25	1.90	71.42	30.90	11.45
		MICHIGAN.											
20436	109	A. J. Rodgers, Jonesville, Mich.	Golden Cross		61	3.718	10.87	1.47	2.30	1.87	72.99	22.20	8.65
20457	110	I. P. Curtin, Ovid, Mich.	White Clawson	36	61	4.004	10.98	1.60	2.37	2.02	71.30	24.01	9.21
20462	250	L. C. Bosabeck, Eaton Rapids, Mich.	Diehl Mediterranean	25	64	4.155	12.25	2.18	2.17	1.77	69.55	20.05	8.10
20483	112	G. H. Cannon, Porterville.	Fultz		62	3.325	11.10	1.78	2.50	1.71	71.36	25.03	9.88
20759	173	Agricultural College, Lansing.	Rural No. 5			3.992	8.07	1.78	2.25	1.83	75.04	24.90	9.67
21086	222	David Woodman, Paw Paw, Mich.	Square Head	37	61	4.186	10.61	1.87	2.25	1.89	71.65	24.88	9.50
		Means				3.897	10.65	1.78	2.31	1.85	71.98	23.51	9.17
		MISSOURI.											
13684	92	Missouri Agricultural College, Columbia.	Fultz	35.30		3.844	11.50	1.75	2.10	1.94	70.46	29.13	11.33
		MONTANA.											
14443	93	L. M. Davis, Missoula, Mont.	Hard Bifc.	60	63	2.448	9.84	2.25	2.75	2.13	69.72	29.02	11.35
14450	249	D. C. O'Keefe, Missoula, Mont.	Blue Flint	64	62	3.299	12.41	2.20	2.22	1.86	68.18	27.67	11.47
		Means				3.359	11.13	2.23	2.48	1.99	68.95	28.35	11.41
		NEBRASKA.											
20131	104	L. M. Myers, Cheyenne County, Nebr.	Spring White Russian	26	60.50	2.772	9.91	2	2.77	2.05	70.32	32.57	12.48
20132	105	W. S. Delano, Lees Park, Nebr.	Scotch Fire Springs	24	60	2.848	9.14	2.16	2.77	2.05	66.73	39.05	14.65

20133	106	I. B. Stewart, Benedict, Nebr.	53	62	3.128	9.35	12.43	1.62	2.50	1.70	72.40	32.80	12.25
20134	107	I. Copesey, Westerville, Nebr.	35	.....	3.560	11.36	11.55	1.83	2.87	2.08	70.31	24.36	9.35
20138	108	L. N. Stewart, Broken Bow, Nebr.	26	60	2.559	11.80	15.23	1.94	3.22	1.76	76.05	33.68	13.08
		Means			2.973	10.31	13.86	1.91	2.83	1.93	71.16	32.57	12.36
		NEW YORK.											
3700	237	P. Henderson & Co., New York.											
3853	211	S. D. Howell, Millville	32	61	3.141	12.49	10.85	1.78	2.25	1.17	71.46	14.09	5.49
3876	225	James H. Gray, Lima	32	61, 50	4.765	9.07	14.53	1.97	2.20	1.90	70.33	34.31	13.33
3885	204	J. G. Billinger, Herkimer	30	62	3.652	10.30	12.60	2.05	1.92	1.83	71.61	25.91	18.95
3892	223	Chas. H. Tuttle, Clockville	20	61	4.317	9.66	13.65	1.76	2.35	1.30	70.95	30.23	12.02
3961	205	J. E. Didama, Medina	38	62	3.744	10.96	14.70	1.91	1.92	1.30	68.88	32.51	12.81
3963	197	N. G. Coon, Medina	35	62	4.253	9.19	9.98	1.99	1.87	1.78	75.14	19.63	7.46
3982	194	A. Hanning, Phelps	35	62	3.959	10.20	9.98	1.86	1.87	1.93	74.16	17.22	6.94
		Means			4.325	11.15	12.43	2	2.07	1.67	70.51	24.98	9.69
		NORTH CAROLINA.											
10010	67	N. H. Gwynn	30	.....	4.987	12.05	11.73	1.77	2.40	1.81	70.24	26.34	10.18
10014	68	B. H. Oliver, Salisbury			3.966	12.59	11.12	1.63	2.30	1.80	70.56	21.98	8.63
		Means			4.477	12.32	11.43	1.70	2.35	1.81	70.40	24.16	9.41
		OHIO.											
11059	216	Albert Neifer, Weston, Ohio.			4.516	11.83	10.33	1.79	2.10	1.75	72.21	17.81	6.99
11071	195	Whipples Bros., Marion, Ohio.			3.947	9.71	11.73	1.89	2.10	2	72.57	24.03	9.77
11078	203	Joseph Kimberlison, Grand Rapids, Ohio.	30	61	3.946	9.47	11.20	1.87	2.32	1.80	73.34	24.35	9.62
		Means			3.803	10.34	11.08	1.85	2.17	1.85	72.71	22.06	8.79
		OREGON.											
3201	119	M. Wilkins, Coburg	35	61	4.096	10.03	9.98	1.87	2.37	1.91	73.51	24.23	9.06
3206	120	do	45	63	4.482	10.37	7.88	2.12	2.17	1.65	75.77	17.34	6.10
3279	242	Geo. Belslaw, Eugene	45	63	4.898	10.90	9.63	1.99	2.15	1.67	73.65	12.33	4.70
3280	240	do	45	63	4.067	10.95	8.93	1.99	2.05	1.78	74.10	12.80	5.10
3285	241	do	45	63	4.497	10.90	9.63	2.13	2.27	1.67	73.40	18.52	7.42
3287	239	do	45	63	4.599	11.76	9.63	1.68	2.32	1.61	73	16.20	6.40
3319	121	do	45	63	4.017	11.44	8.75	1.72	2.50	1.80	73.79	12.96	5.13
3321	76	do	45	63	4.561	11.25	8.58	1.71	2.17	1.88	74.41	16.11	6.09
19268	56	John Allison, Hopewell	40	62, 50	5.368	12.54	8.93	1.62	2.12	1.40	73.39	17.09	6.69
19269	57	Hamilton & Rook, Pendleton	45	62	4.536	13.91	10.50	2.88	2.37	1.63	71.31	22.06	8.19
19270	58	W. S. Shumard, Macleary	45	61	4.724	12.77	8.75	1.85	2.12	1.48	73.03	14.53	5.58
		Means			4.579	11.53	9.19	1.72	2.25	1.69	73.61	16.74	6.41

Description and analyses of wheat - Continued.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moist- ure.	Alumi- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.	Wet gluten.	Dry gluten.
				Bushels.	Pounds.	Grams.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
PENNSYLVANIA.														
2964	118	Samuel Wilson, Mechanicsville, Pa.	Red Wonder.....	47	61	4,968	11.85	11.55	1.79	2.35	1.80	70.66	25.32	9.88
6518	35	Allegheny County Home, Woodsville, Pa.	.....	28	62	3,200	12.14	11.38	1.82	3	1.95	69.71	31.01	12.26
6520	36	W. C. Blackfan, New Hope, Pa.	.....	24.30	64	3,700	11.70	13.65	1.72	2.75	1.72	68.46	28.62	11.32
6521	37	Thomas Baker, Octoraro, Pa.	.....	42	61	3,737	12.01	12.60	1.82	2.23	1.74	69.60	26.18	10.72
6523	38	S. H. Bennett, Aberdeen, Pa.	.....	35	63	3,979	10.72	13.13	1.84	2.07	1.95	70.29	27.45	10.82
6527	39	Ed. K. Bohr, Robesonia, Pa.	No. 1 Long.....	42	61	3,364	11.60	12.78	1.85	3.72	2.06	67.99	30.45	11.50
6561	51	.....	Red Winter.....	35	63	4,059	16.65	15.40	2.50	2.57	2.06	66.82	35.63	13.78
6561	51	.....	Federal.....	20	(a)	3,719	9.23	14	1.79	2	2	70.98	28.40	10.88
6565	52	Jordan Bros., Federal, Pa.	.....	20	64	4,331	9.03	12.95	1.97	2.22	1.61	72.52	28.17	10.82
6583	80	W. J. Martin, Cartawisssa, Pa.	.....	16 to 25	62.50	4,069	11.49	14.18	1.80	2.17	1.97	68.39	32.08	11.80
6586	81	Wm. Shammelt, Brinkerton, Pa.	.....	18	60	4,080	19.00	12.78	1.85	2.27	2.19	70.31	34.13	12.74
6588	82	State College, Bellefonte, Pa.	Fukaster.....	33	60	3,536	11.98	11.38	1.97	2.10	1.87	71	27.49	10.40
		E. A. Thompson, Beech Cliff, Pa.	.....			3,903	11.08	12.98	1.84	2.45	1.91	69.73	29.57	11.41
MEANS														
SOUTH DAKOTA.														
6632	206	T. Lacey, Sioux Falls.....	Blue Stem.....	40	60	3,485	8.92	15.49	1.89	2.55	1.61	69.54	35.71	13.69
6633	196	N. Hartman, Mount Vernon.....	do.....	30 to 60	60	3,064	8.76	14.88	2.17	2.60	1.81	69.78	32.19	12.94
6636	207	M. Hutgen, Tyndall.....	do.....	30 to 60	60	2,958	8.81	14.35	2.21	2.37	2.06	70.23	29.84	11.91
6637	190	J. M. Johnson, Mitchell.....	do.....	38	60	3,871	8.85	15.75	1.96	2.75	1.67	69.02	22.61	12.87
6638	193	A. Maloney, Orland.....	do.....	39	60	3,591	9.29	13.93	2.35	2.35	1.60	69.08	33.02	13.13
6640	201	W. Lewis, Sioux Falls.....	do.....	39	60	3,353	8.88	13.65	2.09	2.59	1.64	71.18	29.44	11.68
6641	227	S. Thorsen, Canton.....	do.....	35	60	3,493	10.10	15.58	1.90	2.32	1.54	69.56	30.95	12
6643	198	C. Bullock, Brookings.....	do.....	33	60	3,179	8.56	13.65	2.18	2.40	1.70	71.51	28.24	11.42
MEANS														
WASHINGTON.														
12710	135	The State of Washington, Olym- pia, Wash.	Chilo Club.....	38	62.25	3,337	9.02	14.89	2.04	2.49	1.70	69.89	30.25	13.71
12711	90	do.....	Pride of Battl.....	41	61.25	4,818	11.11	10.15	1.74	2.10	1.92	72.95	21.61	8.32
12737	136	do.....	Blousa Stem Winter.....	30 to 60	62	3,896	12.34	8.75	1.75	2.02	1.70	70.75	33.76	12.02
12798	199	do.....	Red Chaff.....	30 to 60	62	5,858	10.57	11.35	1.88	2.00	1.97	73.17	17.05	6.81
13960	137	W. O. Bush, Olympia, Wash.	Survell.....	30 to 60	60	4,225	9.94	10.15	1.80	2.27	1.92	73.80	23.63	8.78
13965	138	do.....	Little Club.....	30 to 60	60	5,783	9.37	11.38	1.84	2.37	1.77	73.27	23.88	9.19
13973	139	do.....	California Pringle.....	30 to 60	60	5,783	9.37	11.38	1.84	2.37	1.77	73.27	23.88	9.19
13983	140	do.....	Gilback.....	30 to 60	60	4,081	10.34	9.98	1.84	2.30	1.71	73.83	22.36	8.16

13984	do	Republic or Surprise	30 to 60	5.533	9.76	10.85	2	2.22	72.44	24.28	8.13
13986	do	Tutis	30 to 60	5.810	9.31	10.50	1.84	2.42	74.12	22.35	8.70
13990	do	Blue Stem	30 to 60	4.427	10.62	10.85	1.83	2.74	72.17	19.40	7.30
	Means			4.787	10.46	10.66	1.67	2.31	73.08	23.20	8.50
WEST VIRGINIA.											
14944	W. W. Foreman,	West Liberty,	25	3.115	10.90	12.60	1.71	2.07	70.93	28.98	10.78
	W. Va.			63.25							
14944	do	do	25	3.179	10.16	12.95	1.83	2.12	71.18	28.33	11.33
14956	W. Hoeg,	Short Creek, W. Va.	35	4.030	9.91	14	1.90	2.10	70.18	32.44	12.48
14967	I. M. Seldenstricker,	Lewisburg,	28	62	11.40	13.65	2	2.45	68.65	31.99	12.99
	W. Va.			63							
14979	M. V. Small,	Martinsburg, W. Va.	25	4.042	12.20	13.30	1.73	2.27	68.63	28.37	11.15
	Means			3.716	10.90	13.30	1.83	2.20	69.92	30.02	11.75
WISCONSIN.											
15407	M. Cashman,	Hudson, Wis.	25	3.108	9.65	12.78	2.19	2.70	71.04	25.39	16.00
15438	Charles Dahms,	Shawano	30	3.620	9.25	15.75	2	2.12	68.92	33	13.26
15447	Thomas Davis,	Oshkosh.	30	3.269	9.84	12.25	1.92	2.45	71.57	26.88	10.49
15482	Arthur B. Ewing,	Sylvan	20	3.005	11.85	13.30	1.84	2.37	68.71	29.24	11.08
15517	Ernest Gollueck,	Cedarburg	30	4.220	10.64	10.08	1.56	2.45	72.99	23.56	9.34
15583	W. Harland,	Duplainville	42	3.349	9.20	12.25	1.75	2.12	72.75	20.87	10.87
15776	Fred Mnehl,	Seymour	25	62.50	11.09	13.13	1.60	2.07	70.25	29.89	11.61
15945	I. M. Shoff,	Easton	25	2.735	9.77	14	1.77	2.32	70.25	19.27	11.55
15960	George Snyder,	Oconomowoc	25	3.704	12.53	13.83	1.53	2.20	68.03	33.83	12.40
15991	Anton Stumpleshorst,	Graves-	26	3.615	12.37	12.95	1.91	2.20	68.79	30.08	11.88
	ville.										
16042	Moses Walker,	Berlin	40	3.531	10.95	12.60	1.68	2.40	70.65	27.34	10.51
16046	Ely Walker,	Neeah.	26	61.25	4.242	10.20	1.88	2.25	73.35	23.75	8.91
16066	Caleb Wells,	Milton	40	3.601	11.25	11.90	1.60	2.05	71.50	24.37	9.35
16105	Eliza T. Wilson,	Army	28	3.498	11.09	11.90	1.68	2	71.49	28.10	10.89
16113	Thomas Wislart,	De Pere	25	3.529	10.52	12.43	1.65	2.27	71.38	30.21	11.62
16113	do	do	22	64.50	11.44	13.31	1.65	2.07	67.73	35.35	14.27
16113	Carl Wittkopf,	Plymouth.	22	3.566							
	Means			3.519	10.73	12.85	1.77	2.25	70.58	28	11.13
WYOMING.											
14017	Experiment Farm,	Lander	45	3.538	8.46	11.73	1.81	2.25	73.84	27.40	10.44
14026	do	do	45	3.445	10.81	12.78	1.96	2.15	71.69	30.01	11.46
14028	William Brown,	Sheridan	45	3.720	9.83	14.35	2.35	2.67	68.99	30.80	12.10
14035	Peter George,	La Prille.	45	3.314	14.13	11.03	1.83	2.17	72.95	9.16	9.16
14037	Experiment Farm,	Lander	45	4.686	12.92	9.45	1.38	2.15	72.15	21.50	7.80
14038	A. A. Larnbringer,	Big Horn	45	6.190	10.71	14.88	2.40	1.97	68.29	37.35	14.45
14039	do	do	60	5.137	13.40	12.78	1.57	2.25	67.65	27.69	10.69
	Means			4.290	10.99	12.66	1.91	2.24	70.34	28.54	10.87
Total means, United States											
				3.866	10.62	12.23	1.77	2.36	71.18	26.46	10.31

b No. 14035 excluded from means.

a Above standard.

Description and analyses of wheat—Continued.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moist- ure.	Albumi- noids.	Ether extract.	Crude fiber.	Ash.	Carbo- hydrates.	Wet- gluten.	Dry gluten.
ARGENTINE REPUBLIC.														
23301	234	José Doriga, Buenos Ayres.....	Hard Red.....	Bushels, 28.67	Pounds, 63	Grams, 2.761	Per ct. 12.33	Per ct. 14.26	Per ct. 1.62	Per ct. 2.87	Per ct. 1.91	Per ct. 67.01	Per ct. 30.87	Per ct. 12.30
23601	214	N. Oliván, Buenos Ayres.....	Wheat.....	.....	.....	3.542	9	12.95	2.07	2.17	2.04	72.64	27.25	10.80
23603	213	Miguel S. Onetto, Buenos Ayres.....	No. 1. Hard Red.....	64	32.50	3.368	8.52	12.95	2.26	2.80	1.95	71.52	28.58	11.57
23806	209	Eduardo Thorneý, Buenos Ayres.....	Wheat.....	30.25	61.50	3.372	8.90	14.53	1.68	2.89	2.02	69.98	29.45	11.76
23823	215	Udarritta, Buenos Ayres.....	.....do.....	31	61	2.520	9	10.08	1.58	2.70	2.04	74.60	27.98	11.49
		Means.....	.....	.....	.....	3.113	9.55	12.78	1.84	2.69	1.99	71.15	28.83	11.58
AUSTRALIA.														
5578	77	J. Black & Sons, Mouna, New South Wales.....	Purple Straw.....	35	66.50	5.478	12.97	8.58	.73	1.87	1.82	74.03	18.72	7
5580	174	George Clont, Brungle, New South Wales.....	Steinwedel.....	25	67.75	5.723	8.70	9.63	1.78	1.97	1.78	76.14	21.90	8.11
5586	78	New South Wales World's Fair Commissioners, Sydney, Australia.....	Sammers de Mars.....	30	65	5.258	12.68	9.45	1.80	2.25	1.68	72.14	21	8.06
5594	79	Pawley & McIntyre, Imerell, Australia.....	White Tuscan.....	43	63.50	5.415	11.81	8.75	1.89	2.07	2.01	73.47	20.94	8.33
		Means.....	.....	.....	.....	5.468	11.54	9.10	1.55	2.04	1.82	73.94	20.64	7.88
BULGARIA.														
30566	228	Georges Ivanoff, Dieb-Boudac.....	.....	30 to 50	60 to 63	4.696	12.40	11.55	1.52	1.95	1.67	70.91	29.10	7.97
CANADA.														
8039	122	Jos. Brethour, Burford.....	Russian Spring.....	25	62	5.270	11.15	11.73	1.71	2.62	1.79	71	26.60	10.14
8032	123	Henry Groat, Townsend.....	Red Clawson.....	33	62	4.044	10.12	11.20	1.92	2.35	1.76	72.65	22.82	8.77
8034	124	Andrew Turnbull, North Dumfries.....	Surprise.....	33	62	5.385	10.58	8.23	2.04	2.12	1.67	75.36	19.53	2.80
8036	83	J. E. Richardson, Burford.....	Golden Cross.....	29	61	4.857	11.11	9.80	1.77	2.17	1.88	73.27	20.86	8.10
8072	84	Thomas Fuzey, Woodhouse.....	Red Manchester.....	30	61	4.687	10.46	9.98	1.96	2.40	1.93	73.28	22.91	8.72
8127	18	Thomas Elmes, Burford.....	White Winter.....	40	61	4.376	11.75	9.80	1.73	2.57	1.70	72.45	19.16	7.50
8132	19	Robert Walker, Ancaster.....	American Bronze.....	40	61	4.389	12.75	10.50	1.70	2.50	1.70	70.95	20.17	8.14
8133	20	F. Lloyd Jones, Burford.....	White Clawson Fall.....	45	61	4.803	12.15	10.50	1.68	2.35	1.82	71.50	21.23	8.18
8134	21	.....do.....	Rio Grande Spring.....	36	61	3.276	12.27	11.38	1.99	2.77	2	69.59	22.25	9.14
8141	22	John A. Smith, Charlotteville.....	Golden Cross Fall.....	30	60	4.100	10.87	9.80	1.83	2.21	1.87	73.42	21.85	4.99
8144	23	James Brethour, Burford.....	Wild Goose.....	30	60	4.655	12.17	13.48	2.32	2.17	1.93	67.93	32.56	13.09

8147	24	Rielard Wilson, Townsend	35	60	4,421	11.76	9.63	1.74	2.19	1.83	72.85	15.09	5.66
8219	126	Andrew Clifford, St. Joseph Is- land.			3,567	10.50	10.50	2.20		1.72	71.93	222.84	9.18
8222	127	J. T. Falman, Saltfleet.			4,743	11.64	9.28	1.76	2.12	1.66	73.54	18.54	7.08
8223	128	John W. Clark, Saltfleet.			4,673	11.92	9.28	1.76	2.15	1.73	73.16	14.64	5.32
8241	129	William Tuck, Nelson.			4,459	11.47	8.40	1.88	2.05	1.75	74.45	14.27	5.35
8404	59	John C. Shaw, Woodburne.			4,107	11.95	8.58	1.85	2.05	1.60	73.97	6.38	2.29
8410	60	D. Burt, St. George.	35 to 40	62	4,981	11.64	11.64	1.98	2.12	1.84	72.42	23.91	9.56
8415	62	Wm. Pemock, South Crosby.	35		5,144	12.10	12.43	2.06	2.30	1.96	69.15	25.21	10.08
8417	63	Major Walker, Aeneaster.			4,198	11.95	9.45	1.89	2.10	1.81	72.80	18.12	6.85
8420	64	T. Manderson, Reach.	4,429		4,429	11.24	12.95	2.08	2.20	1.76	69.77	27.37	11.20
8422	65	J. E. Richardson, Princeton	29		3,827	13.98	9.45	1.41	2.12	1.60	72.44	19.84	6.62
9029	44	Government of Manitoba, Win- nipeg.			3,452	10.56	15.05	1.99	3.12	1.45	67.83	33.28	13.47
12549	86	Northwest Territories Govern- ment, Regina.	30 to 35	62 to 65.50	4,105	11.30	15.84	1.86	2	1.74	67.26	37.11	14.40
12555	87	do	30	65.50	3,791	11.50	15.05	1.66	2.07	1.50	67.22	35.87	13.86
12576	88	do	30		4,181	12.30	11.90	1.99	2.25	1.80	69.76	22.83	9.13
19204	217	A. N. Morden, Pincher Creek.	53.50	65.50	3,672	10.07	16.10	1.92	2	1.47	68.44	38.94	15.24
24532	233	Price Ellison, Vernon.	40	62	4,411	11.47	12.08	1.87	2.60	1.88	70.19	31.87	12.18
24534	232	D. G. Gunnings, Spaluncheon, British Columbia.	47.50	62	4,100	11.50	12.08	1.69	2.50	1.87	70.36	29.75	11.25
24535	231	D. Matherson, Spaluncheon.	48.30	62	4,052	10.77	13.65	2.27	2.10	1.86	69.35	31.99	12.76
24536	230	Earl of Aberdeen, Spaluncheon, British Columbia.	40	61	4,197	12.03	11.73	1.70	2	1.88	70.66	27.29	10.40
24540	229	W. H. Landoner, Landoners.	40	61.50	4,118	11.63	15.23	1.77	2.05	1.72	67.60	30.59	12.17
27744	69	T. Manderson, Reach.	35	61	4,294	13.80	9.11	1.79	2.25	1.56	71.49	18.67	7.54
27745	70	Wm. Tuck, Watertown.	54	60	4,478	12.65	8.58	1.82	2.12	1.75	73.08	12.34	4.79
27752	71	Wm. Pemock, South Crosby.	35	61	3,899	11.36	13.48	1.96	2.30	1.82	68.28	26.97	10.83
27753	72	J. S. Pearce, London, Ontario.	32		3,891	11.29	14.18	1.45	2.32	1.72	69.04	27.91	10.88
30074	226	Northwest Territories Govern- ment, Winnipeg.	34.50	63	3,362	9.38	13.30	1.97	2.17	1.42	71.76	29.11	11.45
30075	224	do	35	62	3,976	11.09	15.23	1.91	2	1.51	68.26	32.75	13.39
30076	264	do	32	62	{ 4,085 3,951	{ 10.91 12.90	{ 15.58 13.48	{ 1.51 1.70	{ 2.15 2.37	{ 1.93 1.63	{ 65.92 67.92	{ 24.54 33.13	{ 16.09 13.15
30139	253	W. Sandy, Thornhill.	41	63	{ 3,447 3,486	{ 12.53 13.91	{ 14.41 13.91	{ 1.70 1.79	{ 2.27 2.40	{ 1.63 1.48	{ 67.43 68.44	{ 37.20 29.77	{ 11.36 8
30140	256	W. A. Kilkenny, Broomhill.	28	63	3,389	12.08	15.05	1.60	2.10	1.38	67.79	28.11	11.43
30141	257	W. J. Benny, Eden.	40	61	613.376	11.93	15.40	1.86	2.37	1.41	67.03	28.24	11.69
30142	258	E. and A. Melou, Portage La Prairie.	39	64	643.113	12.73	13.30	1.42	2.42	1.54	68.09	32.52	13.24
30143	259	W. Foxwell, Brandon.	27	64	3,412	12.17	14.70	1.88	2.10	1.44	67.71	24.03	9.83
30145	260	R. H. Honeyman, Eden.	29	64	3,242	12.23	14.97	1.85	2.35	1.61	66.99	30.25	12.30
30146	261	William Hope, Carberry.	29	64.75	3,259	12.10	14.70	1.82	2.25	1.44	67.69	29.35	12.05
30148	262	M. Morrison, Greswald.	31	65	3,380	12.05	14.53	1.89	1.75	1.50	68.28	30.37	12.60
		Means			4,052	11.69	12.25	1.80	2.26	1.69	70.31	25.13	9.76

Description and analyses of wheat—Continued.

Bureau of awards No.	Labo- ratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moist- ure.	Albumi- noids.	Ether extract.	Crudo fiber.	Ash.	Carbo- hydrates.	Wet gluten.	Dry gluten.											
29720	252	COSTA RICA. Canton de Paraiso, Cartago	.....	Bushels. 25 to 40	Pounds. 61.50	Grams. 3,228	Per ct. 12.15	Per ct. 11.90	Per ct. 1.60	Per ct. 2.52	Per ct. 1.73	Per ct. 70.10	Per ct. 27.93	Per ct. 11.11										
29721	253														Canton de Paraiso, Heredia	63.50	3,367	9.33	12.34	1.78	2.35	1.84	72.36	24.69	9.77
															Means	3,298	10.74	12.12	1.69	2.44	1.78	71.23	26.31	10.44
30475	235	SPAIN. Giraldo Crespo, Medina del Campo.	Wheat	.....	.....	5,446	10.50	12.60	1.80	2.42	2.01	70.67	32.57	12.33									
		Means, foreign wheat	.....	.....	.....	4,076	11.47	12.08	1.78	2.28	1.73	70.66	25.36	9.82								
		Total means, all wheat	.....	.....	.....	3,940	10.85	12.20	1.74	2.35	1.81	71.05	26.28	10.22								

DISCUSSION OF ANALYTICAL DATA.

Among domestic samples the largest and finest kernels were found in a sample from Wyoming. One hundred kernels weighed 6.19 grams, or one-fifth of an ounce. The smallest kernels were in a sample from Illinois. The sample containing the most moisture, strange as it may appear, was from Kansas, and likewise the driest sample. In regard to albuminoids, Nebraska leads with a sample containing 17.15 per cent, and Oregon has the smallest portion in any sample, namely, 8.58 per cent. In respect of moist and dry gluten, the Nebraska sample showed the largest percentages, namely, 39.05 and 14.65, respectively, and Oregon furnished a sample showing the smallest percentages, namely, 12.33 and 4.70, respectively.

In the Canadian samples, the one having the largest kernels gave a weight of 5.335 grams, and the one having the smallest, of 3.242 grams per hundred kernels, respectively. In albuminoids the extremes were 16.10 and 8.23 per cent, respectively; in moisture, 13.98 and 9.38 per cent, respectively; in moist gluten, 38.94 and 6.38 per cent, respectively, and in dry gluten, 15.24 and 2.29 per cent, respectively.

Of the other foreign wheats, Australia furnished the sample having the largest kernels, namely, 5.723 grams per hundred. The smallest grains were from the Argentine Republic, namely, 2.920 grams per hundred.

The sample containing the largest percentage of moisture, namely, 12.97, was from Australia, and the one containing the smallest percentage, namely, 8.52, from the Argentine Republic.

In albuminoids, a sample from the Argentine Republic takes the lead with a percentage of 14.53, while a sample from Australia shows the smallest amount, namely, 8.58 per cent.

In moist gluten, a sample from Spain gave the largest amount, namely, 32.57 per cent, and one from Australia the smallest, namely, 18.72 per cent. Spain and Australia also afforded the maximum and minimum percentages of dry gluten, namely, 12.33 and 7 per cent, respectively.

For convenience of comparison, the following table of maxima, minima, and means of the Worlds' Fair samples, compared with the means given by the previous work of the Department and by other authorities is inserted.

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moist- ure.	Albu- mi- noids.	Ether ex- tract.	Crude fiber.	Ash.	Carbo- hy- drates.	Wet gluten.	Dry gluten.
Domestic:	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>
Maxima.....	a 6.190	b 14.53	c 17.15	d 2.50	d 3.72	a 2.35	e 76.05	c 39.05	c 14.65
Minima.....	e 2.125	b 7.11	f 8.58	f .28	b 1.70	f 1.40	g 66.67	f 12.33	f 4.70
Means.....	3.866	10.62	12.23	1.77	2.36	1.82	71.18	26.46	10.31
Canada:									
Maxima.....	5.335	13.98	16.10	2.32	3.12	2	75.36	38.94	15.24
Minima.....	3.242	9.38	8.23	.41	1.75	1.38	65.92	6.38	2.29
Means.....	4.054	11.69	12.25	1.80	2.26	1.69	70.31	25.13	9.76
Foreign:									
Maxima.....	h 5.723	h 12.97	i 14.52	i 2.26	i 2.89	i 2.04	h 76.14	j 32.57	j 12.32
Minima.....	i 2.250	i 8.52	h 8.58	h .73	h 1.87	k 1.67	i 67.01	h 18.72	h 7
Means.....	4.076	11.47	12.08	1.78	2.28	1.73	70.66	25.36	9.82
Means of World's Fair sam- ples:									
Domestic samples (165)....	3.866	10.62	12.23	1.77	2.36	1.82	71.24	26.46	10.31
Canadian samples (62)....	4.054	11.69	12.25	1.80	2.26	1.69	70.31	25.13	9.76
All foreign samples (62)....	4.076	11.47	12.08	1.78	2.28	1.73	70.66	25.36	9.82
All samples (227).....	3.940	10.85	12.20	1.74	2.35	1.81	71.09	26.28	10.22
Means of previous analyses by the Department:									
Domestic (147).....	3.653	9.97	10.53	.....	.....	2.06	.....	.....	.....
United States and British America (407).....	3.644	10.16	12.15	.....	.....	1.92	.....	.....	.....
Colorado (155).....	4.235	7.54	12.54	2.29	1.64	1.82	74.17	33.80	11.07
Means given by Jenkins and Winton:									
Spring (13).....	.....	10.40	12.50	2.20	1.80	1.90	71.20	.....	.....
Winter (262).....	.....	10.50	11.80	2.10	1.80	1.80	72	.....	.....
Means given by König:									
Samples of miscellaneous origin (428).....	.....	13.37	12.51	1.70	2.56	1.79	68.01	.....	.....
Samples from northeast and middle Germany (90)	.....	14.01	10.93	1.65	2.12	1.92	70.01	.....	.....
Samples spring wheat (81)	.....	14.75	11.23	2.03	2.26	2.52	68.61	.....	.....
Samples from south and west Germany (52).....	.....	13.18	12.29	1.71	2.82	1.85	67.96	.....	.....
Samples spring wheat (30)	.....	13.80	14.95	1.56	.....	2.19	67.93	.....	.....
Samples from Austro- Hungary (18).....	.....	11.72	12.66	1.99	3.39	1.75	66.84	.....	.....
Samples from Russia— spring wheat (39).....	.....	12.65	17.65	1.58	.....	1.66	65.74	.....	.....
England (22).....	.....	13.41	10.99	1.86	2.90	1.67	69.21	.....	.....
Scotland (16).....	.....	11.37	10.58	1.73	.....	1.55	72.77	.....	.....
France (70).....	.....	15.20	12.64	1.41	2	1.66	68.92	.....	.....
Denmark (4).....	.....	13.95	9.36	2.34	2.19	1.34	71.40	.....	.....
Spain (9).....	.....	13.37	12.45	1.92	.....	1.80	.....	.....	.....
Africa (34).....	.....	11.80	11.18	1.83	1.82	1.76	70.04	.....	.....
Asia (6).....	.....	12.57	11.09	2.10	1.94	1.46	70.84	.....	.....
Australia (4).....	.....	13.37	10.16	1.39	.....	b.....	.....	.....	.....
North America (504).....	.....	9.92	11.60	2.07	1.70	1.79	69.47	.....	.....
North America—spring(40)	.....	9.36	12.92	2.15	1.72	1.86	67.98	.....	.....

a Wyoming.

b Kansas.

c Nebraska.

d Pennsylvania.

e Illinois.

f Oregon.

g Iowa.

h Australia.

i Argentine Republic.

j Spain.

k Bulgaria.

In the means taken from König as given above the amount of water as found is given.

The means of the other constituents, however, in order to secure a proper comparison are calculated on the supposition that the mean content of water is the same as that in the chief or miscellaneous table, namely, 13.37 per cent.

In the discussion of the comparative results, it will be noticed first, as with other cereals, that the content of moisture in the domestic samples is low, being about 1 per cent less than in the Canadian samples and eight-tenths of 1 per cent less than in all the foreign samples. This remarkable dryness of cereal products appears, therefore, to be a characteristic of those grown in the United States, although the difference is not so marked in the case of wheat as it is in some other cereals. In general, the size of the grains of the domestic samples is less than that of the Canadian and foreign wheats, but in the World's Fair sam-

ples, as might be expected, the kernels were a little larger than those examined in previous work of the Department.

In respect of albuminoids, the American wheats, as a rule, are quite equal to those of foreign origin. This is an important characteristic when it is remembered that both the milling and food values of a wheat depend largely on the nitrogenous matter which is present. It must not be forgotten, however, that merely a high percentage of proteids is not always a sure indication of the milling value of a wheat. The percentage of gluten to the other proteid constituents of a wheat is not always constant, and it is the gluten content of a flour on which its bread-making qualities chiefly depend. The percentage of moist gluten gives in a rough way the property of the glutinous matter of absorbing and holding water under conditions as nearly constant as can be obtained. In general, it may be said that the ratio between the moist gluten and the dry gluten in a given sample is an index for comparison with other substances in the same sample. Upon the whole, however, the percentage of dry gluten must be regarded as the safer index of quality. In respect to the content of glutinous matter, our domestic wheats are distinctly superior to those of foreign origin. They are even better than the Canadian wheats in this respect. It may be fairly inferred, therefore, that while our domestic wheats give a flour slightly inferior in nutritive properties to that derived from foreign samples, it is nevertheless better adapted for baking purposes, and this quality more than compensates for its slight deficiency in respect of nutrition, a deficiency which, however, is so small as to be hardly worth considering.

In this connection, attention should be called to the great influence of climate upon the quality of wheat. The best wheats grown in the United States are produced in the central-northern part of the country, while the poorest are grown in the Southern States. The influence of climate and soil upon the quality of wheat has been fully pointed out by Richardson in Bulletins Nos. 1, 3, and 9 of the Chemical Division of the Department of Agriculture. The following quotation from page 25, Bulletin No. 9, will illustrate the above statement:

CHARACTERISTICS OF THE WHEAT GRAIN.

From observations in this and previous reports, it may be said that of all grain wheat is probably the most susceptible to its environment.

Oats in certain directions are more variable, but in their general character are more permanent, as will appear in subsequent pages. The inherent tendency to change which is found in all grains is most prominent in wheat. It may be fostered by selection and by modifying such of the conditions of environment as it is in the power of man to affect.

The most powerful element to contend with is the character of the season or unfavorable climatic conditions. The injury done in this way is well illustrated in Colorado, and it would seem advisable in such cases to seek seed from a source where everything has been favorable, and begin selection again.

It must be borne in mind that selection must be kept up continuously, and that reversion takes place more easily than improvement. It took but one season to seriously injure Professor Blount's wheats, but it will be two or more years before they have recovered from that injury. Hallett, in England, was able to make his celebrated pedigree wheat by selection, carried on through many years, but the same wheat grown by the ordinary farmer under unfavorable conditions for a few years without care has reverted to an ordinary sort of grain.

The effect of climate is well illustrated by four specimens of wheat which are to be seen in the collection of the Chemical Division. Two of these were from Oregon and Dakota some years ago, and present the most extreme contrast which can be found in this variable grain. One is light yellow, plump, and starchy, and shows on analysis a very small per cent of albuminoids; the other is one of the small, hard, and dark-colored spring wheats of Dakota, which are rich in albuminoids. Between these stand two specimens from Colorado, which have been raised from seed similar to the Oregon and Dakota wheat. They are scarcely distinguishable except by a slight difference in color. The Colorado climate is such as to have modified these two seed wheats, until after a few years' growth they are hardly distinguishable in the kernel.

All localities having widely different climates, soils, or other conditions produce their peculiar varieties and modify those brought to them.

The result of these tendencies to change and reversion from lack of care in seed selection or other cause has led to the practice of change of seed among farmers. A source is sought where either through greater care or more favorable conditions the variety desired has been able to hold its own. Sometimes this change is rendered necessary by conditions which are beyond the power of man to modify. As an example, No. 10 of Professor Blount's wheats, known as "Oregon Club," a white variety from Oregon, has been deteriorating every year since it has been grown in Colorado, whereas if the seed had been supplied every season directly from Oregon the quality would have probably remained the same. In extension of this illustration the fact may be mentioned that the annual renewal of the seed from a desirable and favorable source often makes it possible to raise cereals where otherwise climatic conditions would render their cultivation impossible through rapid reversion. This is particularly the case with extremes in latitude, the effect of which is not found so much upon the composition of the crop as on the yield and size of the grain. In the South, the warmer climate, together, of course, with poorer soil and cultivation in many instances, reduces the yield.

A typical American wheat of the best quality should have approximately the following composition:

Weight of 100 kernels	grams..	3.85
Moisture	per cent..	10.60
Albuminoids	do....	12.25
Oil	do....	1.75
Indigestible fiber	do....	2.40
Ash	do....	1.75
Digestible carbohydrates	do....	71.25
Dry gluten	do....	10.25
Moist gluten	do....	26.50

To bring into a comparative view the means of the data obtained for American cereals exhibited at the World's Columbian Exposition, the following general table is given containing the data above mentioned, with the exception of those relating to rice, together with the approximate typical composition taken from the preceding pages:

Mean data calculated from the analyses of samples exhibited at the World's Columbian Exposition.

	Barley.	Buck-wheat.	Maize.	Oats.	Rye.	Wheat.
Weight of 100 kernels.....grams..	4.19	3.12	38.98	2.92	2.49	3.87
Moisture.....per cent..	10.80	12.15	10.93	10.06	10.62	10.62
Albuminoids.....do....	10.69	10.75	9.88	12.15	12.43	12.23
Oil.....do....	2.13	2.11	4.17	4.33	1.65	1.77
Fiber.....do....	4.05	10.75	1.71	12.07	2.09	2.36
Ash.....do....	2.44	1.89	1.36	3.46	1.92	1.82
Digestible carbohydrates.....do....	69.89	62.33	71.95	58.75	71.37	71.18

Approximate typical composition of domestic samples taken from the data given in the preceding pages.

Weight of 100 kernels.....grams..	4	3	38	3	2.50	3.85
Moisture.....per cent..	10.85	12	10.75	10	10.50	10.60
Albuminoids.....do....	11	10.75	10	12	12.25	12.25
Oil.....do....	2.25	2	4.25	4.50	1.50	1.75
Indigestible fiber.....do....	3.85	10.75	1.75	12	2.10	2.40
Ash.....do....	2.50	1.75	1.50	3.50	1.90	1.75
Digestible carbohydrates.....do....	69.45	62.75	71.75	58	71.75	71.25

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