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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY—BULLETIN No. 120.
H. W. WILEY, Chief of Bureau.

THE FEEDING VALUE OF CEREALS,
AS CALCULATED FROM CHEMICAL ANALYSES.

By

JOSEPH S. CHAMBERLAIN,
Chief, Cattle-Food and Grain Laboratory, Miscellaneous Division.

IN COLLABORATION WITH THE BUREAU OF PLANT INDUSTRY.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.

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1909.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., October 23, 1908.

SIR: I have the honor to transmit for your inspection and approval a manuscript containing the results of a chemical study of the feeding value of certain cereals, especially oats, wheat, and barley, recently completed in the Cattle-Food and Grain Laboratory of this Bureau in collaboration with the Bureau of Plant Industry. I recommend that this report be published as Bulletin No. 120 of the Bureau of Chemistry, its strictly chemical nature suggesting this arrangement, which has the approval of the Chief of the Bureau of Plant Industry.

Respectfully,

Hon. JAMES WILSON,
Secretary of Agriculture.

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H. W. WILEY,
Chief of Bureau.

LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY, MISCELLANEOUS DIVISION,
Washington, D. C., October 1, 1908.

SIR: I submit herewith a report on the feeding value of cereals, by Joseph Chamberlain, Chief of the Cattle-Food and Grain Laboratory of the Miscellaneous Division, acknowledgments being due to Mr. H. W. Houghton, assistant chemist, who performed the analytical work on a portion of the samples examined, and to Mr. T. C. Trescott, in charge of the Nitrogen Section of the Bureau of Chemistry, who made the nitrogen determinations. The work was done in collaboration with the Office of Grain Investigations of the Bureau of Plant Industry, having been begun there by the author prior to his transfer to the Bureau of Chemistry. The report discusses the relation between the chemical composition of cereals and their nutritive value, as well as the comparative value of certain varieties of cereals recently introduced.

Respectfully submitted.

J. K. HAYWOOD,
Chief, Miscellaneous Division.

Dr. H. W. WILEY,
*Chief, Bureau of Chemistry,
U. S. Department of Agriculture.*

CONTENTS:

	Page.
Introduction.....	5
Nutrients on which the feeding value is based.....	6
Proteins.....	6
Fats.....	6
Carbohydrates.....	7
Classification of all separations.....	8
Factors used in calculating food values.....	8
Coefficient of digestibility.....	8
Calorific value and metabolizable energy.....	10
Production value.....	13
Comparative nutritive value and nutritive ratio.....	16
Plan of the present investigation.....	17
Method of estimating the relative food values of grains.....	17
Description of material examined.....	17
Discussion of results.....	18
Oats (<i>Avena sativa</i>).....	18
Comparison of domestic and foreign oats.....	18
Production value and nutritive ratio as a basis for exact valuation.....	26
Conclusions.....	30
Emmer (<i>Triticum dicoccum</i>) and einkorn (<i>Triticum monococcum</i>).....	30
Wheat (<i>Triticum vulgare</i>).....	32
Rye (<i>Secale cereale</i>).....	34
Barley (<i>Hordeum vulgare</i>).....	36
Proso (<i>Panicum miliaceum</i>) and sorghum (<i>Andropogon sorghum</i>).....	40
Maize (<i>Zea mays</i>).....	42
General summary.....	43
Oat group.....	44
Wheat group.....	45
Maize group.....	46
Conclusions.....	47
Detailed tabulation of analytical and calculated results.....	48

LIST OF TABLES.

	Page.
TABLE I. Digestibility of oats for horses and cattle.....	9
II. Coefficients of digestibility.....	9
III. Total and digestible nutrients.....	10
IV. Metabolizable energy of nutrients per pound.....	11
V. Metabolizable energy.....	12
VI. Comparison of metabolizable energy and production value of nutrients per pound.....	13
VII. Production value of nutrients of foods.....	14
VIII. Production value of various foods expressed according to three methods.....	14
IX. Comparative nutritive value and nutritive ratio of grains.....	16
X. Typical United States oats.....	19
XI. United States and Canadian oats, 1893.....	19
XII. United States oats, 1906.....	19
XIII. Swedish Select oats.....	20
XIV. Miscellaneous introduced varieties of oats.....	20
XV. Foreign oats.....	20
XVI. Group values for digestible nutrients, production value, and nutritive ratio of oats, domestic and foreign.....	21
XVII. Comparison of domestic and foreign grown oats of the same varieties	22
XVIII. Oats analyses—average results.....	24
XIX. Comparison of oats and maize as typical energy-producing and fat- producing cereals.....	27
XX. Different varieties of domestic oats compared with foreign oats....	29
XXI. Comparison of the total and digestible nutrients of emmer, einkorn, and oats.....	31
XXII. Emmer and einkorn analyses—average results.....	31
XXIII. Wheat—digestible nutrients, production value, and nutritive ratio.	32
XXIV. Wheat analyses—average results.....	33
XXV. Rye—total and digestible nutrients, production value, and nutri- tive ratio.....	34
XXVI. Rye analyses—average results.....	35
XXVII. Comparison of barley analyses by groups, domestic and foreign....	36
XXVIII. Barley—digestible nutrients averaged by groups, domestic and foreign.....	36
XXIX. Comparison of domestic and foreign barley, averaged by varieties..	37
XXX. Barleys arranged in order of protein content.....	38
XXXI. Barley analyses—average results	39
XXXII. Group averages of total and digestible nutrients of proso, sorghum, and maize.....	41
XXXIII. Proso, sorghum, and maize analyses—average results for the United States.....	42
XXXIV. Maize—digestible nutrients averaged by groups.....	43
XXXV. Oat group—digestible nutrients.....	43
XXXVI. Wheat group—digestible nutrients	44
XXXVII. Maize group—digestible nutrients.....	44
XXXVIII. Oats—individual analyses.....	48
XXXIX. Emmer—individual analyses.....	55
XL. Einkorn—individual analyses.....	56
XLI. Wheat—individual analyses.....	56
XLII. Rye—individual analyses.....	57
XLIII. Barley—individual analyses.....	58
XLIV. Proso—individual analyses.....	62
XLV. Sorghum—individual analyses.....	63
XLVI. Maize—individual analyses.....	64

THE FEEDING VALUE OF CEREALS AS CALCULATED FROM CHEMICAL ANALYSES.

INTRODUCTION.

The chemical analysis of grains and other materials used in feeding domestic animals consists in the determination of the nutritive substances contained therein. The results of such determinations are expressed in percentage amounts, usually, as pounds per 100 pounds. From these determinations the value of the food for feeding purposes is obtained.

The essential nutritive materials contained in all foods are comprised within the three classes of substances, proteins, fats, and carbohydrates, and the determination of these is the object of a feeding-stuff analysis when its food value is desired. In order that the results of various analyses may be directly comparable the moisture content of the food is found, and from this the amounts of the other constituents are calculated to a uniform water-free, or dry, basis. Another determination is also made, namely, that of the ash or mineral matter. The mineral substances present in a food play an important part in the physiological process of digestion, but possess no value as a direct source of energy. Their action is mainly indirect, and as no method of measuring their value is known, they are not considered in calculating the nutritive value of foods. The usual form, therefore, of expressing the results of an analysis of a stock food is to give the amounts of the following substances present: Water, ash, protein, fat, and carbohydrate; the food value of the material being based on the last three.

In the study of such complex materials as feeding stuffs, however, it has been found that a knowledge of the total amounts of these three nutritive constituents is not sufficient to give an exact idea of the food value of any substance. This is due to factors depending, first, on the character of the food itself and, second, on that of the animal using it. The three groups of substances—proteins, fats, and carbohydrates—do not yield all of their material to the animal as nutriment, nor are they nutritive in equal degrees. The proportion that is actually digested and used by the animal is different in each case, i. e., each possesses a certain coefficient of digestibility. Furthermore, each of these groups as ordinarily determined contains separate and distinctly different substances which, under certain conditions or when present in small amounts, may be disregarded, but which, when present in large amounts or when productive of decided effects, even though in small quantities, must be considered separately.

NUTRIENTS ON WHICH THE FEEDING VALUE IS BASED.

PROTEINS.

This class of substances includes the true proteins, which are of an organic nitrogenous nature, very complex and similar in composition and properties to white of egg or lean meat. They are of very great importance, for from them the animal derives the nitrogenous material from which its own muscular tissue is built. The separation of the proteins into individuals or even into classes is very difficult and, though they are not all equal in nutritive value, the investigations throwing light upon this question are so recent and incomplete that it is impossible, at present, to attempt any separation. With vegetable foods the proteins may be left as a group, because those present are the simple proteins and are similar to each other.

There is, however, another class of nitrogenous organic bodies which are not proteins, but which are included with them in determinations made by the usual methods. These substances are the amido compounds. Many of the proteins contain approximately 16 per cent of nitrogen, and it is customary in analyzing protein foods to determine simply the amount of nitrogen present. The result obtained by multiplying this amount by 6.25 is called crude protein. When determined in this way, crude protein includes the amido compounds, which do not contain as much nitrogen as the proteins, nor do they furnish as much, if any, nutriment to the animal. In cereal grains the amount of these amido compounds present is very small, even within the limits of error of the method of separation used,^a and on this account they are disregarded and the crude protein is considered as true protein.^b

FATS.

The method for the determination of fats is that of extraction with ether, and all substances soluble in ether, such as chlorophyll, organic acids, waxes, resins, etc., are included. In some materials allowance would have to be made for such a mixture, but in grains and a great number of ordinary stock foods it is not necessary. The extracted product is not always a pure fat or a mixture of pure fats, but when waxes or resins are present they are in small quantities and their nutritive value is probably almost the same as that of true fats. No great error is introduced, therefore, if the extract is considered as fat, and this is usually done. On account of the impure nature of the extract, the name "ether extract" is often used instead of the term

^a Stutzer's method.

^b The protein factor used in this investigation, except in the case of wheat, is the common one, viz, 6.25. With wheat the now accepted factor of 5.7 has been adopted.

“fat.” In this bulletin, however, the term “fat” is used to signify the crude product obtained by the ordinary extraction of the dry material with anhydrous ether.

CARBOHYDRATES.

In an ordinary analysis of stock foods or similar material all those substances left after the ash, protein, and fat have been determined are included in the term “nitrogen-free extract” and considered as carbohydrate. In materials containing much sugar or when it is desirable to know the amount of starch, as such, these constituents are determined separately. In cereal grains, excepting sweet corn or saccharine sorghums, the amount of sugar is not great and starch is practically the only carbohydrate present. In such cases no separate determination of these substances is made and the total carbohydrate is determined only by difference, i. e., 100 per cent less the amount of ash, protein, and fat combined.

In many vegetable products, however, a considerable portion of this nitrogen-free extract or carbohydrate remainder consists of fibrous material, such as hulls, stalks, and the cellulose portions of plants generally. This material, though a true carbohydrate in nature, has a distinctly different coefficient of digestibility as compared with sugar or starch, and must therefore be considered separately. This coarse fibrous portion of vegetable foods is termed “crude fiber,” and though only slightly digestible it plays a very important part in digestion. It acts as a dilutant of the more concentrated portions of the food, such as starch, necessitates for the whole food thorough mastication, and prevents it from becoming too compact; in other words, it keeps the food mass porous and open to the action of the digestive fluids. If, however, the amount of this crude fiber or roughage is in excess, as in the case of coarse fodders, the amount of energy expended by the animal in securing and digesting the food is so great that its ultimate nutritive value is correspondingly diminished. That part of the crude fiber which is digested has, however, the same nutritive value as the other carbohydrates, so that, except as regards digestibility, the crude fiber is considered with the other carbohydrates.

Another carbohydrate substance, in addition to sugar, starch, and crude fiber, is sometimes considered separately, namely, the pentosans. These are compounds related to the sugars, being polymeric forms of five carbon sugars. Their digestibility and nutritive value, according to Kellner,^a are nearly the same as those of starch, and consequently a separate determination is not necessary. When sugar is present in any considerable amount it must be determined separately, as its nutritive value is slightly different from the other carbohydrates.

^a Kellner, *Die Ernährung der landwirtschaftlichen Nutztiere*, 1905, pp. 88, 153.

The remaining substances sometimes present and included in the nitrogen-free extract, namely, the organic acids, are seldom found in sufficient amount, especially in ordinary fresh foods, to make their consideration necessary.

CLASSIFICATION OF ALL SEPARATIONS.

On account, therefore, of differences in digestibility or in nutritive value, the analytical separation of a feeding material as previously given must be enlarged to include part or all of the following substances:

Proteins:

True proteins.

Amido compounds.

Fats:

True fats.

Waxes, resins, organic acids, chlorophyl, etc.

Carbohydrates:

Sugars, starch, pentosans, and organic acids.

Crude fiber.

In the case of cereal grains and similar materials this classification for separation may be condensed, because of the small amounts of most of the secondary constituents which are present, as follows: Protein, fat, crude fiber, carbohydrate. In the present investigation these are the determinations that have been made.

FACTORS USED IN CALCULATING FOOD VALUES.

COEFFICIENT OF DIGESTIBILITY.

The separation of the nutritive constituents of foods into the groups or classes just described is made because of the differences in their relative digestibility. The effect of the general nature of the food on its digestibility must also be considered. Each of the nutritive constituents, protein, fat, crude fiber, and carbohydrate, has a coefficient of digestibility which differs for each food in which it occurs. Therefore the coefficient of digestibility of each of these constituents must be known for each food under consideration. Such coefficients have been determined by actual feeding experiments on living animals and factors of digestibility calculated from the results. It has also been shown that it is necessary to consider the animal itself as well as the food and the individual constituents. Such experimental results can not be obtained in all cases, but they have been secured by a few investigators for the more common domestic animals and for a considerable number of foods. From the results of such direct experiments the general factors thus obtained may be applied to a variety of foods. The results obtained by Kellner at the Möckern experiment station are considered reliable and

have been used in the present investigation. The coefficients of digestibility as given in his tables ^a may be illustrated as follows:

When oats are fed to horses the following amounts are digested:		Per cent.
Protein.....		80
Fat.....		71
Crude fiber.....		29
Carbohydrate.....		75
When fed to mature fattening cattle the amounts are:		
Protein.....		78
Fat.....		83
Crude fiber.....		26
Carbohydrate.....		77

If these coefficients are applied to a particular case—for example, a sample of oats—the following percentages of the nutrients are found to be available under the conditions specified:

TABLE I.—*Digestibility of oats for horses and cattle.*

Nutrient.	Total.	Digestible.	
		For horses.	For mature fattening cattle.
	Per cent.	Per cent.	Per cent.
Protein.....	12.80	10.32	10.06
Fat.....	4.15	2.95	3.44
Crude fiber.....	12.53	3.63	3.25
Carbohydrate.....	66.58	49.94	51.27

These figures express the mean results of actual feeding experiments and, while variations will necessarily be introduced by each individual animal, they may still be considered as giving fair average results applicable in ordinary cases.

The following tables give the coefficients of digestibility used in this bulletin, the amounts of crude nutrients as found by analysis, and the digestible nutrients as calculated from these:

TABLE II.—*Coefficients of digestibility.*

[For mature fattening cattle.]

Grain.	Protein.	Fat.	Crude fiber.	Carbohydrate.
	Per cent.	Per cent.	Per cent.	Per cent.
Oats ^b	78	83	26	77
Emmer ^c	75	71	44	75
Einkorn ^c	75	71	44	75
Wheat ^d	84	63	47	92
Rye ^b	84	64	53	92
Barley ^b	70	89	33	92
Proso ^e	49.2	76.9	68.3	85.2
Sorghum ^f	65	70	51	91
Maize ^b	72	90	41	95

^a Kellner, *Die Ernährung der landwirtschaftlichen Nutztiere*, 1905, pp. 561, 569.

^b *Ibid.*, p. 569.

^c *Ibid.*, p. 561, "Spelzweizen."

^d *Ibid.*, p. 561.

^e Tangl, *Landw. Jahrb.*, 1905, 34:1, "Besenhrsekorn" fed to oxen.

^f Kellner, *ibid.*, p. 569, "Dari."

TABLE III.—*Total and digestible nutrients.*

[Pounds per hundred pounds.]

Grain.	Protein.		Fat.		Crude fiber.		Carbohydrate.	
	Total.	Di- gesti- ble.	Total.	Di- gesti- ble.	Total.	Di- gesti- ble.	Total.	Di- gesti- ble.
Oats.....	13.76	10.73	4.33	3.59	12.20	3.17	66.39	51.04
Emmer.....	13.28	9.96	1.91	1.36	11.31	4.98	69.42	52.06
Einkorn.....	14.67	11.00	2.19	1.55	13.55	5.96	64.02	48.04
Wheat.....	14.20	11.93	2.36	1.49	2.78	1.30	78.72	72.42
Rye.....	13.44	11.29	1.83	1.17	2.30	1.22	80.24	73.82
Barley.....	13.39	9.37	1.87	1.06	5.64	1.86	76.05	69.96
Proso.....	12.77	6.28	3.27	2.51	8.95	6.11	71.23	60.69
Sorghum.....	11.71	7.61	3.25	2.27	1.80	.92	81.58	74.24
Maize.....	9.91	7.14	4.40	3.92	2.21	1.28	81.96	77.86

CALORIFIC VALUE AND METABOLIZABLE ENERGY.

When the nutrients of food are utilized within the animal body, the ultimate product is either flesh or energy. The unit for measuring this flesh or energy-producing power of a food is the unit of heat energy or the calorie and the value so obtained is termed its calorific or fuel value.

The actual measurement of this calorific value is made in an instrument called a calorimeter, in which an exact amount of substance (e. g., one of the nutrient constituents of foods, such as fat) is burned in an atmosphere of oxygen and the amount of heat so generated is measured and expressed in calories.

When 1 gram of water is raised 1° C. in temperature, the amount of heat used is called a calorie. As this unit is too small for most purposes, it is multiplied by 1,000; that is, the amount of heat required to raise the temperature of 1,000 grams or 1 kilogram of water 1° C. In English units this is equivalent to the amount of heat required to raise the temperature of 1 pound of water 4° F. This unit is called the large Calorie, and is written capitalized to distinguish it from the small calorie.

The total calorific value of a food is equal to the sum of the calorific values of the different nutritive constituents. The entire food is, however, not utilized by the animal, and the calorific value of each nutrient must be determined not on the total amount of nutrient present, but only that part which is digestible. Also, in the processes of digestion there are formed certain intermediate waste products that still possess potential energy, and the energy of the digestible portion of the food must be corrected by the amount of energy in these waste products in order to determine the true amount of energy in the food actually utilized by the animal. This resultant energy

utilized by the animal has been termed available energy or, better, metabolizable energy.^a

The loss of energy due to waste products other than undigested food varies with different animals and with each of the nutrients, so that the corrections necessary can only be made after direct experiment. Such experiments have been made upon carnivorous animals (dogs) by Rübner, and his results giving the available or metabolizable energy of each of the three groups of nutrients have been accepted and applied to other animals as well. Within recent years, however, Kellner and others have carried out experiments with other animals, especially herbivorous animals, and it has been found that the figures given by Rübner for dogs do not apply to herbivorous animals. Kellner's work was with mature fattening cattle, and the following table gives the total calorific value and metabolizable energy in Calories per pound for each of the three groups of nutrients as found by Kellner and the metabolizable energy as found by Rübner. In Kellner's work the corrections were made on the values for wheat gluten as protein, on ordinary ether extract, and on starch as carbohydrates.

TABLE IV.—*Metabolizable energy of nutrients per pound.*

Nutrient	Cattle (Kellner).		Dogs (Rübner)
	Total calorific value.	Metabolizable energy.	Metabolizable energy.
	<i>Calories.</i>	<i>Calories.</i>	<i>Calories.</i>
Protein.....	2,720	2,220	1,860
Ether extract.....	3,780	3,780	4,220
Carbohydrates.....	1,900	1,710	1,860

These figures mean that for every pound of protein digested by cattle 2,720 Calories of energy are produced, but only 2,220 Calories are really available from the food metabolized by the animal for the production of energy or flesh. From the ether extract 3,780 Calories of energy are produced for every pound digested, and of this the entire amount represents metabolized food. The carbohydrates possess 1,900 Calories per pound of total energy, while only 1,710 Calories are yielded by the food really metabolized.

From Table III (p. 10), which gives the amount of total and digestible nutrients, the energy yielded by the metabolized food for the production of animal energy or flesh can be calculated. The following table gives the total nutrients, digestible nutrients, and

^a Armsby, Principles of Animal Nutrition, 1906, p. 270.

metabolizable energy. The last is calculated both according to the figures of Kellner and of Rübner, for the purpose of comparison:

TABLE V.—*Metabolizable energy.*

[Pounds per hundred pounds.]

Grain.	Protein.				Fat.			
	Total nutri-ents.	Digestible nutri-ents.	Fuel value.		Total nutri-ents.	Digestible nutri-ents.	Fuel value.	
			Calories (Kellner).	Calories (Rübner).			Calories (Kellner).	Calories (Rübner).
Oats.....	13.76	10.73	19,958	23,820	4.33	3.59	15,150	13,570
Emmer.....	13.28	9.96	18,525	22,110	1.91	1.36	5,740	5,141
Einkorn.....	14.67	11.00	20,460	24,420	2.19	1.55	6,542	5,860
Wheat.....	14.20	11.93	22,190	26,490	2.36	1.49	6,288	5,632
Rye.....	13.44	11.29	21,000	25,060	1.83	1.17	4,938	4,423
Barley.....	13.39	9.37	17,428	20,800	1.89	1.66	7,005	6,275
Proso.....	12.77	6.28	11,680	13,940	3.27	2.51	10,592	9,488
Sorghum.....	11.71	7.61	14,154	16,890	3.25	2.27	9,580	8,581
Maize.....	9.91	7.14	13,280	15,850	4.40	3.92	16,542	14,820

Grain.	Crude fiber.				Carbohydrate.				Total fuel value.	
	Total nutri-ents.	Digestible nutri-ents.	Fuel value.		Total nutri-ents.	Digestible nutri-ents.	Fuel value.		Calories (Kellner).	Calories (Rübner.)
			Calories (Kellner).	Calories (Rübner.)			Calories (Kellner).	Calories (Rübner.)		
Oats.....	12.20	3.17	5,896	5,421	66.29	51.04	94,940	87,280	135,944	130,091
Emmer.....	11.31	4.98	9,263	8,516	69.42	52.06	96,830	89,020	130,358	124,787
Einkorn.....	13.55	5.96	11,085	10,190	64.02	48.04	89,320	82,150	127,407	122,620
Wheat.....	2.78	1.30	2,418	2,223	78.72	72.42	134,690	123,840	165,586	158,185
Rye.....	2.30	1.22	2,269	2,086	80.24	73.82	137,320	126,230	165,527	157,799
Barley.....	5.64	1.86	3,460	3,181	76.05	69.96	130,120	119,630	158,013	149,886
Proso.....	8.95	6.11	11,364	10,450	71.23	60.69	112,880	103,780	146,516	137,658
Sorghum.....	1.80	0.92	1,711	1,573	81.58	74.24	138,080	126,950	163,525	153,994
Maize.....	2.21	1.28	2,380	2,190	81.96	77.86	144,820	133,140	177,022	166,000

As before stated, the metabolizable energy of a food is the total amount of energy which an animal is able to derive from that portion of food that is digested and actually used by it after allowing for all waste. This was originally termed the available energy of the food and was considered to be a measure of the value of the food. There are, however, still other factors entering into the problem that need to be considered which make it necessary to distinguish between this available or metabolizable energy and the net available energy of the food.

The animal body has been likened by Armsby to a steam boiler fed by means of a mechanical stoker, the power for operating which comes from the steam generated in the boiler itself. The available energy of the coal for producing steam power is equivalent to the fuel value of the coal less that of the refuse and again diminished by the amount of energy used in operating the mechanical stoker. Similar conditions obtain in the animal body. In order to get the food and chew and digest it, a certain amount of the animal energy

must be used, and the real available energy of the food is therefore equivalent to the metabolizable energy, or gross available energy, less the energy expended during the eating and digestion.

PRODUCTION VALUE.

The finally available energy of the food may be of value in two ways, depending on the object for which the animal is fed. It may be desired simply to prevent the loss of flesh or energy, i. e., the object may be to maintain the animal in all respects in a certain desirable condition. Food given for such a purpose is known as a "maintenance ration," and each of the nutrients has a value as a part of such a ration, which value can only be determined by experiments on animals, for it has been found that the metabolizable energy and the energy as maintenance are not equal. This work has been done by Armsby,^a who found in general that 62.92 per cent of the metabolizable energy of clover hay was available for maintenance.

On the other hand, a ration may be fed to animals for the purpose of producing increase in flesh, and consequently more than a maintenance ration must be given. In this case, that part of the food that is in excess of what is required for maintenance is used by the animal for increase in flesh and has a definite value as such. In experiments to determine the value of a given food for producing flesh, the material is fed in addition to a basal maintenance ration and its value determined as measured by the gain in flesh produced. The value so found has been termed the *production value* of the food. Kellner^b has determined these production values for the pure nutrients when fed in addition to a basal maintenance ration to mature fattening cattle. He found that while the ratio of the nutrients to each other remained nearly the same the actual values for production are only about one-half the metabolizable values.

TABLE VI.—Comparison of metabolizable energy and production value of nutrients per pound.

Nutrient.	Metabolizable energy.	Production value.
	Calories.	Calories.
Protein.....	2,220	1,016
Ether extract.....	3,780	2,273
Carbohydrates.....	1,710	1,071

The most direct and the simplest method of expressing this production value is in Calories per pound or per 100 pounds, as is done by Armsby^c in recent publications of the Pennsylvania agricultural

^a Pennsylvania Agr. Exp. Sta. (1905), Bul. 71, p. 12.

^b Loc. cit., p. 153.

^c Loc. cit.

experiment station in cooperation with the Bureau of Animal Industry of the Department of Agriculture. In Kellner's work, however, the values are expressed in different terms. It has been found^a that the production values in Calories for the various nutrients correspond to the production of a definite weight of body tissue, chiefly fat. The figures so obtained are as follows:

TABLE VII.—*Production value of nutrients of foods.*

Nutrient.	Production value.	
	Calories per pound.	Pounds flesh gained per 100 pounds nutrient.
Protein.....	1,016	23.5
Ether extract:		
Coarse fodders.....	2,041	47.4
Grains.....	2,273	52.6
Concentrated foods.....	2,585	59.8
Starch and crude fiber.....	1,071	24.8
Sugar.....	812	18.8

If one of these nutrients be selected as a standard and its value, stated in Calories or in pounds flesh gained, be regarded as unity, the total production value may also be expressed in terms of this unit. Starch is the nutrient that has been taken as unity in this case, and its value of 1,071 Calories per pound, or 24.8 pounds of fat gained per hundred pounds, is the unit of measurement. The value of each nutrient in pounds of starch is calculated, and from this the total value of the food in pounds of starch, equivalent to 100 pounds of the food, is obtained. This is termed the starch value (or "Stärkewert").

There are, then, three terms in which the production value of a food may be expressed: (1) Calories per 100 pounds; (2) pounds of flesh gained per 100 pounds; (3) starch value per 100 pounds. These three methods of expression are illustrated and shown comparatively in Table VIII, giving the digestible nutrients and the individual and total production values in terms of each unit described.

TABLE VIII.—*Production value of various foods expressed according to three methods.*

[Pounds per hundred pounds of dry matter.]

Grain.	Protein.				Ether extract.			
	Digestible.	Production value.			Digestible.	Production value.		
		Calories.	Flesh gained.	Starch value.		Calories.	Flesh gained.	Starch value.
Oats.....	10.73	10,893	2.52	10.2	3.59	8,171	1.89	7.6
Emmer.....	9.96	10,127	2.34	9.4	1.36	3,068	.71	2.9
Einkorn.....	11.00	11,153	2.58	10.4	1.55	3,502	.81	3.3
Wheat.....	11.93	12,233	2.83	11.4	1.49	3,372	.78	3.1
Rye.....	11.29	11,457	2.65	10.7	1.17	2,637	.61	2.5
Barley.....	9.37	9,511	2.20	8.9	1.66	3,761	.87	3.5
Proso.....	6.28	6,398	1.48	6.0	2.51	5,706	1.32	5.3
Sorghum.....	7.61	7,738	1.79	7.2	2.27	5,144	1.19	4.8
Maize.....	7.14	7,263	1.68	6.8	3.92	8,906	2.06	8.3

^a Kellner, loc. cit., pp. 153, 379.

TABLE VIII.—*Production value of various foods expressed according to three methods—Con.*

Grain.	Crude fiber.				Carbohydrates.				Total production value.		
	Diges- tible.	Production value.			Diges- tible.	Production value.					
		Calo- ries.	Flesh gained.	Starch value.		Calo- ries.	Flesh gained.	Starch value.	Calo- ries.	Flesh gained.	Starch value.
Oats.....	3.17	3,415	0.79	3.2	51.04	54,730	12.66	51.0	77,209	17.86	72.0
Emmer.....	4.98	5,360	1.24	5.0	52.06	55,810	12.91	52.1	74,356	17.20	69.4
Einkorn.....	5.96	6,398	1.48	6.0	48.04	51,620	11.94	48.1	72,673	16.81	67.8
Wheat.....	1.30	1,383	.32	1.3	72.42	77,642	17.96	72.4	94,500	21.86	88.1
Rye.....	1.22	1,297	.30	1.2	73.82	71,958	18.31	73.8	94,544	21.87	88.2
Barley.....	1.86	1,989	.46	1.8	69.96	75,005	17.35	70.0	90,264	20.88	84.2
Proso.....	6.11	6,571	1.52	6.1	60.69	65,062	15.05	60.7	83,736	19.37	78.1
Sorghum.....	.92	9,443	.23	.9	74.24	79,590	18.41	74.2	93,463	21.62	87.2
Maize.....	1.28	1,383	.32	1.3	77.86	83,480	19.31	77.9	100,985	23.36	94.2

The advantage in expressing the production values in Calories per hundred pounds is that the results are easily comparable, whether the object of feeding is the production of flesh, as with fattening cattle, or the production of muscular energy, as with work horses. The disadvantage is that the unit is so small that the number expressing the final value is too large to convey a distinct idea concerning it. Numbers of five and six figures are difficult to grasp readily, and though differences are at the same time magnified the real meaning of the results is harder to comprehend with large numbers than with smaller ones. It is also true that to the average mind not trained in scientific thought the term "Calories per hundred pounds" is much more vague than either "pounds of flesh" gained or even the "starch value." The last, while expressed in numbers which are as easily compared as those expressing pounds of flesh gained, is not quite so commonly understood and, though readily transferable for either flesh or energy production, it has been set aside, the preference being given to the expression "pounds of flesh gained per hundred pounds of food." This term is readily understood by all who feed stock and is definite and applicable in the majority of cases.^a

On account of these facts, the production values for each nutrient and for the whole food have been calculated and expressed in this investigation in terms of "pounds of flesh gained per hundred pounds of food." Attention must be called to the fact that this term does not mean exactly pounds of live weight gained, for the latter includes with the gain in the flesh or fat the increase in water also and will therefore always be somewhat higher. However, while not exactly synonymous, the two terms are approximately the same and express the increase in flesh or weight as the result of feeding 100 pounds of food in addition to a basal maintenance ration.

^aSince the above was written, Armsby (Science, 1907, 26: 670) has proposed a new unit for the energy value of rations, namely, the "Therm=T," equivalent to 1,000 large Calories, or 1,000,000 gram calories.

COMPARATIVE NUTRITIVE VALUE AND NUTRITIVE RATIO.

According to the figures given by Rübner for the metabolizable energy of the nutrients of food, protein and starch have an equal value, namely, 1,860 Calories, while the ether extract has 2.25 times as much, namely, 4,220 Calories. This relation has led to the use of two factors for valuation based directly on the amount of digestible nutrients present. If the amount of ether extract is multiplied by 2.25 it is then measured on the same scale as the other nutrients and the sum of the amounts of all the nutrients is therefore directly comparable, one food with another. The total amount of nutrients so found is known as the comparative nutritive value; that is, comparative nutritive value = protein + carbohydrate + (ether extract $\times$ 2.25). The figures thus obtained express the relative value of foods measured by the amount of digestible nutrients present.

Another factor based on these facts is the nutritive ratio which expresses the relative amounts, in a food, of the two classes of nutrients, namely, the heat-producing nutrients and those producing flesh or tissue. The proteins of a food are the constituents which build up the tissue of the animal and are productive of muscular energy. The carbohydrates and fats, on the other hand, are chiefly heat or fat producers. The ratio between these two groups has been long considered as of value in indicating the general character of the food as fattening and heat producing or as productive of increased muscular tissue and energy.

This ratio, "protein : (carbohydrates + ether extract $\times$ 2.25) :: 1 : x," is termed "broad" when it is :: 1 : 8-12 as in maize and indicates a predominance of heating or fattening elements; and it is termed "narrow" when it is :: 1 : 4-7, as in oats, in which the constituents producing muscular tissue are in excess. The comparative nutritive value and the nutritive ratio of these grains, which have been discussed in the preceding tables, are shown in Table IX.

TABLE IX.—Comparative nutritive value and nutritive ratio of grains.

Grain.	Comparative nutritive value.	Nutritive ratio.	Grain.	Comparative nutritive value.	Nutritive ratio.
Oats.....	73.01	5.8	Barley.....	84.92	8.0
Emmer.....	70.06	6.0	Proso.....	78.73	11.5
Einkorn.....	68.49	5.2	Sorghum.....	87.88	10.5
Wheat.....	89.00	6.5	Maize.....	95.10	12.3
Rye.....	88.96	6.9			

Table IX shows clearly the significance of the term "nutritive ratio" as exemplified by the two characteristically different grains maize and oats, the former being a heat-producing food with a ratio 1:12.3, and the latter a tissue-forming food whose ratio is 1:5.8.

PLAN OF THE PRESENT INVESTIGATION.

METHOD OF ESTIMATING THE RELATIVE FOOD VALUES OF GRAINS.

While the direct experimental method is without question the one on which to rely for the determination of the maintenance or production values of feeding stuffs, it is not always possible to make such investigations on living animals with a large number of foods. Such direct experiments have been made both in this country and Europe by the investigators previously mentioned, and their work embraces quite a number of different animals and foods. Taking the results of these investigations as a basis, and using the factors that have thus been found to apply to certain animals and certain foods, it is possible to calculate from simple analytical data the production values of a larger number of samples of feeding stuffs than could possibly be determined in any other way. The production values and nutritive ratios of foods thus determined form the best basis now available for a comparative or even for an actual valuation of stock foods.

In the present investigation of the feeding value of cereal grains this method has been used to determine the relative value of the different grains studied. It is not claimed that these results are as accurate as those that would have been obtained had careful feeding experiments been made with each sample, but as the factors used in calculating the final values are based upon average results with each group or class of grain studied, the calculated values are the best obtainable from simple analytical results. Neither total fuel value, total metabolizable energy, nor comparative nutritive value have been calculated, because with grains, where the chief object in feeding is the production of flesh, the production value and nutritive ratio express the values best. As stated previously, the factors used are those given by Kellner, except in the case of sorghum, to which material the recent results of Tangl are more applicable. For coefficients of digestibility as given in Table II (p. 9), figures for the identical species of cereal were used when this was known without question, as with oats, barley, rye, wheat, and maize. For emmer and einkorn the figures are those for the German "Spelzweizen," which is identical with one, but not with the other. The two grains are, however, so similar that little error is probably introduced. For nonsaccharine sorghums, the figures are those for "Dari," and for proso, Tangl's figures for "Besenhirsekorn," fed to oxen. For production values the factors of Kellner given in Tables VI and VII (pp. 13 and 14) are used.

DESCRIPTION OF MATERIAL EXAMINED.

The material examined in the present investigation consists of samples of different grains that have been under field trial by the Office of Grain Investigations of the Bureau of Plant Industry dur-

ing the last few years. The following cereal grains are represented: Oats, emmer, einkorn, wheat, rye, barley, proso, sorghum, and maize. Under each class the samples consist, when possible, of both the original imported seed and grain grown from this seed in various sections of the United States.

The greater part of the work on the introduction of new cereal grains has had to do with the semiarid regions of this country, the cereals introduced having been selected either on account of (1) drought-resistant qualities, or (2) rust or disease resistance, in addition to their yield and general character. Whether or not these qualities are maintained on introduction into this country can only be determined by field tests, moreover, two questions arise in regard to these introduced grains: (1) Are they of equal or superior quality to domestic varieties, and (2) do they maintain their characteristic properties and qualities when grown for successive years in the United States.

The analyses made in this investigation and their correlation for the relative valuation of the samples studied are an attempt to answer these questions without entering into a study of the direct effect of change of environment on the properties of cereals.

DISCUSSION OF RESULTS.

The complete tabular results of all analyses with the calculated production values for each nutrient and for the whole food are given in the tables at the close of the bulletin (p. 48). The discussion of tables of average results are presented in the following pages, each cereal being discussed under a separate caption.

OATS (*Avena sativa*).

COMPARISON OF DOMESTIC AND FOREIGN OATS.

The present investigation was undertaken primarily to study the properties and composition of the Swedish Select oat, a very desirable variety, the seed of which was introduced from Russia in 1899 by the Office of Grain Investigations, U. S. Department of Agriculture. This oat is especially resistant to drought and rust, is strong and hardy, and makes a good yield. It answers, therefore, particularly well all the requirements for introduction.

Among the oats analyzed there are 128 samples of the Swedish Select oat grown in various sections of the United States. In addition to these, there are 89 samples from 13 varieties of introduced oats which have been grown in the United States for a short time, usually not more than three years. There are also 25 samples, representing 10 varieties of purely domestic oats. This makes 242 samples, representing 24 varieties of oats grown in the United States either from purely domestic seed or from recently introduced

foreign seed. For comparison with these analyses, 54 samples, representing 37 varieties of strictly foreign-grown oats, were analyzed, including most of the varieties represented in the two classes of introduced oats just mentioned.

This selection of samples makes it possible to compare domestic and foreign grown oats in general, as well as samples of the same variety grown in Europe and in this country and different varieties of introduced grain that have been grown in the United States for several years.

The composition of a typical domestic oat, expressed both as total and digestible nutrients, has been given as follows: ^a

TABLE X.—*Typical United States oats.*

[Recalculated to dry basis per hundred pounds.]

Nutrient.	Total.	Digestible.
	Pounds.	Pounds.
Moisture.....	10.00	.....
Protein.....	13.33	10.40
Fat.....	5.00	4.15
Crude fiber.....	13.33	3.46
Carbohydrate.....	64.44	49.62

The mean of 72 samples of United States and Canadian oats analyzed at the Columbian Exposition in Chicago in 1893 is given in Table XI.^b

TABLE XI.—*United States and Canadian oats, 1893.*

[Recalculated to dry basis per hundred pounds.]

Nutrient.	Total.	Digestible.
	Pounds.	Pounds.
Moisture.....	9.96	.....
Protein.....	13.40	10.45
Fat.....	4.91	4.07
Crude fiber.....	13.24	3.44
Carbohydrate.....	64.73	49.84

The mean of 25 samples of purely domestic oats studied in this investigation has been found to be as follows:

TABLE XII.—*United States oats, 1906.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	Pounds.	Pounds.
Moisture.....	8.20	.....
Protein.....	13.60	10.60
Fat.....	5.62	4.67
Crude fiber.....	11.46	2.98
Carbohydrate.....	65.18	50.19

^a U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1180.^b U. S. Dept. Agr., Bureau of Chemistry, 1895, Bul. 45, p. 29.

The 128 samples of Swedish Select oats grown in the United States were found to have a mean composition as follows:

TABLE XIII.—*Swedish Select oats.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	<i>Pounds.</i>	<i>Pounds.</i>
Moisture.....	7.10	
Protein.....	12.85	10.02
Fat.....	4.00	3.32
Crude fiber.....	12.23	3.18
Carbohydrate.....	66.99	51.58

The mean of 242 samples of recently introduced miscellaneous varieties grown in the United States was found to be as follows:

TABLE XIV.—*Miscellaneous introduced varieties of oats.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	<i>Pounds.</i>	<i>Pounds.</i>
Moisture.....	7.82	
Protein.....	13.76	10.73
Fat.....	4.33	3.59
Crude fiber.....	12.20	3.17
Carbohydrate.....	66.29	51.04

Fifty-four samples of foreign-grown oats, including most of the varieties represented in Table XIV, were found to have the mean composition shown in Table XV.

TABLE XV.—*Foreign oats.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	<i>Pounds.</i>	<i>Pounds.</i>
Moisture.....	8.31	
Protein.....	11.63	9.07
Fat.....	5.86	4.86
Crude fiber.....	10.89	2.83
Carbohydrate.....	67.91	52.28

Table XVI gives the digestible nutrients, the total production values, and the nutritive ratios of these representative groups, together with a few analyses obtained from other sources, the last named being calculated from the original analyses reported in the places cited.

TABLE XVI.—*Group values for digestible nutrients, production value, and nutritive ratio of oats, domestic and foreign.*

[Pounds per hundred pounds of dry matter.]

Description of grain.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrate.	Calories.	Gain in flesh.	
Typical United States, 1898 ^a		10.40	4.15	3.46	49.62	77,395	17.88	6.0
Mean, United States and Canada, 1893 ^b	72	10.45	4.07	3.44	49.84	77,049	17.80	6.0
Miscellaneous, United States, 1906.....	242	10.73	3.59	3.17	51.04	77,209	17.86	5.8
Strictly United States, 1906.....	25	10.60	4.67	2.98	50.19	78,377	18.11	6.0
Swedish Select, United States, 1906.....	128	10.02	3.32	3.18	51.58	76,431	17.68	6.2
Miscellaneous European, 1906.....	54	9.07	4.86	2.83	52.28	79,327	18.35	7.3
Foreign ^c		9.26	4.59	3.09	51.69	78,510	18.17	7.0
Foreign ^d	307	9.07	5.02	2.93	51.57	79,024	18.28	7.2

^a U. S. Department of Agriculture, Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1180.^b U. S. Department of Agriculture, Bureau of Chemistry, 1895, Bul. 45, p. 29.^c Kellner, loc. cit., p. 561, recalculated to dry basis.^d König, *Chemie der menschlichen Nahrungs- und Genussmittel*, 1903, p. 533, recalculated to dry basis.

It will be seen from these data that there is a distinct difference between the foreign-grown oats and those grown in the United States. The foreign-grown oats, such as the miscellaneous samples reported by König, the standard used by Kellner, and the 54 samples of foreign-grown oats analyzed in the present investigation, show these differences plainly. This variation in composition may be stated as follows: Oats grown in the United States are characterized, as a rule, by higher protein, lower carbohydrate, lower fat, and higher crude fiber. These differences in composition affect the production value and the nutritive ratio, often making the former lower in the oats grown in the United States and the latter narrower. The differences in the production values are not great, however; the maximum difference in pounds of flesh gained between the domestic-grown Swedish Select oat (17.68 pounds) and the miscellaneous foreign oats analyzed in this bulletin (18.35 pounds) being only 0.67 pound, while the minimum difference between the highest domestic oat and the lowest foreign oat was only 0.06 pound of flesh gained per hundred pounds of oats fed. The results obtained in the present study afford a direct comparison of the foreign oat and the same oat grown in the United States, since in most cases the domestic-grown oat was obtained from the same seed as the sample from which the analysis of the foreign oat was made.

TABLE XVII.—*Comparison of domestic and foreign grown oats of the same varieties.*

[Per hundred pounds of dry matter.]

Variety.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrate.	Calories.	Gain in flesh.	
Swedish Select:		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>		<i>Lbs.</i>	
Foreign.....	3	9.89	3.62	2.98	52.89	78,160	18.08	6.5
United States.....	128	10.02	3.32	3.18	51.58	76,431	17.68	6.2
Belgian Winter:								
Foreign.....	4	8.76	5.66	2.28	54.00	82,115	18.99	7.9
United States.....	4	8.82	4.38	3.56	49.97	76,258	17.64	7.2
Tobolsk:								
Foreign.....	2	9.68	5.06	3.35	50.68	79,262	18.33	6.8
United States.....	9	10.12	4.08	3.49	50.30	77,252	17.87	6.2
North Finnish Black:								
Foreign.....	3	8.19	4.54	2.75	51.37	78,949	18.26	6.3
United States.....	12	9.44	4.06	3.44	50.56	76,733	17.75	6.7
Shatilov:								
Foreign.....	1	9.41	4.81	3.47	49.93	77,727	17.98	6.8
United States.....	1	9.19	3.43	5.00	46.57	72,410	16.75	6.4
Red Algerian:								
Foreign.....	1	8.24	4.98	2.75	52.70	79,154	18.31	8.1
United States.....	10	10.29	4.32	3.18	49.75	77,036	17.82	6.1
United States.....	164	+	—	+	—	—	—	—
Foreign.....	14	—	+	—	+	+	+	+

^a The United States grown Shatilov has less protein than the foreign.^b The United States grown North Finnish Black has a broader nutritive ratio than the foreign.

In considering this table it will be noticed that while in most cases the number of domestic samples was considerably larger than the number of foreign and in two cases only one sample each was analyzed, still the comparison is even more striking than in the preceding table. The general statement that the domestic oats contain more protein and crude fiber and less fat and carbohydrate with a lower total production value and a narrower nutritive ratio is upheld by the results in this table with two exceptions. Of the variety Shatilov, only one sample each of domestic and foreign origin having been analyzed, the domestic grain fell below the foreign grown in protein content though it showed the characteristic composition in all other points. The North Finnish Black domestic-grown oat showed the characteristic distinction from the foreign grown in all the nutritive constituents and in the production value, but in the nutritive ratio it differed by being broader, not narrower, than the foreign-grown grain.

These characteristic differences, as shown by average results, are exemplified in a striking way by some individual cases, though, of course, there are also some marked exceptions. The group averages for protein content of domestic and foreign oats show a higher protein content for the domestic samples (Table XVIII, p. 24), and the complete table of individual data (Table XXXVIII, p. 48) shows that of the 54 foreign-grown samples there is only one that has a protein content above the average of the domestic grain. This is No. 1224, North Finnish Black grown in Finland, with digestible protein per hundred pounds amounting to 12.33 pounds, the average of all United

States samples being 10.73 pounds. Of the 242 domestic samples there are only 58 which fell below the average (9.07 pounds) of foreign-grown oats in protein content, and furthermore there is only one sample out of the 54 foreign-grown oats which has a nutritive ratio as narrow or narrower than the average of the United States samples, namely 5.8. This is the same sample, No. 1224, with a nutritive ratio of 5.1. There are only 39 of the 242 domestic samples which have a nutritive ratio as broad or broader than the average (7.3) of the foreign. Three foreign samples show a production value as low, or lower, than the average United States grain, while there are 18 samples of the United States oats that have a production value as high or higher than the maximum foreign grown.

Of the United States samples the variety which gave the highest average protein content is the Sixty Day oat, 39 samples of which had an average digestible protein content of 11.46 pounds. The highest individual samples were two samples of Sixty Day oat, one grown in Ohio, No. 1297, with 15.40 pounds digestible protein, and the other in South Dakota, No. 1274, with 15.12 pounds. These three instances were also the ones showing the narrowest nutritive ratios, which were, respectively, 5.3, 3.7, and 3.9. The lowest average protein content of the United States grain was found in four samples of Belgian Winter, which gave 8.82 pounds of digestible protein, being 0.25 pound lower than the average foreign oats and only 0.06 pound higher than the four corresponding samples of Belgian Winter grown in Europe. The nutritive ratio of these domestic Belgian Winter samples was the broadest of all of the United States oats, namely, 7.2, only 0.1 lower than the foreign average.

Thus it is evident that the characteristic tendency of the oats grown in the United States, when compared with oats grown in Europe, is toward a higher protein content with a correspondingly lower amount of carbohydrate, resulting in a narrow nutritive ratio combined with a slightly lower production value.

In comparison with the other cereals, oats belong to the energy or muscle-producing grains with high protein and narrow nutritive ratio as contrasted with the fat or heat-producing grains, such as maize, which possess a smaller amount of protein and a broad nutritive ratio. As shown by Tables XVI and XVII, the oats grown in the United States appear to be less inclined toward the maize type and to have their oat characteristics more strongly emphasized than do the same or similar varieties grown in Europe.

TABLE XVIII.—Oats analyses—average results.

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N × 6.25).				Fat.			Crude fiber.			Carbohydrate.			Total production value.	
						Total.	Digestible.	Production value.	(Gain in flesh.)	Total.	Digestible.	Production value.	(Gain in flesh.)	Total.	Digestible.	Production value.	(Gain in flesh.)	Calories.	Nutritive ratio.	
54	Miscellaneous.....	Foreign.....	8.31	91.69	3.61	11.63	9.07	2.37	5.86	4.86	2.56	10.89	2.83	0.70	67.91	52.28	12.96	18.35	79,327	7.3
2	Hubless.....	do.....	8.04	91.96	2.51	18.37	14.33	2.37	3.26	3.30	2.74	12.80	3.73	.18	70.05	53.94	13.37	19.66	84,900	4.6
128	Swedish Select.....	United States.....	7.10	92.90	3.90	12.85	10.02	2.35	3.90	3.32	2.15	12.23	3.18	.78	66.99	51.58	13.79	17.08	76,431	6.2
39	Sixty Day.....	do.....	8.90	91.10	3.94	14.69	12.97	2.69	3.89	3.23	2.15	13.40	2.86	.71	66.55	51.24	12.71	17.81	76,993	5.3
9	Tobolsk.....	do.....	8.53	91.47	3.37	12.97	10.12	2.38	4.91	4.08	1.80	13.43	3.49	.87	65.32	50.30	12.47	17.87	72,410	6.2
2	Shadlov.....	do.....	8.99	91.01	4.39	11.78	9.19	2.07	4.13	3.43	1.24	19.25	5.00	1.24	60.44	46.57	11.55	16.75	72,410	6.4
4	Belgian winter.....	do.....	8.18	91.82	4.80	11.31	8.82	2.07	4.23	3.38	2.22	13.69	3.56	.88	64.90	46.97	12.39	17.64	76,258	7.2
12	North Finnish black.....	do.....	8.76	91.24	4.00	12.10	9.44	2.22	4.89	4.06	2.14	13.32	3.44	.85	65.67	50.58	11.83	17.75	76,733	6.7
3	Crown red.....	do.....	8.70	91.28	4.64	13.25	10.34	2.43	4.33	3.59	1.89	15.81	4.11	1.02	61.97	47.71	11.54	17.17	74,226	5.8
8	Rust proof.....	do.....	7.74	92.26	3.75	12.74	9.94	2.44	4.61	3.83	2.01	11.73	3.02	.75	65.72	50.60	12.55	17.75	76,733	6.0
5	Culberson winter.....	do.....	8.74	91.26	3.56	12.74	9.94	2.34	4.91	4.15	2.27	11.73	3.05	.76	65.72	50.60	12.55	18.36	79,370	6.6
10	Red Algerian.....	do.....	8.61	91.39	4.74	13.19	10.29	2.42	5.20	4.52	2.71	12.25	3.07	.79	64.62	49.02	12.34	17.82	77,036	6.2
7	Burt.....	do.....	8.56	91.44	4.37	14.24	11.19	2.63	6.21	5.15	2.71	11.41	2.97	.74	63.67	49.02	12.36	18.24	78,852	5.7
2	Snom.....	do.....	8.84	91.31	3.42	12.22	10.31	2.42	6.23	5.17	2.16	12.58	3.27	.81	67.85	52.24	12.95	18.69	80,797	6.4
13	Miscellaneous.....	do.....	8.37	91.63	4.06	12.96	10.11	2.38	6.13	4.91	2.16	12.58	3.27	.81	67.85	52.24	12.46	17.81	76,993	6.2
242	All U. S. varieties.....	do.....	7.82	92.18	3.96	13.76	10.73	2.52	4.33	3.59	1.80	12.20	3.17	.79	66.20	51.04	12.66	17.86	77,209	5.8
25	Purely domestic.....	do.....	8.20	91.80	3.86	13.00	10.00	2.49	5.62	4.67	2.55	11.46	2.98	.74	65.18	50.19	12.44	18.11	78,289	6.0
19	Swedish select.....	Nebraska.....	6.63	93.37	4.39	12.66	9.87	2.32	3.74	3.10	1.63	14.22	3.70	.92	64.94	50.00	12.40	17.27	74,658	6.1
14	do.....	South Dakota.....	6.87	93.13	3.84	13.13	10.24	2.41	4.48	3.72	1.96	12.13	3.15	.78	66.42	51.14	12.68	17.83	77,079	6.1
14	do.....	Iowa.....	6.68	93.32	4.02	11.40	8.89	2.09	3.87	3.21	1.69	13.96	3.63	.90	66.80	51.44	12.76	17.44	75,393	7.0
15	do.....	Michigan.....	7.03	92.97	3.56	12.94	10.09	2.37	4.62	3.54	1.76	11.83	3.08	.76	67.65	52.09	12.02	17.81	76,993	6.2
12	do.....	Wisconsin.....	6.67	93.33	3.53	11.49	8.96	2.11	4.11	3.41	1.79	12.35	3.21	.80	68.52	52.76	13.03	17.78	76,863	7.2
6	do.....	Montana.....	6.90	93.37	4.09	13.63	10.63	2.50	4.39	3.89	2.05	9.59	2.49	.62	68.00	52.36	12.98	18.15	78,463	6.0
6	do.....	Kansas.....	6.90	93.10	4.42	14.46	11.28	2.65	3.95	3.28	1.73	12.12	3.15	.73	68.92	49.99	12.40	17.56	75,912	5.4
5	do.....	Washington.....	7.40	92.60	3.78	12.66	9.87	2.32	4.45	3.69	1.94	11.09	2.62	.65	69.01	53.11	13.18	18.03	78,203	6.5
5	do.....	New York.....	7.20	92.71	3.39	13.01	10.15	2.39	3.54	2.94	1.55	11.03	2.88	.71	68.98	53.11	13.17	17.82	77,036	6.2
4	do.....	Pennsylvania.....	7.08	92.92	3.78	14.44	11.26	2.65	3.33	2.76	1.45	11.79	3.07	.73	66.00	51.33	12.73	17.59	76,041	5.4
4	do.....	Illinois.....	7.86	92.14	3.19	13.58	10.94	2.49	4.15	3.44	1.81	11.31	2.94	.76	67.77	52.18	12.94	17.97	77,684	5.9
4	do.....	Colorado.....	8.33	91.67	4.46	14.74	11.50	2.70	3.79	3.15	1.66	11.14	2.90	.71	65.87	50.72	12.88	17.66	76,344	5.3
3	do.....	North Carolina.....	7.11	92.80	4.03	12.63	9.85	2.31	3.41	2.83	1.49	12.99	3.38	.84	66.94	51.54	12.78	17.42	75,307	6.2

3	do.....	7.92	92.08	3.56	13.42	10.47	2.46	3.16	2.02	1.38	11.57	3.01	.75	68.19	52.50	13.02	17.61	76,128	5.9
3	do.....	7.76	92.24	4.57	11.83	9.23	2.17	4.61	3.63	2.01	9.92	2.58	.64	69.06	53.17	13.18	18.00	77,814	7.0
2	do.....	7.58	92.42	4.15	14.87	11.60	2.73	3.22	2.75	1.45	11.91	3.10	.77	65.73	50.61	12.55	17.50	75,652	5.2
2	do.....	7.79	91.21	4.47	11.81	9.21	2.16	3.06	2.21	1.16	15.84	4.12	1.02	62.41	48.05	11.92	10.26	70,292	6.2
2	do.....	8.47	90.53	3.57	12.47	9.73	2.29	5.05	4.19	2.20	9.84	2.50	.03	68.56	53.56	13.28	18.40	79,543	6.7
2	do.....	7.21	92.79	3.34	13.78	10.75	2.53	4.24	3.52	1.55	10.25	2.09	.67	68.28	52.57	13.04	18.09	78,203	5.9
3	do.....	8.50	91.50	3.21	13.79	10.76	2.53	4.04	3.55	1.76	10.66	2.77	.69	68.31	52.60	13.05	18.03	77,944	5.8
128	do.....	7.10	92.90	3.90	12.55	10.02	2.25	4.00	3.52	1.75	12.23	3.18	.79	66.99	51.58	12.79	17.68	76,450	6.2
14	Sixty Day	9.05	90.95	3.74	14.96	11.67	2.74	4.25	3.53	1.86	10.71	2.78	.69	66.33	51.07	12.60	17.95	77,598	5.3
4	do.....	8.38	91.62	4.09	14.78	11.53	2.71	4.25	3.53	1.86	10.10	2.63	.65	66.77	51.41	12.75	17.97	77,684	5.4
21	do.....	8.90	91.10	4.03	14.50	11.31	2.66	3.59	2.98	1.57	11.37	2.96	.73	66.65	51.32	12.73	17.69	76,473	5.4
39	do.....	8.90	91.10	3.94	14.69	11.46	2.69	3.89	3.23	1.70	11.00	2.86	.71	66.55	51.24	12.71	17.81	76,993	5.3
7	Tobolsk.....	8.44	91.56	3.82	12.64	9.70	2.23	4.96	4.12	2.17	13.89	3.61	.89	65.39	50.35	12.48	17.82	77,036	6.5
2	do.....	9.34	90.66	3.54	14.64	11.57	2.72	4.72	3.92	2.06	11.84	3.08	.76	65.05	50.08	12.42	17.96	77,641	5.3
9	do.....	8.53	91.47	3.37	12.97	10.12	2.78	4.91	4.08	2.15	13.43	3.49	.87	65.32	50.29	12.47	17.87	77,252	6.2
5	North Finnish black	9.33	90.67	4.03	11.66	9.69	2.14	3.81	3.16	1.66	15.74	4.09	1.01	64.75	49.85	12.36	17.17	74,226	6.7
7	do.....	8.35	91.65	3.98	12.42	9.69	2.28	5.67	4.71	2.48	11.59	3.01	.75	66.33	51.08	12.67	18.18	78,592	6.7
12	do.....	8.76	91.24	4.00	12.10	9.44	2.22	4.89	4.06	2.14	13.32	3.46	.86	65.67	50.56	12.54	17.76	76,777	6.7
2	Red Algerian.....	8.98	91.02	4.31	12.78	9.97	2.34	4.95	4.11	2.16	12.99	3.38	.84	64.98	50.05	12.41	17.75	76,712	6.3
8	do.....	8.51	91.49	4.55	13.29	10.36	2.44	5.26	4.37	2.30	12.07	3.14	.78	64.53	49.69	12.32	17.84	77,101	6.2
10	do.....	8.61	91.39	4.74	13.19	10.29	2.42	5.20	4.32	2.27	12.25	3.18	.79	64.62	49.75	12.24	17.82	77,036	6.2

PRODUCTIVE VALUE AND NUTRITIVE RATIO AS A BASIS FOR EXACT VALUATION.

From a study of the data presented in these or similar tables of analysis of feeding stuffs, it is seen that by considering simply differences in the amounts of the four nutritive constituents a very indefinite conclusion is often reached. If two distinctly different cereals are considered, such as oats and corn, the differences in the amounts of the nutritive constituents are considerable, as would be expected. When, however, we have to deal with cereals that are very similar, such as rye and wheat, or with simply different samples or varieties of the same cereal, the differences in the amounts of the nutritive constituents are so small and so nearly counterbalance each other that it is impossible to form any opinion as to their relative value based on these factors alone. It is, therefore, necessary to secure some factor that either sums up or magnifies the slight differences in composition if a true valuation of similar feeding stuffs is to be made. Even with such a factor it is natural that differences should not be great between different samples or different varieties of the same cereal. The most distinctly different foreign and domestic oat, for example, can not show wider differences in composition than are possible between plants belonging to the same species.

Various efforts have been made to obtain such a factor, and it has seemed to the writer that the best comparison and relative valuation of similar or slightly different samples of feeding materials is secured by a consideration of the *production value*, and especially when this is considered in connection with the *nutritive ratio*. The production value gives, in the most accurate terms known, the amount of energy (expressed either in calories, weight of flesh gained, or in any other unit), which a definite amount of a certain food will produce when fed as a production ration in addition to a basal maintenance ration. The nutritive ratio gives the relation between the protein and other nutrient constituents of a food, i. e., between the constituents essential in producing muscular energy and those essential in producing fat and heat. As the uses of various foods are different, one class for producing muscular energy or work and the other class for increasing flesh or maintaining animal heat, so the value of a food will depend upon the use for which it is intended, and it is not possible to use any factor for the valuation of foods without considering this point.

Cereal grains, as a class, are naturally much alike in their general composition, but may be divided into two subclasses or groups, the one typified by oats or wheat, high in protein, relatively low in carbohydrate, with a narrow nutritive ratio, and the other, typified by maize, being the opposite of the first, low (relatively) in protein, rich in carbohydrate, and with a broad nutritive ratio.

With these two typical grains as examples we may judge of the tendency of a variety or sample, under certain observed conditions

of growth, etc., to partake of the properties of one or the other of these extremes and in the case of these two cereals themselves to observe whether a variety or sample shows by its composition a more strongly typified individual of its class or whether it is less typical and inclined toward the other class.

TABLE XIX.—*Comparison of oats and maize as typical energy-producing and fat-producing cereals.*

[Pounds per hundred pounds of dry matter.]

Grain.	Digestible nutrients.				Production value.		Nutritive ratio.
	Protein.	Fat.	Crude fiber.	Carbohydrate.	Calories.	Flesh gained.	
Oats.....	10.73	3.59	3.17	51.04	77,209	17.86	5.8
Maize.....	7.14	3.92	1.28	77.86	100,985	23.36	10.5

The production value and the nutritive ratio being the summation or multiplication of the individual differences in composition are, as is so plainly shown in this table, much better adapted to serve as a basis for a relative valuation of the materials than is any one or all of the separate constituents. As has previously been pointed out, however, it can not be said, in this particular case, that because a hundred pounds of maize will produce an increase in flesh 5.5 pounds greater than can be produced with an equal weight of oats that therefore maize is more valuable than oats; or that because the nutritive ratio of oats is 4.7 lower than that of maize it is consequently of less value. It is true that the amount of productive energy in 100 pounds of maize is greater than in an equal amount of oats by some 23,000 Calories and its intrinsic food value is that much greater; but it is not true that, for all purposes, maize is a more valuable food than oats. It is impossible to compare the value of foods distinctly different in their nature and properties solely by means of any of the factors given in this table or previously discussed.

If, however, two samples or varieties of the same cereal or of two cereals very similar, such as rye and wheat, or emmer and einkorn, or proso and maize, are compared, then, from a consideration of these factors, a just and definite idea of their relative value as animal foods may be formed. A combination of the two factors—production value and nutritive ratio—gives the clearest and most trustworthy basis for such valuation. If two samples of oats or two samples of different cereals of the oat type are compared, it may be said that the one possessing the highest production value and the lowest or narrowest nutritive ratio is the most valuable for the feeding purposes for which oats are used, namely, as producers of muscular energy or working strength.

On the other hand, of two samples of maize, the one possessing the highest production value and the highest or broadest nutritive ratio is the most valuable as a fat-producing food. Of course it is true that differences are not always clean cut, so that allowance must often be made, and a difference in one factor may be more than counterbalanced by that in another; but, nevertheless, it is upon a consideration of these two factors that a true and just valuation of animal foods must be based.

In considering, then, the oats that have been under discussion the question now arises: Have these different varieties of foreign grain changed by their introduction into the United States, and, if so, is this change toward a still more strongly typical oat or in the reverse direction? This is without reference to the effect of the change of environment on the physiological properties of resistance to drought and disease, which must be determined by other studies.

In the tables on the comparison of domestic and foreign grown oats (Tables XVI and XVII, pp. 21 and 22) it is shown that the distinct difference between United States and foreign oats is that the former are higher in protein content and possess a narrower nutritive ratio and sometimes a lower production value. The important difference is not, however, in the production value, but in the nutritive ratio. Upon examination of the tables it appears that the differences in the production values are not great, and, though the foreign oats studied have the highest production values that were found, they are not much above the purely domestic oat, the maximum difference being about 0.25 pound of flesh gained per 100 pounds grain fed, or about 1,000 Calories or 1 Therm, according to the new unit of Armsby. The average production value for the five groups of United States oats given in Table XVI, page 21, is 17.87 pounds of flesh gained or 77,266 Calories, while the average of the three groups of foreign oats is only 18.26 pounds of flesh gained, or 78,954 Calories, a difference of only 0.39 pound of flesh gained, or 1,688 Calories. This difference is not large, especially when it is remembered that the purely domestic oats have a mean production value of 18.11 pounds of flesh gained, only 0.15 pound below the foreign average.

The nutritive ratio, however, shows a very noticeable difference. The nutritive ratio of the domestic oats, with one exception, varies from 1:4.6 to 1:6.6, while that of the foreign is 1:7.0 to 1:7.3. This shows clearly, in another way, the fact previously emphasized that the domestic oat is richer in protein. Table XX shows the different varieties of purely United States oats compared with the three groups of foreign oats.

TABLE XX.—*Different varieties of domestic oats compared with foreign oats.*

[Pounds per hundred pounds of dry matter.]

Variety.	No. of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbo-hydrate.	Flesh gained.	Calories.	
Domestic oats:								
Rust proof.....	8	10.39	3.83	3.02	50.60	17.75	76,733	6.0
Culberson Winter.....	5	9.94	5.15	3.05	50.62	18.36	79,370	6.6
Burt.....	7	11.19	5.15	2.97	49.02	18.24	78,852	5.7
Snoma.....	2	10.31	5.17	2.41	52.24	18.69	80,797	6.4
Prince Edward Island..	1	13.56	5.17	2.63	47.92	18.44	79,716	4.6
Big Four.....	1	8.77	3.80	3.91	50.37	17.52	75,739	7.2
White Russian.....	1	10.87	5.00	2.78	50.70	18.44	79,716	5.9
Mean.....	25	10.60	4.67	2.98	50.19	18.11	78,377	6.0
Typical U. S. oat, 1898 a.....		10.40	4.15	3.46	49.62	17.88	77,395	6.0
Mean U. S. and Can- ada, 1893 a.....	72	10.45	4.07	3.44	49.84	17.80	77,049	6.0
Foreign oats:								
Chamberlain.....	54	9.07	4.86	2.83	52.28	18.35	79,327	7.3
Kellner a.....		9.26	4.59	3.09	51.69	18.17	78,510	7.0
König a.....	307	9.07	5.02	2.93	51.57	18.28	79,024	7.2

a Chamberlain, loc. cit.

These are the results that without question should be used as a basis for the comparison of United States and foreign oats and on which we should decide whether introduced varieties are desirable so far as the effect of the introduction on their composition is concerned. An examination of the three results of (1) a typical United States oat as given in 1898, (2) the mean of 72 United States and Canadian samples in 1893, and (3) the mean of 25 samples of strictly United States oats of 1906 show that the typical oats grown in the United States at the three dates—1893, 1898, and 1906—are very nearly alike, especially in the more important factors—protein, carbohydrate, production value, and nutritive ratio—and that they differ materially from the foreign oats reported in this table.

This shows that the composition of United States oats, as given, is not obtained during one season nor on one variety, but that the average composition of oats grown in such different localities, as shown in the detailed tables given at the close of this bulletin (p. 48) and in different years, is distinctly different in certain points from a similar average composition of foreign oats.

The factor which shows the least variation is the production value. This means that while the amount of the nutritive constituents is different the real nutritive and productive value is only slightly changed. That is, while the food value of the domestic oats remains on the average nearly as high, and in individual instances is higher than the foreign oats, its distinctive character as producing muscle and energy rather than fat is emphasized. Thus, the mean of the purely domestic oats as to production value is only slightly lower than that of the foreign oats, namely, 18.11 pounds of flesh gained, or 78,377 Calories, compared with 18.17 to 18.35 pounds of flesh

gained, or 78,510 to 79,327 Calories. The difference in the nutritive ratios is, however, considerable, namely, 1:6.0 and 1:7.2. The loss, therefore, in production value appears to be more than compensated for by the gain in protein over carbohydrate.

It will be seen that the production value of the typical oat of 1893 and 1898, as well as that of the Rust Proof and Big Four varieties, is considerably lower than that of the other domestic oats and of the foreign oats. The cause of the higher production value of these other varieties is that the amount of fat is high, so that the production value is high, while at the same time the ratio of protein to carbohydrate is low.

If one individual variety, for example, domestic Swedish Select, be closely compared with the foreign seed, the same general relations are found to exist. From Tables XVII and XVIII (pp. 22 and 24) it is seen that in twelve States out of twenty the domestic oats increased in protein content over the original foreign seed, in four cases the production value increased, and in all but five the nutritive ratio became narrower.

From four States the protein was approximately equal to the foreign and only four out of the twenty fell below the foreign. The four States yielding oats containing less protein than the foreign seed were: Iowa (8.89), Wisconsin (8.96), Idaho (9.23), and Missouri (9.21), the foreign seed averaging 9.89. With Tobolsk, North Finnish Black, Belgian Winter, Red Algerian, and Shatilov, the only other varieties of which we have the analysis of the foreign seed from which the domestic grain was grown, the same facts are true, with the exception of Shatilov, as previously mentioned.

CONCLUSIONS.

The general conclusion, therefore, in regard to the oats is that the domestic grain is more strongly typical of its class than the foreign-grown oats, and that on introduction into the United States the foreign varieties change somewhat in composition, but this change is toward rather than away from the typical oat—this typical oat being characterized by high protein and narrow nutritive ratio, a grain essentially productive of muscular strength.

EMMER (*Triticum dicoccum*) AND EINKORN (*Triticum monococcum*).

These two cereals, emmer (*Triticum dicoccum*) and einkorn (*Triticum monococcum*), belong botanically to the same genus as wheat, but on account of the fact that they are both used as food without the removal of the hull they may better be compared with oats. The large amount of crude fiber reduces the protein and carbohydrate below that of wheat and lowers the production value even to less than that of oats. The nutritive ratio for einkorn likewise falls below that of oats, being as low as 1:5.2. Einkorn is more fibrous

than emmer, and has more crude fiber, a lower production value, and a narrower nutritive ratio. Table XXI shows a comparison of emmer, einkorn, and oats.

TABLE XXI.—*Comparison of the total and digestible nutrients of emmer, einkorn, and oats.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Nutrients.								Total production value.		Nutri- tive ratio.
	Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calo- ries.	
	Total.	Digest- ible.	Total.	Digest- ible.	Total.	Digest- ible.	Total.	Digest- ible.			
Emmer.....	13.28	9.96	1.91	1.36	11.31	4.98	69.42	52.06	17.20	74,356	6.0
Einkorn.....	14.67	11.00	2.19	1.55	13.55	5.96	64.02	48.04	16.81	72,670	5.2
Oats.....	13.76	10.73	4.33	3.59	12.20	3.17	66.29	51.04	17.86	77,209	5.8

The comparison of these three cereals will be discussed more fully in the general conclusion. There being only one sample of foreign emmer no comparison of domestic and foreign grain of these two varieties is possible. The highest protein content of the emmers was in a sample from South Dakota, 1903, No. 1051, having 18.69 pounds of total protein and 14.02 pounds of digestible protein per hundred pounds, the average protein being 13.28 pounds total and 9.96 pounds digestible.

In the case of the einkorn, No. 1065, a sample from Kansas, 1905, had the highest protein content, a total of 16.25 pounds and 12.19 pounds of digestible protein per hundred pounds.

TABLE XXII.—*Emmer and einkorn analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N×6.25).		
						Total.	Digestible.	Production value—gain in flesh.
1	Emmer:							
24	Black emmer.....	Foreign.....	8.92	91.08	3.88	12.00	9.00	2.11
4	Do.....	United States.....	8.68	91.32	4.07	13.28	9.96	2.34
	Einkorn: Miscellaneous.....	do.....	8.34	91.66	5.57	14.67	11.00	2.58

Number of analyses.	Variety.	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
1	Emmer:							
24	Black emmer.....	Foreign.....	1.47	1.04	0.55	10.72	4.72	1.17
4	Do.....	United States.....	1.91	1.36	.71	11.31	4.98	1.24
	Einkorn: Miscellaneous.....	do.....	2.19	1.55	.81	13.55	5.96	1.48

TABLE XXII.—*Emmer and einkorn analyses—average results—Continued.*

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1	Emmer:							
24	Black emmer.....	Foreign.....	71.93	53.95	13.38	17.21	74,399	6.8
4	Do.....	United States.....	69.42	52.06	12.91	17.20	74,356	6.0
	Einkorn: Miscellaneous.....	do.....	64.02	48.04	11.94	16.81	72,670	5.2

WHEAT (*Triticum vulgare*).

The wheat samples analyzed for this investigation comprise only a small number representing the principal classes of American wheat and a few samples of American and foreign durum. In explanation of the seeming neglect of this important cereal, it may be said that the primary object of this study was the analysis of oats, barley, rye, emmer, einkorn, proso, and sorghum; wheat and maize were only introduced when it became desirable to report the chemical results alone in the form of a bulletin. Furthermore, there have been many extended series of analyses made of both of these cereals, and for the purposes of comparison such results can readily be used.

The digestible nutrients in the wheat samples analyzed and in typical groups as taken from other sources are given in Table XXIII.

TABLE XXIII.—*Wheat—digestible nutrients, production value, and nutritive ratio.*

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrates.*	Calories.	Flesh gained.	
Foreign durum.....	3	14.17	1.42	1.13	70.56	94,501	21.86	5.3
Domestic durum.....	12	13.02	1.72	1.33	70.77	94,457	21.85	5.8
Northwest Spring, United States.....	4	11.78	1.41	1.17	73.04	94,717	21.91	6.6
Kansas Winter, United States.....	3	11.06	1.14	1.31	73.55	94,068	21.76	7.0
Soft Winter, United States.....	5	9.96	1.20	1.17	75.24	94,760	21.92	7.9
United States wheat, 1893 <i>a</i>	166	10.48	1.25	1.24	74.27	94,460	21.85	7.5
Canada wheat, 1893 <i>a</i>	49	10.62	1.28	1.20	74.28	94,635	21.89	7.4
English wheat (König) <i>b</i>	15	9.72	2.15	1.57	74.43	96,235	22.26	8.3
Russian wheat (König) <i>c</i>	33	14.82	1.15	1.19	69.85	93,809	21.70	4.9
Germany Spring (König) <i>d</i>	30	12.22	1.13	1.53	62.75	84,905	19.64	5.0
Winter (König) <i>d</i>	42	10.87	1.24	1.53	63.99	84,080	19.45	6.3
Typical United States wheat <i>f</i>		10.50	1.23	1.26	73.33	93,465	21.62	7.4

a U. S. Dept. Agr., Bureau of Chemistry, 1895, Bul. 45, pp. 45, 47.*b* Loc. cit., p. 422.*c* Loc. cit., p. 421.*d* Loc. cit., p. 418, 419.*e* Calculated.*f* U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1189.

No direct comparison can be made between foreign and domestic wheat, as was done with both oats and barley, because the domestic grain was not the product of directly introduced foreign wheat. In the case of the durum wheat this was true in a general way, but not as with the other cereals.

It will be readily seen that the highest protein wheats are those from Russia, while the spring wheats of North Germany and the durum and spring wheats of the United States rank next. While the highest production value occurs in the English wheat which is very low in protein, all of the hard wheats high in protein are likewise high in total production value. The actual production value is much higher for wheat than for any of the other energy-producing cereals. This is readily explained because of the small amount of crude fiber present, almost the entire amount of nitrogen-free extract constituents being in the form of true carbohydrate which possesses a relatively high coefficient of digestibility.

While the effect of introduction on European oats and barley is to increase the protein content, the effect produced on Russian durum wheat, which is originally a very hard, high protein wheat, is, at least in most localities, to lower the protein content to some extent. Other results, however, show that in the drier semiarid regions of the United States the protein content even of Russian durum wheat is maintained or may even be increased, so that this is not really any exception to the general effect of introduction on foreign-grown cereals.

The hard wheats, possessing, as they do, a large amount of protein, have a narrow nutritive ratio, so that taken together with the high production value they are naturally the most concentrated of the energy-producing cereals of the oat class.

TABLE XXIV.—Wheat analyses—average results.

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N×5.7).		
						Total.	Digestible.	Production value—gain in flesh.
3	Durum.....	Russia.....	11.02	88.98	1.78	16.87	14.17	3.33
1	<i>T. vulgare</i>	do.....	9.43	90.57	1.85	16.76	14.07	3.31
1	<i>T. sativum</i>	India.....	9.58	90.42	2.30	11.97	10.05	2.36
12	Durum.....	United States.....	9.77	90.23	2.02	15.50	13.02	3.06
4	Northwest spring.....	do.....	10.11	89.89	1.85	14.02	11.78	2.77
3	Kansas winter.....	do.....	10.68	89.32	2.28	13.17	11.06	2.60
5	Soft winter.....	do.....	10.55	89.45	2.00	11.86	9.96	2.34
24	All varieties.....	do.....	10.10	89.90	2.02	14.20	11.93	2.80

Number of analyses.	Variety.	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
3	Durum.....	Russia.....	2.25	1.42	0.75	2.40	1.13	0.28
1	<i>T. vulgare</i>	do.....	1.72	1.08	.57	2.45	1.15	.28
1	<i>T. sativum</i>	India.....	2.62	1.65	.87	3.06	1.44	.36
12	Durum.....	United States.....	2.73	1.72	.91	2.83	1.33	.33
4	Northwest spring.....	do.....	2.24	1.41	.74	2.50	1.17	.29
3	Kansas winter.....	do.....	1.81	1.14	.60	2.79	1.31	.32
5	Soft winter.....	do.....	1.91	1.20	.63	2.49	1.17	.29
24	All varieties.....	do.....	2.36	1.49	.78	2.78	1.30	.32

TABLE XXIV.—*Wheat analyses—average results—Continued.*

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
3	Durum.....	Russia.....	76.70	70.56	17.50	21.86	94,501	5.3
1	<i>T. vulgare</i>	do.....	77.22	71.04	17.62	21.76	94,068	5.3
1	<i>T. sativum</i>	India.....	80.05	73.65	18.26	21.85	94,457	7.8
12	Durum.....	United States.....	76.92	70.77	17.55	21.85	94,457	5.8
4	Northwest spring.....	do.....	79.39	73.04	18.11	21.91	94,717	6.6
3	Kansas winter.....	do.....	79.95	73.55	18.24	21.76	94,068	7.0
5	Soft winter.....	do.....	81.77	75.24	18.66	21.92	94,760	7.9
24	All varieties.....	do.....	78.72	72.42	17.96	21.86	94,515	6.5

RYE (*Secale cereale*).

As a feeding grain rye is very similar to wheat, the two being more nearly alike in the essential points, namely, protein content, production value, and nutritive ratio, than any other two cereals.

There are no foreign varieties among the samples of rye analyzed in this study, so that a direct comparison of the introduced varieties with the same varieties grown abroad was impossible. From other analyses made in this country and from analyses reported by König a comparison somewhat similar to that made with oats and barley is possible. In Table XXV the results obtained in this study and those obtained in 1893 and 1898 by the Bureau of Chemistry are compared with foreign rye, the analyses of which are reported by König:

TABLE XXV.—*Rye—total and digestible nutrients, production value, and nutritive ratio.*

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Nutrients.								Production value.		Nutritive ratio.
		Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calories.	
		Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.			
Domestic:												
All varieties, 1906.....	17	13.44	11.29	1.83	1.17	2.30	1.22	80.24	73.82	21.87	94,544	6.9
Typical United States, 1898 ^a		13.69	11.50	1.67	1.07	2.35	1.25	80.17	73.76	21.86	94,502	6.7
All United States, 1893 ^b	18	13.91	11.68	1.85	1.18	2.34	1.24	79.85	73.46	21.90	94,680	6.6
Foreign: German (König) ^c	119	12.89	10.83	1.88	1.20	3.02	1.60	79.78	73.40	21.78	94,178	7.2

^a U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1184.^b U. S. Dept. Agr., Bureau of Chemistry, 1893, Bul. 45, p. 37.^c Loc. cit., p. 474.

While the foreign and domestic ryes in Table XXV have no direct relation to each other, as in the case of the oats and barley, and while the differences are not large, it will be noticed that the same general relation exists here as with the other cereals, namely, that the United

States grain is higher in protein than the foreign. In the case of rye, the production value also is higher. The domestic samples, also, though analyzed in three different years, agree more closely with each other than they do with the foreign-grown grain.

From an examination of Table XLII, page 57, it will be seen that the rye with the highest protein content is a sample of Ivanov, grown in Kansas in 1905 (No. 1070), the total protein amounting to 17.44 pounds per 100 pounds, or 14.65 pounds digestible. The three samples with the highest protein content represent each of the varieties examined and were grown in the States of Kansas and Nebraska, the total protein in these three samples being for No. 1070, 17.44 pounds; for No. 1082, 16.44 pounds; and for No. 1076, 15.62 pounds per hundred pounds. The digestible protein equals 14.65 pounds, 13.81 pounds, and 13.12 pounds, respectively. The nutritive ratios of these samples are the narrowest of all the samples, being 1:5.0, 5.4, and 5.8, respectively.

TABLE XXVI.—*Rye analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety	Locality.	Water.	Dry matter.	Ash.	Protein (N×6.25).		
						Total.	Digestible.	Production value—gain in flesh.
6	Ivanov.....	United States.	9.39	90.61	2.15	12.88	10.82	2.54
5	Abbruzzes.....	do.....	9.18	90.82	2.23	13.46	11.31	2.66
5	Spring.....	do.....	9.58	90.42	2.14	14.18	11.91	2.80
1	.....	do.....	9.37	90.63	2.27	13.06	10.97	2.58
17	All varieties.....	do.....	9.38	90.62	2.18	13.44	11.29	2.65

Number of analyses.	Variety	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
6	Ivanov.....	United States.	1.84	1.18	0.62	2.39	1.27	0.31
5	Abbruzzes.....	do.....	1.83	1.17	.61	2.24	1.19	.29
5	Spring.....	do.....	1.82	1.16	.61	2.23	1.18	.29
1	.....	do.....	1.84	1.18	.62	2.47	1.31	.32
17	All varieties.....	do.....	1.83	1.17	.61	2.30	1.22	.30

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
6	Ivanov.....	United States.	80.73	74.27	18.42	21.89	94,630	7.2
5	Abbruzzes.....	do.....	80.24	73.82	18.31	21.87	94,544	6.9
5	Spring.....	do.....	79.63	73.26	18.17	21.87	94,544	7.1
1	.....	do.....	80.36	73.93	18.33	21.85	94,457	7.1
17	All varieties.....	do.....	80.24	73.82	18.31	21.87	94,544	6.9

BARLEY (*Hordeum vulgare*).

The barleys which were studied in this investigation comprise 8 samples of imported grain representing four varieties and 123 samples of grain grown in the United States representing 16 varieties. A comparison of the composition of these various samples with that of other compiled analyses is shown in Table XXVII.

TABLE XXVII.—Comparison of barley analyses by groups, domestic and foreign.

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Moisture.	Ash.	Protein.	Fat.	Crude fiber.	Carbo-hydrate.
Typical United States, 1898 ^a		10.85	2.80	12.34	2.52	4.32	78.02
United States and Canadian, 1893 ^b	32	10.80	2.74	11.98	2.39	4.54	78.35
North and middle Germany ^c	98	12.95	3.52	11.50	2.15	4.86	77.97
Foreign samples, 1906.....	8	9.38	2.81	12.52	2.06	4.58	78.03
United States, 1906.....	123	9.32	3.04	13.39	1.87	5.64	76.05
Hull-less, 1906.....	5	9.07	2.36	16.09	1.90	2.64	77.01

^a U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1173.^b U. S. Dept. Agr., Bureau of Chemistry, 1895, Bul. 45, p. 14.^c König, Chemie der menschlichen Nahrungs- und Genussmittel, 1903, p. 508 (recalculated to dry basis).

A difference at once observed on examining this table is that the barleys grown in the United States in 1906 have a higher protein content than the foreign barleys analyzed at the same time. This is also true, to a less degree, of the United States barleys of 1893 and 1898 compared with the analyses reported by König.

It would naturally be expected that the United States barleys would be higher in protein because in this country high protein barleys are considered the best for brewing purposes, while in Europe the best brewing barleys are considered to be those low in protein. Although the barleys studied in this investigation belong to the feeding class rather than to the brewing, the tendency in this country to grow for high protein and in Europe for low protein would have an effect on both feeding and brewing barleys in general. The digestible nutrients, production values, and nutritive ratios of these barleys is shown in Table XXVIII.

TABLE XXVIII.—Barley—digestible nutrients averaged by groups, domestic and foreign.

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbo-hydrate.	Calories.	Flesh gained.	
Typical United States.....		8.64	2.24	1.42	71.78	92,339	21.36	9.0
United States and Canada, 1893.....	32	8.39	2.13	1.50	72.08	92,253	21.34	9.3
Foreign (König).....	98	8.05	1.91	1.60	71.73	91,086	21.07	9.6
Foreign, 1906.....	8	8.76	1.83	1.51	71.78	91,604	21.19	8.8
United States, 1906.....	123	9.37	1.66	1.86	69.96	90,264	20.88	8.0
Hull-less.....	5	11.26	1.69	.87	70.85	92,166	21.32	6.7

The same general facts are again shown as were found in the case of the oats, namely, the foreign-grown grain is poorer in protein and richer in carbohydrate; higher in production value and broader in nutritive ratio. A comparison of individual varieties (Table XXIX), of which both foreign and domestic samples were analyzed, shows the same relations to exist.

TABLE XXIX.—*Comparison of domestic and foreign barley, averaged by varieties.*

[Pounds per hundred pounds of dry matter.]

Variety.	Number of samples.	Nutrients.								Production value.		Nutritive ratio.
		Protein.		Fat.		Crude fiber.		Carbohy- drate.		Calories.	Fat gained.	
		Total.	Digesti- ble.	Total.	Digesti- ble.	Total.	Digesti- ble.	Total.	Digesti- ble.			
Black Arabian:												
Foreign.....	5	12.52	8.76	2.11	1.88	4.79	1.58	77.82	71.59	91,604	21.19	8.8
United States..	6	14.04	9.83	2.03	1.81	4.92	1.62	75.84	69.77	90,610	20.96	7.7
Swan Neck:												
Foreign.....	1	13.94	9.76	2.18	1.94	4.06	1.34	76.78	70.63	91,475	21.16	7.8
United States..	5	14.49	10.14	2.20	1.96	4.52	1.49	76.06	69.97	91,345	21.13	7.5
Kitzing:												
Foreign.....	1	11.82	8.27	1.94	1.73	4.15	1.37	79.24	72.90	91,950	21.27	9.4
United States..	2	15.25	10.67	2.00	1.78	4.36	1.44	75.56	69.51	90,912	21.03	7.0
Fan:												
Foreign.....	1	11.75	8.22	1.77	1.58	4.50	1.48	79.14	72.81	91,604	21.19	9.5
United States..	1	14.62	10.23	1.79	1.59	5.04	1.66	75.52	69.48	90,264	20.88	8.3

In every case where the same variety was grown in its original foreign home and then later in the United States it increased in protein and the nutritive ratio became narrower, while the production value decreased very slightly. The resulting effect, therefore, is the production of a better feeding barley than the original.

An examination of the table of averages for barley (Table XXXI) will show that the maximum protein content was found in the two United States samples of Kitzing, namely, total, 15.25 pounds per 100 pounds, or 10.67 pounds digestible, the carbohydrate in the same sample being 75.56 pounds total and 69.51 pounds digestible. The lowest protein content, on the other hand, was found in the eight foreign-grown samples, namely, 12.52 pounds total and 8.76 pounds digestible, the carbohydrate in the same samples being 78.03 pounds total and 71.78 pounds digestible. The production value of the United States Kitzing was 21.03 pounds of flesh gained or 90,912 Calories and of the foreign samples 21.19 pounds of flesh gained or 91,604 Calories, the nutritive ratio being 1:7.0 for the domestic and 1:8.8 for the foreign. It is noticeable that in this variety (Kitzing) the protein content is the highest of all, while at the same time the production value is only slightly lower than that of the foreign-grown grain. The same can be said in general of the varieties Swan Neck, Hanna, and Princess. This means that these

varieties are especially adapted for use as feeding barleys, having a high protein content, a narrow nutritive ratio, and at the same time a high production value.

Table XXX gives the varieties of barley considered in the order of their protein content, together with their production values and nutritive ratios.

TABLE XXX.—*Barleys arranged in order of protein content:*

[Pounds per hundred pounds of dry matter.]

Variety.	Protein.	Production value, flesh gained.	Nutritive ratio.
Hull-less.....	16.09	21.32	6.7
Kitzing.....	15.25	(5) ^a 21.03	7.0
Swan Neck.....	14.49	(2) 21.13	7.5
Black Arabian.....	14.04	(7) 20.96	7.7
Black Smyrna.....	13.98	(8) 20.85	7.6
Hanna.....	13.82	(3) 21.04	7.8
Manchuria.....	13.44	(11) 20.68	7.9
Princess.....	13.42	(4) 21.04	8.1
Telli.....	13.08	(12) 20.65	8.1
Beldi.....	12.92	(10) 20.69	8.3
Tennessee Winter.....	12.84	(9) 20.81	8.4
White Smyrna.....	12.49	(6) 21.02	8.8
Foreign: Black Arabian.....	12.52	(1) 21.19	8.8

^a Figures in parentheses express order according to production value.

It will be noticed that the order of the nutritive ratio is exactly the reverse of that of the protein content; that is, the higher the protein content the lower or narrower the nutritive ratio. This is, of course, as would be expected. In regard to the production value, while it is true that the foreign samples with low protein and correspondingly high carbohydrate have the higher production value, some of the domestic samples with high protein have also a high production value. This is due to the fact that the fat content is high or the crude fiber low and is especially noticeable with the varieties Kitzing, Swan Neck, Hanna, and Princess.

Some individual cases may be noticed showing the maximum and minimum limits in protein content, etc. The highest protein content of all individual samples, excepting the hull-less varieties, is found in No. 1102, Hanna, South Dakota, 1904, third crop after introduction, total protein, 19.94 pounds per 100 pounds; digestible protein, 13.61 pounds. The production value of this sample is 20.59 pounds flesh gained and the nutritive ratio is 1:5.2. The lowest protein content occurs in the case of No. 1185, Princess, California, 1902, first crop after introduction, the total protein amounting to 8.44 pounds, and the digestible protein to 5.91 pounds, the production value being 21.32 pounds of flesh gained and the nutritive ratio 1:13.6. The highest production value is found for No. 1215, Giant Winter, Oregon, 1904, second crop after introduction, the production value being

21.72. The nutritive ratio in this case is 1:12.4 and the digestible protein amounts to 6.56 pounds. No. 1165, Beldi, South Dakota, 1905, third crop after introduction, shows the lowest production value, namely 20.24 pounds of flesh gained, the nutritive ratio in this case being 1:6.2, and the digestible protein, 11.37 pounds. From these cases and from an examination of the complete table (Table XLIII, p. 58) it will be seen that, as has been stated, a high protein usually corresponds to a low production value and a narrow nutritive ratio. In the cases just cited the barley having the highest protein content has a production value only a little higher than the lowest and, vice versa, the one having the highest production value has a protein content only slightly higher than the lowest.

Therefore, for the best feeding barleys, it is essential to secure in one sample or variety a high protein and narrow nutritive ratio, while at the same time the production value remains high. For barleys, then, as for oats, the general conclusion is that the effect of introduction appears to be to increase the protein content and to narrow the nutritive ratio. At the same time the total production value is slightly diminished, but in even a less degree than in the case of oats.

The effect of the introduction has been therefore to improve the barleys as a feeding grain, the tendency being toward the production of those characters, mentioned in the preceding paragraph, which are essential to the best barleys for such purposes.

TABLE XXXI.—*Barley analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein ($N \times 6.25$).		
						Total.	Digestible.	Production value—gain in flesh.
5	Black Arabian	Foreign	9.43	90.57	2.75	12.52	8.76	2.06
3	Miscellaneous	do.	9.30	90.70	2.91	12.50	8.75	2.06
8	Average		9.38	90.62	2.81	12.52	8.76	2.06
6	Black Arabian	United States	9.59	90.41	3.16	14.04	9.83	2.31
32	Hanna	do.	9.44	90.56	2.97	13.82	9.67	2.27
23	Tennessee winter	do.	9.50	90.50	3.17	12.84	8.99	2.11
5	Swan Neck	do.	9.30	90.70	2.74	14.49	10.14	2.38
2	Kitzing	do.	9.35	90.65	2.83	15.25	10.67	2.51
12	Beldi	do.	9.05	90.95	3.15	12.92	9.04	2.12
10	Black Smyrna	do.	9.55	90.45	3.05	13.98	9.79	2.30
4	Princess	do.	9.55	90.45	2.85	13.42	9.39	2.21
12	Tell	do.	8.89	91.11	3.01	13.08	9.16	2.15
10	White Smyrna	do.	9.06	90.94	2.95	12.49	8.74	2.05
7	Miscellaneous	do.	8.98	91.02	3.15	13.18	9.23	2.17
123	Average		9.32	90.68	3.04	13.39	9.37	2.20
5	Hull-less	United States	9.07	90.93	2.36	16.09	11.26	2.65

TABLE XXXI.—*Barley analyses—average results—Continued.*

Number of analyses.	Variety.	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
5	Black Arabian.....	Foreign.....	2.11	1.88	0.99	4.79	1.58	0.39
3	Miscellaneous.....	do.....	1.96	1.74	.92	4.24	1.40	.35
8	Average.....	.....	2.06	1.83	.96	4.58	1.51	.37
6	Black Arabian.....	United States.....	2.03	1.81	.95	4.92	1.62	.40
32	Hanna.....	do.....	1.97	1.75	.92	4.66	1.54	.38
23	Tennessee winter.....	do.....	1.78	1.58	.83	6.02	1.99	.49
5	Swan Neck.....	do.....	2.20	1.96	1.03	4.52	1.49	.37
2	Kitzing.....	do.....	2.00	1.78	.94	4.36	1.44	.36
12	Beldi.....	do.....	1.90	1.69	.89	7.11	2.35	.59
10	Black Smyrna.....	do.....	1.88	1.67	.88	5.68	1.87	.47
4	Princess.....	do.....	1.73	1.54	.81	4.67	1.54	.38
12	Telli.....	do.....	1.68	1.50	.79	7.12	2.35	.58
10	White Smyrna.....	do.....	1.85	1.65	.87	5.32	1.76	.44
7	Miscellaneous.....	do.....	1.66	1.48	.78	6.58	2.17	.54
123	Average.....	.....	1.87	1.66	.87	5.64	1.86	.46
5	Hull-less.....	United States.....	1.90	1.69	.89	2.64	.87	.21

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
5	Black Arabian.....	Foreign.....	77.82	71.59	17.75	21.19	91,604	8.8
3	Miscellaneous.....	do.....	78.39	72.12	17.88	21.21	91,690	8.8
8	Average.....	.....	78.03	71.78	17.80	21.19	91,604	8.8
6	Black Arabian.....	United States.....	75.84	69.77	17.30	20.96	90,610	7.7
32	Hanna.....	do.....	76.57	70.44	17.47	21.04	90,956	7.8
23	Tennessee winter.....	do.....	76.19	70.10	17.38	20.81	89,962	8.4
5	Swan Neck.....	do.....	76.06	69.97	17.35	21.13	91,345	7.5
2	Kitzing.....	do.....	75.56	69.51	17.24	21.03	90,912	7.0
12	Beldi.....	do.....	74.91	68.92	17.09	20.69	89,443	8.3
10	Black Smyrna.....	do.....	75.40	69.36	17.20	20.85	90,134	7.6
4	Princess.....	do.....	77.32	71.13	17.64	21.04	90,956	8.1
12	Telli.....	do.....	75.10	69.09	17.13	20.65	89,270	8.1
10	White Smyrna.....	do.....	77.39	71.20	17.66	21.02	90,869	8.8
7	Miscellaneous.....	do.....	75.34	69.31	17.19	20.68	89,400	8.1
123	Average.....	.....	76.05	69.96	17.35	20.88	90,264	8.0
5	Hull-less.....	United States.....	77.01	70.85	17.57	21.32	92,166	6.7

PROSO (*Panicum miliaceum*) AND SORGHUM (*Andropogon sorghum*).

These two grains, the proso or broom corn millet and the non-saccharine sorghums, may be considered together, as were the emmer and einkorn. They, however, differ more from each other than do the latter grains because of the considerable amount of crude fiber in the proso and the small amount in the sorghum. This gives to the sorghum a higher carbohydrate content and a higher production value. In protein content and in nutritive ratio, however, they are very similar, and in these and also in production value they both have the general characteristics of maize and belong to the same class.

TABLE XXXII.—*Group averages of total and digestible nutrients of proso, sorghum, and maize.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Nutrients.								Total production value.		Nutri- tive ratio.
	Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calories.	
	Total.	Di- gesti- ble.	Total.	Di- gesti- ble.	Total.	Di- gesti- ble.	Total.	Di- gesti- ble.			
Proso.....	12.77	6.28	3.27	2.51	8.95	6.11	71.23	60.69	19.37	83,736	11.5
Sorghum.....	11.71	7.61	3.25	2.27	1.80	.92	81.58	74.24	21.62	93,463	10.5
Maize.....	9.91	7.14	4.40	3.92	2.21	1.28	81.96	77.86	23.36	100,985	12.3

Proso and sorghum, like maize, are lower in protein and higher in carbohydrate, giving higher production value and broader nutritive ratio than the other cereals and thus stand at the opposite extreme from oats.

Of the prosos (Table XLIV), the highest protein content is found for No. 1022 from Oklahoma, namely, 16.87 pounds, digestible protein 8.30 pounds per 100 pounds, giving to this sample the narrowest nutritive ratio (1:8.2) and the lowest production value, 18.70 pounds gain in flesh. The highest carbohydrate content was found in a Colorado sample, No. 1029, with 75.22 pounds total and 64.09 pounds digestible. This gives a production value of 19.76 pounds gain in flesh, which is the highest with one exception, No. 1016, for which the nutritive ratio is 1:14.6, the broadest of the entire list. The average protein content is 12.77 pounds total and 6.28 pounds digestible. The average production value and nutritive ratio are, respectively, 19.37 pounds gain in flesh, or 83,736 Calories, and 1:11.5.

Of the sorghums the highest protein content is in No. 771, which has 14.50 pounds total and 9.42 pounds digestible, the nutritive ratio being relatively narrow, namely, 1:8.2. The highest carbohydrate content is found in No. 770 with 85.31 pounds total and 77.64 pounds digestible. This sample has a production value of 21.71 pounds gain in flesh, the maximum being 21.87 pounds in No. 781. It has the broadest nutritive ratio of any of the samples examined, namely, 1:14.3. The average composition of the sorghum samples is given in Table XXXIII.

TABLE XXXIII.—*Proso, sorghum, and maize analyses—average results for the United States.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N $\times$ 6.25).		
						Total.	Digestible.	Production value—gain in flesh.
17	Proso: Red Orenburg.....	United States.	8.98	91.02	3.59	12.84	6.32	1.49
9	Red Voronezh.....	do.	8.83	91.17	4.03	13.08	6.43	1.51
10	Black Voronezh.....	do.	8.80	91.20	3.82	12.27	6.04	1.42
2	Yellow Manitoba.....	do.	9.54	90.46	4.10	13.37	6.58	1.55
38	Average.....	do.	8.93	91.07	3.78	12.77	6.28	1.48
10	Sorghum: Miscellaneous.....	do.	11.71	88.29	1.75	11.71	7.61	1.79
12	Maize: Miscellaneous.....	do.	13.06	86.94	1.52	9.91	7.14	1.68

Number of analyses.	Variety.	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
17	Proso: Red Orenburg.....	United States.	3.29	2.53	1.33	8.56	5.85	1.45
9	Red Voronezh.....	do.	3.09	2.38	1.25	9.72	6.64	1.65
10	Black Voronezh.....	do.	3.33	2.56	1.35	8.84	6.04	1.50
2	Yellow Manitoba.....	do.	3.52	2.71	1.43	9.32	6.37	1.58
38	Average.....	do.	3.27	2.51	1.32	8.95	6.11	1.52
10	Sorghum: Miscellaneous.....	do.	3.25	2.27	1.19	1.80	.92	.23
12	Maize: Miscellaneous.....	do.	4.40	3.92	2.06	2.21	1.28	.32

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
17	Proso: Red Orenburg.....	United States.	71.71	61.10	15.15	19.42	83,953	11.5
9	Red Voronezh.....	do.	70.09	59.71	14.81	19.22	83,088	11.2
10	Black Voronezh.....	do.	71.74	61.12	15.16	19.43	83,996	12.1
2	Yellow Manitoba.....	do.	69.68	59.38	14.72	19.28	83,347	10.9
38	Average.....	do.	71.23	60.69	15.05	19.37	83,736	11.5
10	Sorghum: Miscellaneous.....	do.	81.58	74.24	18.41	21.62	93,463	10.5
12	Maize: Miscellaneous.....	do.	81.96	77.86	19.31	23.36	100,985	12.3

MAIZE (*Zea mays*).

The analyses of maize given in the tables were made for another study, but they have been used here for the purpose of comparison and because no samples of this cereal were included among those first examined for the present investigation.

A comparison of the analyses reported in this bulletin with those given by the Bureau of Chemistry in previous bulletins and with those reported by König is given in Table XXXIV.

TABLE XXXIV.—*Maize—digestible nutrients averaged by groups.*

[Pounds per hundred pounds of dry matter.]

Character of samples.	Number of samples.	Nutrients.								Production value.		Nutritive ratio.
		Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calories.	
		Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.			
Domestic, United States, 1906.....	12	9.90	7.14	4.40	3.92	2.21	1.28	81.96	77.86	23.36	100,985	12.3
Typical, United States, 1898.....	11	11.21	8.05	4.76	4.28	1.96	.80	80.40	76.38	23.28	100,640	10.8
World's Fair, 1893.....	18	11.09	7.98	4.68	4.21	1.92	.79	80.78	76.74	23.31	100,770	10.9
Jenkins and Winston.....	208	11.78	8.48	6.06	5.45	2.36	.97	78.12	74.20	23.50	101,590	10.3
Foreign, König.....	137	10.91	7.85	4.95	4.45	2.64	1.08	80.01	76.01	23.39	101,115	11.1

From Table XXXIV it is seen that while the domestic maize analyzed in 1906 is considerably lower in protein than the other United States samples and than the foreign, the difference between domestic and foreign grain does not seem to be as marked in this case as with some of the other cereals. In the production value the difference is even less, the extreme variation being only 0.22 pound of flesh gained. The most striking point, however, is that the production value is much higher and the nutritive ratio much broader in the case of maize than for any other cereal.

GENERAL SUMMARY.

Considering, now, the general results in regard to the feeding value of the cereal grains as obtained in this study it appears that, as feeding materials, they fall into three classes typical of the three grains most commonly used, namely, wheat, oats, and maize (or corn). Within one or the other of these groups all of the cereals may be included. This is equally true of those grains commonly grown, such as barley and rye, and of those much less common, such as emmer and proso. Collecting the results as given in the tables of averages (Tables XVIII, XXII, XXIV, XXVI, XXXI, XXXIII) it is seen how distinct this grouping is.

TABLE XXXV.—*Oat group—digestible nutrients.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Protein.	Fat.	Crude fiber.	Carbohydrate.	Production value—gain in flesh.	Nutritive ratio.
Oats.....	10.73	3.59	3.17	51.04	17.86	5.8
Emmer.....	9.96	1.36	4.98	52.06	17.20	6.0
Elmkorn.....	11.00	1.55	5.96	48.04	16.81	5.2

TABLE XXXVI.—*Wheat group—digestible nutrients.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Protein.	Fat.	Crude fiber.	Carbo-hydrate.	Production value—gain in flesh.	Nutritive ratio.
Wheat.....	11.93	1.49	1.30	72.42	21.86	6.5
Barley.....	9.37	1.66	1.86	69.96	20.88	8.0
Rye.....	11.29	1.17	1.22	73.82	21.87	6.9

TABLE XXXVII.—*Maize group—digestible nutrients.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Protein	Fat.	Crude fiber.	Carbo-hydrate.	Production value—gain in flesh.	Nutritive ratio.
Maize.....	7.14	3.92	1.28	77.86	23.36	12.3
Proso.....	6.28	2.51	6.11	60.69	19.37	11.5
Sorghum.....	7.61	2.27	.92	74.24	21.62	10.5

OAT GROUP.

In the oat group, as was stated in the introduction, are found those grains which, being high in protein and high in crude fiber, are low in carbohydrate and possess a relatively lower production value and a narrow nutritive ratio. The production value alone can not, however, be taken as a basis for judgment of the value of these grains as feeds.

It is due to the large amount of crude fiber that the amount of digestible carbohydrate is low, thus lowering the production value. At the same time, however, this low carbohydrate makes the relative amount of protein to carbohydrate high, and the grains are characterized as high protein, energy-producing foods rather than heat-producing like those rich in carbohydrate.

The value, therefore, of the oat class of cereals is that they possess high protein and a narrow nutritive ratio. With the less common grains, emmer and einkorn, it is seen that while the protein in emmer is somewhat lower, the production value and nutritive ratio are nearly the same as that of oats. Einkorn, owing to higher crude fiber, falls below the other two in production value and nutritive ratio. It is plain, however, that both of these grains belong in the oat class rather than in the wheat class. While in fat content they resemble wheat and not oats, and in protein content they could be classed with either, as this factor alone is almost the same in the two classes, the large amount of crude fiber, with its resulting effect upon production value and nutritive ratio, places them defi-

nately with the oats. The hulled emmer would, if fed as such, be as much like wheat as it is, unhulled, like oats. As to the intrinsic nutritive value of these three grains of the oat class, our only criterion is the actual production value in Calories of heat energy which 100 pounds of each grain possesses. From this point of view they would rank as follows: Oats, having a value of 17.86 pounds of flesh gained per 100 pounds of grain fed, or 77,209 Calories of heat energy; emmer, with 17.20 pounds of flesh gained, or 74,356 Calories, and einkorn with 16.81 pounds of flesh gained, or 72,670 Calories. These differences in production value are not, however, important, since equal differences are often found between samples of each one of these grains themselves. The average protein content of emmer is nearly 1 per cent lower than that of oats, yet there are 108 samples out of 242 of United States oats which have a protein content less than the average of the emmer, and 7 samples of emmer out of 25 have a higher protein content than the average of the oats. The maximum protein content for emmer was found in the case of No. 1051, with 14.02 pounds of digestible protein, the maximum in the case of the oats being No. 1297, with 15.40 pounds of digestible protein; the minimum protein content for emmer was 6.47 pounds digestible, and for oats 7.12 pounds. For the production value the variations are less marked. Only 21 samples of oats out of 242 fall below 17.20 pounds, the average production value for emmer, while the maximum value for emmer is 17.59 pounds (No. 1061), which is below the average for oats, the maximum production value of einkorn being 17.04 pounds for No. 1068.

While, therefore, there is considerable natural difference between emmer and einkorn on the one hand and oats on the other, this difference seems to be no more marked than similar differences between different samples of oats. For feeding purposes then, the less common cereals, emmer and einkorn, when used without the removal of the hulls, may be considered as belonging with oats in the group of high protein, muscle, or energy-producing foods and nearly equal to the latter in intrinsic food value.

WHEAT GROUP.

In the wheat group of cereals are the three common grains—wheat, barley, and rye. This group is characterized by high protein, as is the oat group, but differs from it in having low crude fiber, which results in a high digestible carbohydrate. The production value is, therefore, high and the nutritive ratio broader than in the oat group, though not broad as compared with other high carbohydrate foods. In this group, therefore, are found foods

which, although high in carbohydrate and in intrinsic food value, yet, because of their high protein, possess an average nutritive ratio and are muscle producing rather than heat producing. On this account wheat has been considered the standard feeding grain where fattening was not the sole object.

When compared with each other and judged by their production values the three members of this group will rank wheat, rye, and barley, the wheat and rye being practically identical in their production value, though the nutritive ratio is narrower and the protein higher in the wheat. These two grains, therefore, are more nearly alike in their composition and value than any other two cereals.

In the case of barley there is a greater difference, due primarily to a considerably lower protein content. This, together with a higher crude fiber, makes the production value lower and the nutritive ratio broader than either of the other two members of this group. Four samples of barley had a protein content higher than the average for wheat, but no barley equaled the wheat average in production value. The effort; however, in this country to grow and breed barleys for high-protein content will probably result in raising the average in this respect and in producing feeding barleys that are more nearly equal to wheat in value.

MAIZE GROUP.

In the last group of cereals—the maize group—are found grains more distinctly different from the other two groups than these are from each other. While the other two groups are similar in being high-protein, energy-producing foods, the maize-group cereals are low in protein. Maize, the typical cereal of the group, is characteristically a high carbohydrate, fat or heat producing food, and because of its relatively low protein possesses a very broad nutritive ratio. The intrinsic food value is higher than that of any of the other cereals. Taken as a group, however, the two distinguishing characteristics are low-protein content and broad nutritive ratio.

The two less common cereals, proso and nonsaccharine sorghum, plainly belong to the maize group when judged by these two standards. In production value both the proso and the sorghum are lower than wheat and rye, and in crude fiber proso is more like the oat group, yet the protein in both is very low and the nutritive ratio much broader than any other cereal except maize. In fat content proso and sorghum are higher than all others except oats and maize. Proso differs from maize and sorghum principally in the amount of crude fiber, which necessarily lowers the amount of digestible carbohydrate. The nutritive ratio, however, is broader than that of sorghum.

Therefore, while proso and sorghum clearly belong with maize in the group of low protein, broad nutritive ratio, fat or heat producing foods, in their intrinsic food value they fall considerably below it. Sorghum in this respect is of about equal value with wheat, while proso is below that of barley, though above oats, maize being higher in its food value than any other cereal.

CONCLUSIONS.

The conclusions drawn from the work presented in this bulletin may be expressed as follows:

(1) The effect of the introduction into the United States of foreign varieties of cereals has been to increase the protein content of the grain. Only two cereals were studied in regard to this point, namely, oats and barley. With both of these grains this increase in protein is an improvement. It increases the high-protein, muscle-producing value of the oats and raises the intrinsic food value of the barley, so that it becomes more nearly equal to that of wheat. Selection and breeding for high-protein content in feeding barleys is a distinct improvement in their value for this purpose.

(2) As feeding grains the cereals may be grouped into three classes typified by our three most common grains, namely, (a) oat group, (b) wheat group, (c) maize group.

Of these three groups the oat group stands at one end as a typical muscle or energy producing food and the maize group at the other end as fat or heat producing. The wheat group is intermediate between these two.

In the oat group belong the less common cereals, emmer and einkorn, and in the maize group proso and nonsaccharine sorghum.

(3) The two cereals emmer (*Triticum dicoccum*) and einkorn (*Triticum monococcum*) belong to the same group as the oats and like it are characterized by high protein and relatively low carbohydrate. They have a lower intrinsic food value than the other grains, but a narrow nutritive ratio and consequently are muscle or energy producers. In food value they are nearly the same as oats, and their cultivation where oats can not be grown is to be advocated.

(4) The two cereals proso or broom-corn millet (*Panicum miliaceum*) and the nonsaccharine sorghum (*Andropogon sorghum*) belong to the maize group, and though lower in food value than maize itself they equal the oat group. They are of great importance when maize can not be grown and when there is need for a high carbohydrate and heat or fat producing food.

(5) Barley and rye belong to the wheat group and are nearly equal to it in food value.

DETAILED TABULATION OF ANALYTICAL AND CALCULATED RESULTS.

TABLE XXXVIII.—Oats—individual analyses.

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein. (N × 6.25.)			Fat.			Crude fiber.		Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
266	Pfiffelbacher's Prolific	295	Germany	Original	9.85	90.15	4.04	12.06	9.41	2.21	5.05	4.19	2.20	10.77	2.80	0.69	52.42	13.00	18.10	78,246	6.9
267	Gray Thick Head	296	do	do	9.80	90.14	4.27	13.19	10.29	3.42	4.90	4.07	2.14	11.48	2.93	.74	66.17	50.95	17.93	77,511	6.1
268	Gray Winter	297	do	do	9.82	90.48	4.25	12.94	10.09	3.27	7.03	5.83	3.07	9.33	2.43	.64	66.41	51.15	12.68	80,926	6.6
269	Pewsummer Hammerel	302	do	do	9.03	90.97	3.84	10.00	7.80	1.83	6.40	5.31	2.79	11.77	3.06	.76	67.99	52.35	12.98	79,370	8.6
270	Anderbeck	303	do	do	9.34	90.66	3.94	11.44	8.92	2.10	5.77	4.79	2.52	11.16	2.91	.82	67.67	52.10	12.92	78,300	7.4
271	Bavarian Mountain	304	do	do	9.18	90.82	3.50	10.66	7.85	1.84	5.78	4.80	2.62	12.77	3.32	.71	69.04	53.16	13.16	78,506	8.5
272	Victoria	305	do	do	9.17	90.83	3.67	10.19	7.95	1.87	6.04	5.01	2.64	11.41	2.97	.74	66.71	51.36	12.74	79,457	8.5
273	Longfellow	306	do	do	9.80	90.20	3.97	11.87	9.26	2.18	6.04	5.01	2.64	11.41	2.97	.74	66.71	51.36	12.74	79,457	8.5
274	Danish Island	308	do	do	9.67	90.33	3.87	11.50	8.97	2.05	6.14	5.01	2.68	10.64	2.72	.69	67.33	51.84	12.86	78,895	7.6
275	Yellow Thuringen	309	do	do	8.97	91.03	4.70	11.19	8.73	2.05	6.14	5.01	2.68	10.64	2.72	.69	67.33	51.84	12.86	79,024	7.4
276	Milton	310	do	do	9.14	90.86	4.01	11.44	8.92	1.84	5.68	4.46	2.35	10.15	2.64	.65	69.03	53.15	13.18	79,154	8.5
277	Waterloo	312	do	do	9.23	90.77	3.81	10.06	7.85	1.84	5.68	4.46	2.35	10.15	2.64	.65	69.03	53.15	13.18	79,154	8.5
278	Yellow Giant	314	do	do	9.52	90.48	4.21	12.56	9.80	2.30	5.69	4.72	2.48	10.15	2.64	.65	67.59	51.89	12.87	79,111	6.6
279	Yellow Flanders	316	do	do	9.19	90.81	4.12	11.44	8.92	2.10	6.13	5.09	2.68	11.04	2.87	.71	67.27	51.79	12.84	79,240	7.4
280	Georgian	317	do	do	8.93	91.07	4.06	10.75	8.45	1.92	6.55	5.44	2.06	10.48	2.72	.67	66.41	51.14	12.68	80,364	7.1
281	White Polish	318	do	do	10.30	89.70	4.12	10.40	9.35	2.27	6.55	5.44	2.06	10.48	2.72	.67	67.52	52.22	12.70	79,143	8.0
282	Rugen	319	do	do	10.18	89.62	4.12	10.94	8.63	2.08	6.34	5.26	2.77	11.10	2.89	.69	67.52	51.90	12.80	79,889	7.9
283	Barbachlov	321	do	do	10.34	89.66	4.34	11.94	9.26	2.18	6.34	5.26	2.77	11.10	2.89	.69	67.52	51.90	12.80	79,889	7.9
284	Podolia	322	do	do	10.51	89.49	4.32	10.94	8.63	2.08	6.34	5.26	2.77	11.10	2.89	.69	67.52	51.90	12.80	79,889	7.9
285	White Swedish	323	do	do	9.68	90.32	3.94	9.69	7.80	1.78	5.64	4.68	2.46	11.38	2.96	.73	69.35	53.40	13.24	75,263	7.4
286	do	288	England	do	7.50	92.50	3.33	12.00	9.36	2.18	5.69	4.72	2.48	11.30	2.96	.73	69.35	53.40	13.24	75,263	7.4
287	do	288	do	do	9.35	90.65	3.19	11.87	9.26	2.18	5.69	4.72	2.48	11.30	2.96	.73	69.35	53.40	13.24	75,263	7.4
288	do	288	do	do	7.29	92.71	3.15	11.87	9.26	2.18	5.69	4.72	2.48	11.30	2.96	.73	69.35	53.40	13.24	75,263	7.4
289	do	289	do	do	11.40	88.60	3.02	12.19	9.51	2.23	7.31	6.07	3.19	8.92	2.92	.72	71.12	54.76	13.58	79,154	8.1
290	do	290	do	do	6.80	93.11	2.78	9.94	7.75	1.82	4.94	4.10	2.16	11.05	2.75	.71	71.11	54.75	13.58	79,154	8.1
291	do	291	do	do	9.02	90.98	2.68	10.38	8.10	1.90	4.88	4.05	2.13	10.95	2.62	.68	68.45	52.70	13.07	78,437	8.2
292	do	292	do	do	7.12	92.88	4.04	10.56	8.24	1.94	6.00	4.98	2.62	10.59	2.57	.65	68.45	52.70	13.07	78,437	8.2
293	do	293	do	do	7.14	92.86	3.04	11.31	10.38	2.07	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
294	do	294	do	do	7.43	92.57	2.64	11.31	8.82	2.07	4.39	3.64	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
295	do	295	do	do	7.33	92.77	3.31	11.25	8.71	2.06	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
296	do	296	do	do	7.27	92.63	3.34	11.81	9.21	2.06	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
297	do	297	do	do	7.37	92.77	3.31	11.25	8.71	2.06	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
298	do	298	do	do	7.37	92.77	3.31	11.25	8.71	2.06	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
299	do	299	do	do	7.37	92.77	3.31	11.25	8.71	2.06	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
300	do	300	do	do	7.37	92.77	3.31	11.25	8.71	2.06	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4
301	do	301	do	do	7.37	92.77	3.31	11.25	8.71	2.06	4.58	4.03	2.44	11.04	2.64	.75	70.02	53.92	13.20	80,797	6.4

Black Meadag...	297	do.	do.	8.07	91.03	3.55	11.31	8.82	2.07	5.23	4.76	2.50	12.96	3.37	1.64	66.14	50.93	12.63	18.04	77.98	7.0
Black Conlommiers	299	do.	do.	7.69	92.31	3.41	10.94	8.53	2.28	0.24	5.18	2.72	9.83	2.56	.63	69.61	50.93	13.20	18.04	80.58	7.0
Gray Houdon	270	do.	do.	7.35	92.05	3.48	12.44	9.70	2.58	0.22	5.18	2.71	9.83	2.56	.63	69.61	50.93	12.95	18.57	80.278	0.8
Jouanette d'Chenailles	271	do.	do.	7.33	92.47	3.44	11.66	9.63	2.33	0.32	5.25	2.76	9.86	2.56	.71	68.39	51.37	12.71	18.35	79.321	0.6
Early Stamp	272	do.	do.	7.33	92.47	3.44	11.66	9.63	2.33	0.32	5.25	2.76	9.86	2.56	.71	68.39	51.37	12.71	18.35	80.278	0.6
Black Brig	279	do.	do.	8.39	91.61	3.51	10.81	8.43	1.98	5.80	4.81	2.53	9.37	2.44	.60	70.51	54.29	13.46	18.91	81.748	7.1
Belgian Winter	166	do.	do.	8.34	93.66	3.10	12.31	9.60	2.34	6.04	5.31	2.90	9.78	2.55	.55	71.39	54.29	13.45	18.94	82.742	7.2
do.	276	do.	do.	7.96	92.04	2.22	10.25	7.90	1.86	6.65	5.52	2.90	8.45	2.20	.55	71.00	54.67	13.50	18.99	82.094	8.7
do.	276	do.	do.	8.09	93.01	3.38	10.13	7.99	1.88	6.90	5.53	3.01	8.41	2.19	.54	71.00	54.67	13.50	18.99	83.823	3.5
Hull-less	277	do.	do.	7.68	92.22	2.90	22.44	17.40	1.41	5.81	4.82	2.54	3.24	.84	.21	65.61	50.52	12.52	19.39	83.823	3.5
do.	278	do.	do.	8.40	91.40	2.13	14.31	11.16	2.62	6.71	5.57	2.93	11.59	3.01	.15	74.49	57.36	14.22	19.92	86.114	6.3
North Finnish Black	254	Finland	do.	7.32	92.48	3.62	12.88	10.05	2.36	5.42	4.50	2.93	11.59	3.01	.75	66.24	51.00	12.65	18.13	78.376	6.4
do.	174	do.	do.	7.50	92.50	4.19	11.81	9.21	2.16	5.62	4.91	2.58	10.23	2.66	.66	67.85	52.24	12.95	18.35	79.027	7.2
do.	167	do.	do.	7.24	92.76	3.62	15.81	12.33	2.90	5.07	4.21	2.21	9.84	2.56	.63	65.66	50.56	12.54	18.28	79.024	5.1
do.	283	do.	do.	9.08	90.92	3.35	13.04	10.19	1.37	5.46	4.53	2.38	11.02	2.56	.71	67.11	51.67	12.13	18.29	79.017	9.6
Gentile	169	do.	do.	8.42	93.58	4.68	8.56	6.68	1.50	5.74	4.70	2.50	17.50	4.55	.13	63.52	48.91	12.13	18.29	74.917	9.6
Swedish Select	134	Russia	do.	7.25	92.75	2.90	12.69	9.84	2.33	5.02	4.17	2.30	13.71	3.56	.89	65.59	50.27	12.46	17.86	77.206	6.4
do.	134	do.	do.	5.96	94.04	2.60	12.62	9.48	.21	3.74	3.00	1.63	11.97	2.90	.72	70.29	54.12	13.42	18.27	78.981	6.6
do.	213	do.	do.	6.73	93.25	3.00	11.73	9.17	2.23	0.11	5.07	2.67	13.43	3.49	.87	66.22	50.39	12.47	18.41	78.938	6.9
Tobolsk	135	do.	do.	7.90	92.10	2.84	12.63	9.85	2.31	0.08	5.03	2.66	12.53	3.21	.80	64.22	50.39	12.47	18.41	79.580	6.7
Zhelanil	136	do.	do.	6.16	93.75	3.63	12.44	9.70	2.28	0.79	5.39	2.94	13.53	3.52	.77	60.87	49.93	12.38	17.98	77.727	6.8
Shatlov	144	do.	do.	6.16	93.54	3.94	12.04	9.41	2.21	0.79	5.41	2.93	13.36	3.47	.74	64.16	49.40	12.19	18.56	80.255	6.2
Burt	293	Va.	do.	7.69	92.31	3.69	13.56	10.58	2.49	7.04	5.80	3.08	11.53	3.00	.77	63.82	49.14	12.19	18.41	79.580	6.2
do.	293	do.	do.	8.78	91.22	3.96	13.44	10.48	2.94	7.47	6.57	3.26	9.73	2.52	.63	62.73	48.30	11.98	18.81	81.316	5.2
do.	222	do.	do.	10.17	89.83	4.01	16.06	12.53	2.91	6.71	5.37	2.93	12.04	3.13	.78	60.91	46.90	12.63	17.53	80.105	7.1
Suoma. Rust Proof.	339	S. Dak	do.	8.02	91.98	3.48	16.00	12.48	2.93	4.50	3.31	1.96	14.01	3.64	.94	60.91	46.90	12.63	17.53	75.263	4.7
Appliers	213	Nebr	do.	6.65	93.35	4.81	11.37	8.87	2.08	3.64	3.02	1.45	14.55	3.78	.94	63.47	51.80	12.85	17.14	74.096	6.9
Swedish Select	213	do.	do.	6.51	93.46	3.96	12.50	9.65	2.27	3.32	2.76	1.52	14.98	3.89	.96	64.78	49.88	12.37	17.12	75.330	6.3
do.	213	do.	do.	6.50	93.50	4.39	12.37	9.65	2.27	3.48	2.80	1.66	12.80	3.33	.89	63.62	48.93	12.37	17.12	74.010	6.2
do.	213	do.	do.	5.95	94.05	4.63	16.00	12.48	2.58	4.01	3.33	1.75	13.81	3.59	.89	63.58	48.95	12.14	17.36	75.047	5.5
do.	1903	(1)	do.	5.42	94.58	4.55	14.06	10.97	2.48	4.01	3.33	1.66	16.78	4.36	.89	63.31	48.75	12.09	16.76	72.463	6.7
do.	213	do.	do.	5.30	94.70	4.98	11.56	10.04	2.36	3.71	3.08	1.62	15.12	3.93	.97	63.27	48.75	12.08	17.03	73.621	5.9
do.	213	do.	do.	5.93	93.63	4.24	13.75	10.72	2.67	3.73	3.00	1.63	13.21	3.43	.95	65.07	50.10	12.43	17.43	75.350	5.6
do.	213	do.	do.	8.44	91.56	4.34	9.13	7.12	2.67	3.69	2.90	1.57	20.08	5.22	.90	62.66	48.25	11.90	16.49	71.286	8.5
do.	213	do.	1903 (1)	8.83	91.17	4.64	12.13	7.90	1.46	3.60	2.90	2.10	17.69	4.60	1.14	63.93	49.22	12.30	16.75	72.410	7.7
do.	213	do.	1905 (3)	7.38	92.62	4.69	10.13	7.90	1.26	3.60	2.90	2.10	17.69	4.60	1.14	63.93	49.22	12.30	16.75	72.410	7.7
do.	213	do.	1904	7.38	92.62	4.69	10.13	7.90	1.26	3.60	2.90	2.10	17.69	4.60	1.14	63.93	49.22	12.30	16.75	72.410	7.7
do.	213	do.	do.	6.92	93.08	3.78	11.69	9.12	2.46	3.90	3.28	1.73	13.27	3.45	.80	67.31	51.83	12.58	17.59	75.869	5.4
do.	213	do.	1904	6.65	93.35	4.44	11.00	8.58	2.02	3.80	3.28	1.68	14.81	3.85	.83	65.89	50.74	12.58	17.23	74.485	7.2
do.	213	do.	do.	6.79	93.21	4.35	11.37	8.87	2.08	3.97	3.30	1.74	12.81	3.83	.83	67.50	51.97	12.59	17.50	75.825	7.1
do.	213	do.	1904	6.67	93.43	3.85	11.37	8.87	2.08	3.71	3.30	1.62	13.29	3.46	.80	67.58	52.19	12.94	17.47	75.825	7.0
do.	213	do.	1904	5.99	94.01	3.86	12.75	9.94	2.42	3.16	2.62	1.34	12.58	3.27	.81	66.36	51.10	12.67	17.46	74.356	6.7
do.	213	do.	do.	7.17	92.83	3.99	16.12	12.57	2.95	3.06	2.54	1.34	12.72	3.31	.82	64.66	49.79	12.35	17.83	75.479	4.7
do.	213	do.	do.	6.43	93.57	4.13	14.94	11.65	2.40	4.34	3.60	1.89	11.20	2.91	.72	65.39	50.55	12.60	17.60	77.079	5.3
do.	213	S. Dak	do.	6.46	93.54	3.57	13.12	10.23	2.70	4.37	3.63	1.91	12.98	3.37	.84	66.00	50.82	12.60	17.58	76.933	6.1
do.	134	do.	1902	6.72	93.28	3.83	11.62	9.06	2.30	3.64	3.02	1.78	13.13	3.26	.81	66.00	50.82	12.60	17.58	76.933	6.1
do.	134	do.	1902	6.46	93.54	3.31	12.66	9.80	2.30	4.09	3.39	1.78	13.11	3.41	.85	66.93	52.64	13.78	17.71	76.590	6.4

mitted from the average.

TABLE XXXVIII.—Oats—individual analyses—Continued.

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Protein. (N X 6.25.)				Fat.			Crudo fiber.			Carbohydrate.				Total production value.		Nutritive ratio.
							Ash.	Total.		Digestible.	Pro d u c t i o n value—gain in flesh.	Total.	Digestible.	Pro d u c t i o n value—gain in flesh.	Total.	Digestible.	Pro d u c t i o n value—gain in flesh.	Total.	Digestible.	Pro d u c t i o n value—gain in flesh.	Gain in flesh.	Calories.	
439	Swedish Select	134	S. Dak.	1902	70	94.30	2.94	11.44	8.92	2.10	5.04	4.18	2.20	13.43	3.49	0.87	67.15	51.70	12.82	17.99	77,771	7.2	
440	do.	134	do.	1902	6.05	93.95	3.99	15.31	11.94	2.88	4.60	3.82	1.99	10.93	3.36	.83	65.17	50.18	12.44	18.08	78,160	5.2	
441	do.	134	do.	1902	5.76	94.24	4.19	13.00	10.14	2.30	4.55	3.78	1.99	12.16	3.16	.79	66.10	50.90	12.62	17.78	76,863	6.2	
430	do.	213	do.	1903	5.39	94.61	3.99	12.69	9.90	2.59	4.34	3.77	2.09	12.32	3.20	.74	67.66	52.10	12.92	17.50	76,863	5.6	
351	do.	134	do.	1904	7.23	92.77	4.80	14.12	11.01	2.53	4.78	3.97	2.09	11.55	3.00	.74	64.75	49.86	12.36	17.78	76,863	7.4	
353	do.	134	do.	1904	7.07	92.93	3.87	11.00	8.58	2.02	4.67	3.88	2.04	14.22	3.70	.92	66.24	51.01	12.65	17.63	76,214	7.4	
354	do.	134	do.	1904	7.12	92.88	3.95	17.25	13.45	3.16	4.88	4.05	2.19	10.32	2.68	.66	63.60	48.97	12.14	18.09	78,203	4.5	
1242	do.	213	do.	1905 (1)	8.66	91.34	3.97	13.06	10.19	2.39	5.01	4.16	2.19	10.64	2.77	.69	67.32	51.83	12.85	18.12	78,333	6.3	
1243	do.	213	do.	1905 (3)	8.22	91.78	3.62	12.31	9.60	2.26	4.64	3.85	2.03	10.94	2.84	.70	68.49	52.73	13.08	18.07	78,117	6.7	
1307	do.	213	do.	1905	8.95	91.05	3.65	11.44	8.92	2.10	4.71	3.91	2.06	13.48	3.50	.87	66.22	51.37	12.74	17.77	76,820	7.1	
1308	do.	213	do.	1905 (5)	8.98	94.02	3.58	10.44	8.14	1.91	4.71	3.05	1.60	13.25	3.44	.85	69.06	53.17	13.18	17.54	75,825	7.8	
417	do.	213	Iowa.	1903	5.90	94.10	3.89	13.00	10.14	2.38	3.36	2.79	1.47	13.69	3.56	.88	66.06	50.79	12.61	17.34	74,901	6.0	
418	do.	213	do.	1903	5.11	94.89	3.93	12.12	9.45	2.22	3.89	3.23	1.70	15.20	3.95	.98	64.86	49.94	12.98	17.28	74,701	6.5	
419	do.	213	do.	1903	5.00	95.00	5.06	13.37	10.43	4.45	3.76	3.12	1.67	17.47	4.54	1.13	60.31	46.46	11.52	16.74	72,367	5.6	
420	do.	213	do.	1903	5.27	94.73	4.55	9.19	7.17	1.68	3.82	3.17	1.67	12.87	3.35	.83	69.60	53.99	13.29	17.47	73,523	8.9	
362	do.	213	do.	1904	6.09	93.91	4.23	10.56	8.24	1.94	3.41	2.83	1.49	18.70	4.86	1.21	63.00	48.51	12.93	16.67	72,004	7.2	
368	do.	213	do.	1904	6.34	93.66	4.26	12.87	10.04	2.36	3.23	2.68	1.41	13.83	3.60	.89	65.81	50.67	12.96	17.22	74,462	6.0	
370	do.	213	do.	1904	6.27	93.73	3.92	10.81	8.43	1.98	4.19	3.48	1.83	14.14	3.68	.91	66.94	51.77	13.33	17.50	75,692	7.5	
382	do.	213	do.	1904	6.58	93.42	3.83	9.81	7.65	1.80	4.14	3.44	1.81	12.39	3.22	.80	68.83	53.77	13.06	17.73	75,782	7.9	
386	do.	213	do.	1904	6.81	93.19	3.55	10.31	8.04	1.89	3.84	3.19	1.68	13.88	3.61	.90	68.42	52.13	12.93	17.70	76,517	6.4	
398	do.	213	do.	1904	6.35	93.65	3.97	12.50	9.75	2.29	3.82	3.17	1.67	12.51	3.25	.83	67.67	52.10	12.92	17.56	75,912	7.8	
1237	do.	213	do.	1905 (3)	8.89	91.11	3.75	10.44	8.14	1.91	4.18	3.47	1.83	13.96	3.63	.90	67.17	52.49	13.02	17.71	76,500	6.6	
1238	do.	213	do.	1905 (2)	9.42	90.58	3.83	12.37	9.65	2.03	4.43	3.68	1.94	11.20	2.91	.72	67.74	52.16	12.94	17.81	76,930	6.9	
1306	do.	134	do.	1905 (6)	9.51	90.49	3.80	11.75	9.16	2.15	4.41	3.66	1.93	12.30	3.20	.70	67.01	52.16	12.94	17.81	75,350	5.8	
422	do.	213	Mich.	1903	4.99	95.01	3.68	13.37	10.43	2.45	3.78	3.14	1.65	14.16	3.68	.91	65.01	50.06	12.42	17.43	76,171	5.3	
423	do.	213	do.	1903 (1)	5.28	94.62	3.10	14.62	11.40	2.68	3.38	2.81	1.48	12.68	3.30	.82	66.22	50.99	12.64	17.62	75,998	5.7	
424	do.	213	do.	1903 (1)	5.23	94.77	3.08	14.50	11.31	2.06	3.57	2.96	1.56	12.64	3.24	.80	65.79	50.96	12.56	17.58	75,998	5.7	
356	do.	213	do.	1904	6.69	93.31	3.88	11.19	8.73	2.65	5.21	4.32	2.23	11.61	3.03	.75	68.08	52.42	13.00	18.07	78,117	7.5	
360	do.	213	do.	1904	7.17	92.83	3.54	11.87	9.26	2.18	4.26	3.54	1.86	10.57	2.75	.68	69.70	53.72	13.32	18.04	77,707	7.0	
363	do.	213	do.	1904	6.30	93.70	3.54	12.69	9.90	2.33	4.40	3.82	2.01	10.25	2.66	.68	68.92	53.07	13.16	18.16	78,506	6.5	
364	do.	213	do.	1904	6.09	93.91	3.65	11.81	9.21	2.16	4.11	3.41	1.79	11.52	3.00	.74	68.17	51.67	12.81	17.84	77,122	6.9	
387	do.	213	do.	1904	6.02	93.98	3.73	10.75	8.38	1.97	5.23	4.34	2.28	13.75	3.43	.83	67.11	51.67	12.81	17.91	77,423	7.7	
388	do.	213	do.	1904	6.38	93.62	3.73	10.19	7.95	1.97	3.38	3.22	1.69	14.51	3.71	.92	67.40	52.13	12.93	17.81	76,993	7.9	
388	do.	213	do.	1904	6.88	93.12	3.44	15.56	12.14	2.85	3.91	3.25	1.71	11.00	3.02	.65	65.49	50.42	12.50	17.70	76,993	5.0	
1254	do.	213	do.	1905 (2)	8.39	91.61	3.38	13.06	10.19	2.39	3.10	2.57	1.35	11.05	2.87	.71	69.41	53.44	13.25	17.70	76,517	6.1	

1255	do.	213	do.	1905 (2)	8.56	91.44	3.55	13.87	10.82	2.54	4.46	3.70	1.95	10.03	2.76	68	67.49	51.96	12.88	18.05	78.030	5.8
1256	do.	213	do.	1905 (2)	9.46	90.54	3.64	11.82	9.22	2.17	3.51	2.91	1.53	12.54	3.25	69	68.53	52.76	13.08	17.59	76.041	6.8
1257	do.	213	do.	1905 (2)	9.22	90.78	3.32	13.05	10.14	2.85	3.02	2.51	1.82	10.95	2.85	70	69.71	53.67	13.31	17.12	76.043	6.1
1258	do.	213	do.	1905 (2)	8.60	91.37	3.52	15.75	12.28	2.80	4.24	3.52	1.80	9.79	2.55	71	69.71	53.67	13.31	17.12	76.043	6.1
1259	do.	213	do.	1905 (2)	8.60	91.40	3.16	12.19	9.51	2.23	4.32	3.59	1.80	9.80	2.55	72	68.70	53.67	13.31	17.12	76.043	6.1
1260	do.	213	do.	1905 (2)	8.46	93.54	3.04	11.44	8.92	2.10	4.12	3.42	1.80	12.70	3.30	73	68.70	53.67	13.31	17.12	76.043	6.1
1261	do.	213	do.	1905 (2)	6.30	93.70	3.76	9.75	7.69	1.79	4.24	3.62	1.85	12.49	3.23	74	68.70	53.67	13.31	17.12	76.043	6.1
1262	do.	213	do.	1905 (2)	6.30	93.67	3.25	10.90	9.75	2.29	4.41	3.65	1.93	11.49	3.03	75	68.70	53.67	13.31	17.12	76.043	6.1
1263	do.	213	do.	1905 (2)	6.54	93.46	3.52	12.19	9.51	2.30	4.38	3.60	1.93	11.46	3.03	76	68.70	53.67	13.31	17.12	76.043	6.1
1264	do.	213	do.	1905 (2)	6.32	93.68	2.90	12.56	9.80	2.30	4.38	3.60	1.93	11.46	3.03	77	68.70	53.67	13.31	17.12	76.043	6.1
1265	do.	213	do.	1905 (2)	6.30	94.10	4.14	8.75	6.82	1.60	4.38	3.60	1.93	11.46	3.03	78	68.70	53.67	13.31	17.12	76.043	6.1
1266	do.	213	do.	1905 (2)	5.87	94.13	3.43	11.06	8.63	2.03	4.38	3.60	1.93	11.46	3.03	79	68.70	53.67	13.31	17.12	76.043	6.1
1267	do.	213	do.	1905 (2)	5.63	94.37	4.00	13.81	10.77	2.03	4.38	3.60	1.93	11.46	3.03	80	68.70	53.67	13.31	17.12	76.043	6.1
1268	do.	213	do.	1905 (2)	6.24	93.76	3.57	10.09	8.34	1.90	4.15	3.44	1.81	11.39	2.96	81	68.70	53.67	13.31	17.12	76.043	6.1
1269	do.	213	do.	1905 (2)	6.47	93.53	3.08	11.94	9.31	2.19	3.87	3.21	1.80	11.51	2.99	82	68.70	53.67	13.31	17.12	76.043	6.1
1270	do.	213	do.	1905 (2)	9.39	90.61	3.85	11.06	8.63	2.03	4.38	3.60	1.93	11.46	3.03	83	68.70	53.67	13.31	17.12	76.043	6.1
1271	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	84	68.70	53.67	13.31	17.12	76.043	6.1
1272	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	85	68.70	53.67	13.31	17.12	76.043	6.1
1273	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	86	68.70	53.67	13.31	17.12	76.043	6.1
1274	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	87	68.70	53.67	13.31	17.12	76.043	6.1
1275	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	88	68.70	53.67	13.31	17.12	76.043	6.1
1276	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	89	68.70	53.67	13.31	17.12	76.043	6.1
1277	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	90	68.70	53.67	13.31	17.12	76.043	6.1
1278	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	91	68.70	53.67	13.31	17.12	76.043	6.1
1279	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	92	68.70	53.67	13.31	17.12	76.043	6.1
1280	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	93	68.70	53.67	13.31	17.12	76.043	6.1
1281	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	94	68.70	53.67	13.31	17.12	76.043	6.1
1282	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	95	68.70	53.67	13.31	17.12	76.043	6.1
1283	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	96	68.70	53.67	13.31	17.12	76.043	6.1
1284	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	97	68.70	53.67	13.31	17.12	76.043	6.1
1285	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	98	68.70	53.67	13.31	17.12	76.043	6.1
1286	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	99	68.70	53.67	13.31	17.12	76.043	6.1
1287	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	100	68.70	53.67	13.31	17.12	76.043	6.1
1288	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	101	68.70	53.67	13.31	17.12	76.043	6.1
1289	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	102	68.70	53.67	13.31	17.12	76.043	6.1
1290	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	103	68.70	53.67	13.31	17.12	76.043	6.1
1291	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	104	68.70	53.67	13.31	17.12	76.043	6.1
1292	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	105	68.70	53.67	13.31	17.12	76.043	6.1
1293	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	106	68.70	53.67	13.31	17.12	76.043	6.1
1294	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	107	68.70	53.67	13.31	17.12	76.043	6.1
1295	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	108	68.70	53.67	13.31	17.12	76.043	6.1
1296	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	109	68.70	53.67	13.31	17.12	76.043	6.1
1297	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	110	68.70	53.67	13.31	17.12	76.043	6.1
1298	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	111	68.70	53.67	13.31	17.12	76.043	6.1
1299	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	112	68.70	53.67	13.31	17.12	76.043	6.1
1300	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	113	68.70	53.67	13.31	17.12	76.043	6.1
1301	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	114	68.70	53.67	13.31	17.12	76.043	6.1
1302	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	115	68.70	53.67	13.31	17.12	76.043	6.1
1303	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	116	68.70	53.67	13.31	17.12	76.043	6.1
1304	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	117	68.70	53.67	13.31	17.12	76.043	6.1
1305	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	118	68.70	53.67	13.31	17.12	76.043	6.1
1306	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	119	68.70	53.67	13.31	17.12	76.043	6.1
1307	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	120	68.70	53.67	13.31	17.12	76.043	6.1
1308	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	121	68.70	53.67	13.31	17.12	76.043	6.1
1309	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	122	68.70	53.67	13.31	17.12	76.043	6.1
1310	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	123	68.70	53.67	13.31	17.12	76.043	6.1
1311	do.	213	do.	1905 (2)	6.09	93.91	3.94	12.75	9.94	2.34	4.29	3.89	1.78	10.29	2.68	124	68.70	53.67	13.31	17.12	76.043	6.1
1312	do.	213	do.	1905 (2)	6.09</																	

TABLE XXXVIII.—Oats—individual analyses—Continued.

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.		Dry matter.		Protein (N X 6.25).			Fat.		Crude fiber.		Carbohydrate.			Total production value.		Nutritive ratio.	
213	Swedish Select.	213	N. C.	1905 (3)	9.77	91.03	3.85	11.88	9.27	2.18	2.83	2.35	1.24	12.40	3.22	0.80	69.04	53.16	13.18	17.40	75.220	6.9
213		Ind.	1903 (1)	9.22	93.78	3.39	12.69	9.90	2.33	2.33	3.39	2.67	1.48	12.06	3.14	0.78	68.47	52.72	13.07	17.66	76.344	6.8
213		do.	1904 (1)	8.48	91.52	3.43	13.38	10.43	2.45	2.45	3.22	2.81	1.40	11.68	3.04	0.75	70.28	52.68	13.04	17.64	76.258	6.9
213		do.	1905 (1)	9.05	90.95	3.87	14.19	11.07	2.60	2.60	2.87	2.38	1.25	10.96	2.85	0.71	68.11	52.44	13.00	17.56	75.912	5.5
213		Idaho.	1904	7.16	92.84	4.57	10.69	8.34	1.96	1.96	3.72	3.09	1.63	9.98	2.69	0.64	71.04	54.70	13.56	17.79	76.906	7.7
213		do.	1905 (1)	7.97	92.03	4.79	13.31	10.38	2.44	2.44	4.87	4.04	2.13	9.87	2.57	0.64	67.16	53.71	12.82	18.03	77.944	6.1
213		do.	1905 (1)	8.14	91.86	4.35	11.50	8.97	2.15	2.15	2.55	2.46	1.22	10.56	2.75	0.68	68.12	52.45	13.01	17.56	75.722	7.3
213		Tex.	1904	6.46	93.54	4.09	14.44	11.26	2.65	2.65	2.79	2.32	1.22	10.26	2.58	0.86	63.35	48.78	12.09	17.44	75.393	5.0
213		do.	1905 (2)	8.71	91.29	4.22	15.31	11.94	2.81	2.81	3.85	3.20	1.68	13.27	3.45	1.03	64.21	49.44	12.26	17.03	73.621	6.5
213		Mo.	1905 (1)	6.80	93.14	4.36	11.94	9.31	2.19	2.19	3.54	2.94	1.55	15.95	4.15	1.01	60.21	46.67	11.57	15.50	67.006	5.9
213		do.	1903 (1)	10.72	89.28	4.59	11.69	9.12	2.14	2.14	1.79	1.48	2.15	10.32	2.68	0.66	70.24	54.08	13.42	18.43	79.073	7.0
213		do.	1905 (1)	9.75	90.25	3.53	12.00	9.36	2.20	2.20	4.91	4.08	2.15	10.32	2.68	0.66	70.24	54.08	13.42	18.43	79.073	7.0
213		N. Dak.	1905 (3)	9.20	90.80	3.62	12.94	10.09	2.37	2.37	5.20	4.32	2.17	9.36	2.48	0.60	68.88	53.04	13.15	18.39	79.500	6.5
213		do.	1905 (1)	9.64	90.36	3.20	15.06	11.75	2.76	2.76	2.62	2.17	1.14	9.53	2.48	0.61	68.59	53.59	13.29	17.80	79.949	5.2
213		Ohio.	1905 (1)	9.44	90.36	3.20	15.06	11.75	2.76	2.76	2.62	2.17	1.14	9.53	2.48	0.61	68.59	53.59	13.29	17.80	79.949	5.2
213		Wyo.	1905 (4)	9.35	90.65	3.53	13.50	10.53	2.47	2.47	4.71	3.91	2.06	12.09	3.14	0.67	69.17	50.95	12.63	17.94	77.555	6.0
213	Me.	1905 (1)	6.12	93.48	2.89	12.81	9.99	2.35	2.35	4.78	3.97	2.09	10.02	2.86	0.71	69.17	50.95	12.63	17.94	77.555	6.0	
213	Canada.	1905 (2)	8.19	93.81	3.56	13.81	10.77	2.53	2.53	3.91	3.25	1.71	11.02	2.86	0.62	68.57	53.13	13.08	17.88	77.293	5.8	
213	do.	1905 (2)	8.23	91.77	3.13	13.75	10.72	2.52	2.52	4.57	3.79	1.99	9.68	2.92	0.74	68.08	52.49	13.01	17.50	74.356	6.0	
213	do.	1905 (2)	8.23	91.77	3.13	13.75	10.72	2.52	2.52	4.57	3.79	1.99	9.68	2.92	0.74	68.08	52.49	13.01	17.50	74.356	6.0	
213	Sixty Day	1905 (3)	8.06	90.94	4.49	13.87	10.82	2.78	2.78	2.97	2.47	1.30	10.31	2.68	0.68	66.91	49.81	12.35	17.52	75.739	3.0	
165	Kans.	1905 (1)	8.55	91.45	4.62	15.19	11.85	2.83	2.83	4.43	3.68	1.94	10.88	2.83	0.70	64.69	49.51	12.35	17.52	77.036	3.3	
165	Nebr.	1903	6.56	93.44	4.56	15.44	12.04	2.85	2.85	3.44	2.86	1.50	10.52	2.74	0.62	68.44	52.70	13.07	17.62	76.171	4.9	
165	N. Dak.	1903 (3)	9.20	90.74	4.56	15.56	12.14	2.85	2.85	3.44	2.86	1.50	10.52	2.74	0.62	68.44	52.70	13.07	17.62	76.171	4.9	
165	do.	1905 (1)	9.09	90.91	3.79	13.50	10.53	2.47	2.47	4.58	3.80	2.00	9.69	2.52	0.62	68.44	52.39	12.99	17.86	78.938	5.5	
165	do.	1905 (1)	8.40	91.40	3.45	14.03	11.41	2.68	2.68	4.57	3.79	1.99	9.31	2.42	0.60	68.91	49.21	12.20	17.80	76.949	4.3	
165	S. Dak.	1905 (1)	8.40	91.40	3.45	14.03	11.41	2.68	2.68	4.57	3.79	1.99	9.31	2.42	0.60	68.91	49.21	12.20	17.80	76.949	4.3	
165	do.	1902 (2)	8.96	91.04	3.60	17.75	13.84	3.25	3.25	3.75	3.11	1.64	10.99	2.86	0.65	63.15	48.63	12.06	17.98	77.727	3.9	
165	do.	1902 (2)	8.96	91.04	3.60	17.75	13.84	3.25	3.25	3.75	3.11	1.64	10.99	2.86	0.65	63.15	48.63	12.06	17.98	77.727	3.9	
165	do.	1903 (3)	9.18	90.82	3.50	14.31	11.16	2.62	2.62	4.02	3.34	1.72	10.06	2.88	0.71	67.10	51.67	12.81	17.90	77.382	5.6	
165	do.	1904 (4)	9.12	90.88	3.63	14.63	11.41	2.68	2.68	3.93	3.26	1.71	10.90	2.83	0.78	68.56	52.79	13.09	17.77	77.820	6.7	
165	do.	1905 (4)	8.88	91.12	3.53	12.00	9.36	2.20	2.20	3.89	3.23	1.65	10.43	2.61	0.63	66.91	51.06	12.66	17.89	77.338	4.9	
165	do.	1905 (4)	9.49	90.51	3.61	15.88	12.32	2.91	2.91	3.77	3.13	1.79	9.83	2.56	0.63	66.31	50.43	12.51	17.94	77.555	4.7	
165	do.	1903 (3)	9.46	90.94	4.13	16.44	12.82	3.01	3.01	4.10	3.40	2.05	9.30	2.42	0.60	63.57	48.95	12.14	17.82	78.793	4.8	
165	do.	1904 (4)	8.51	91.49	3.74	18.69	14.58	3.43	3.43	4.40	3.90	1.63	9.77	2.69	0.63	66.18	50.96	12.64	17.88	77.293	4.8	
165	do.	1905 (5)	8.91	91.09	4.08	16.25	12.67	2.98	2.98	3.72	3.02	1.90	10.36	2.69	0.71	67.73	52.15	12.94	18.00	77.814	6.0	
165	do.	1905 (7)	8.92	91.08	3.99	15.56	10.58	2.49	2.49	4.36	3.62	1.90	10.36	2.69	0.71	67.73	52.15	12.94	18.00	77.814	6.0	
165	do.	1903 (2)	8.61	91.37	3.81	11.50	8.97	2.11	2.11	5.05	4.69	2.47	11.08	2.88	0.71	67.06	52.33	12.98	18.27	78.981	7.3	
165	do.	1904 (3)	8.61	91.39	3.74	10.87	8.48	1.99	1.99	5.59	4.64	2.44	12.94	3.36	0.83	66.86	51.48	12.77	18.63	77.944	7.7	

1285	do.	165	do.	1902 (1)	9.43	90.57	3.93	15.94	12.43	2.92	3.59	2.98	1.57	10.82	2.81	70	65.72	50.61	12.55	17.74	70,090	4.8
1286	do.	165	do.	1903 (1)	9.57	90.98	4.07	16.31	9.60	2.90	4.51	3.74	1.97	10.32	2.68	66	69.19	53.27	13.21	18.10	78,246	6.7
1287	do.	165	Wash.	1904 (3)	9.02	90.43	3.69	16.81	13.11	3.08	4.83	4.01	1.91	9.08	2.36	68	65.19	50.20	12.45	18.22	78,765	4.7
1288	do.	165	Tex.	1905 (2)	8.79	91.21	3.58	15.75	12.68	2.93	3.20	2.60	1.80	10.04	2.84	78	64.88	49.96	12.39	17.46	75,479	4.8
1289	do.	165	Idaho.	1906 (1)	8.79	91.27	3.58	15.75	10.82	2.93	4.53	3.68	1.94	8.85	2.30	70	69.00	53.19	13.19	17.81	76,993	7.4
1290	do.	165	Wyo.	1906 (1)	8.81	91.19	3.81	13.87	10.82	2.54	4.13	3.68	1.94	8.85	2.30	87	69.04	53.16	13.18	18.23	78,808	5.9
1291	do.	165	Colo.	1906 (1)	8.25	91.77	4.70	16.25	12.67	2.98	3.81	3.16	1.70	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1292	do.	165	Cal.	1906 (1)	8.38	91.62	4.41	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1293	do.	165	Cal.	1906 (1)	8.25	91.77	4.70	16.25	12.67	2.98	3.81	3.16	1.70	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1294	do.	165	Oreg.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1295	do.	165	Utah.	1906 (1)	8.25	91.77	4.70	16.25	12.67	2.98	3.81	3.16	1.70	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1296	do.	165	Ohio.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1297	do.	165	N. Y.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1298	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1299	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1300	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1301	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1302	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1303	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1304	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1305	do.	165	Ill.	1906 (1)	8.57	91.47	4.34	14.44	11.24	1.68	3.81	3.33	1.75	13.67	3.55	88	63.50	48.93	12.33	17.37	75,000	6.0
1311	Tobolsk.	135	Kans.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1312	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1313	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1314	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1315	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1316	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1317	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1318	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1319	do.	135	S. Dak.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1320	Shatlov.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1321	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1322	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1323	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1324	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1325	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1326	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1327	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1328	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1329	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1330	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1331	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1332	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1333	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1334	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1335	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1336	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1337	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1338	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1339	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1340	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1341	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1342	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1343	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1344	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1345	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1346	do.	144	do.	1906 (3)	9.32	90.68	3.75	13.63	10.63	2.94	4.81	3.84	2.02	11.55	3.17	79	65.83	50.69	12.57	17.46	75,479	4.8
1347	do.	144	do.	1906 (3)	9.32	90.68																

TABLE XXXVIII.—Oats—individual analyses—Continued.

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein. (N X 0.25.)			Fat.		Crude fiber.		Carbohydrate.			Total production value.		Nutritive ratio.		
								Total.	Digestible.	Product in flesh.	Total.	Digestible.	Product in flesh.	Total.	Digestible.	Product in flesh.	Calories.	Gain in flesh.				
1339	Kherson.....	212	Nebr.....	1904	8.58	91.42	3.93	12.13	9.46	2.22	3.98	3.30	1.74	12.67	3.29	0.82	67.29	51.81	10.37	15.15	65,493	6
1340	Red Rust Proof	256	Kans.....	1905 (3)	8.19	91.81	3.43	14.44	11.26	2.65	5.33	4.42	2.33	10.38	2.70	.67	66.42	51.14	12.68	18.93	79,240	5.7
1368	Texas Red Rust Proof.	451	do.....	1905 (1)	8.35	91.65	3.98	15.00	11.70	2.73	4.96	4.12	2.17	11.29	2.94	.73	64.82	49.92	12.38	18.03	79,240	5.3
226	do.	451	do.	1905 (1)	7.92	92.98	3.73	13.44	10.48	2.46	5.52	4.58	2.41	12.66	3.29	.82	64.63	49.76	12.34	18.03	77,944	5.6
1369	Kans.	458	do.	1904 (1)	7.72	92.28	4.60	10.31	8.04	1.89	5.40	4.48	2.36	14.18	3.69	.92	65.51	50.44	12.51	17.68	76,431	7.4
1370	do.	458	do.	1905 (2)	7.72	92.14	4.07	14.81	11.55	2.71	5.71	4.74	2.49	11.31	2.94	.73	64.10	49.36	12.24	18.17	78,549	5.4
1371	Tex.	458	do.	1904 (1)	7.69	92.31	3.15	15.19	11.85	2.78	5.78	4.80	2.52	10.17	2.64	.65	67.71	52.14	12.94	18.31	79,157	5.3
1372	N. C.	458	do.	1904 (1)	8.18	91.82	3.96	12.38	9.66	2.27	5.74	4.80	2.52	10.17	2.64	.65	67.71	52.14	12.94	18.31	79,157	5.3
1341	Apple's Rust Proof.	339	Cal.	1905 (1)	6.94	93.04	3.12	11.00	8.58	2.02	6.44	5.43	2.81	11.26	2.93	.73	68.18	52.50	13.02	18.70	80,840	5.4
320	do.	339	do.	1905	8.84	91.16	2.85	15.37	11.99	2.82	6.44	5.43	2.86	10.64	2.77	.69	64.69	49.74	12.33	18.09	78,203	6.4
1376	Culberson Winter.	273	Md.	1906	7.67	92.33	4.15	12.75	9.94	2.34	5.99	4.97	2.61	12.53	3.26	.81	64.58	49.73	12.33	18.09	77,338	8.4
1342	do.	273	Tex.	1904 (1)	8.67	91.33	3.94	9.94	7.75	1.82	5.40	4.53	2.38	13.51	3.51	.87	67.15	51.70	12.82	17.89	77,338	8.4
1343	do.	273	Ill.	1903 (1)	9.22	90.78	3.02	13.06	10.19	2.39	6.35	5.25	2.95	10.37	2.75	.08	66.60	51.28	12.72	18.74	81,013	6.5
1372	do.	273	Md.	1905 (2)	9.30	90.70	3.84	12.56	9.80	2.30	6.33	5.25	2.72	11.37	2.96	.73	65.88	50.73	12.58	18.37	79,413	6.7
1373	do.	273	do.	1905 (3)	8.66	91.34	4.05	17.38	13.56	3.19	6.23	5.17	2.72	10.11	3.07	.05	62.23	47.92	11.88	18.44	79,716	4.6
1345	Prince Edward's Island.	219	Kans.....	1905 (2)	8.64	91.36	4.87	13.69	10.08	2.51	5.75	4.77	2.51	11.81	3.07	.76	63.88	49.19	12.20	17.98	77,727	5.4
1346	do.	280	do.	1905 (2)	8.56	91.44	4.08	15.06	11.75	2.76	5.82	4.83	2.54	10.92	2.84	.92	64.62	49.37	12.34	18.24	78,851	5.4
1347	Red Algerian.	280	N. Dak.	1905 (2)	9.00	90.91	3.94	12.19	9.51	2.23	5.04	4.18	2.20	14.19	3.69	.92	64.62	49.37	12.34	17.69	76,474	6.0
1348	do.	286	S. Dak.	1905 (2)	8.86	91.14	4.67	13.37	10.43	2.45	4.85	4.03	2.12	11.78	3.36	.90	64.62	49.37	12.34	17.69	76,474	6.0
1349	do.	286	do.	1905 (2)	8.63	91.35	4.05	13.25	11.11	2.61	4.52	3.75	1.97	12.99	3.38	.84	64.19	49.43	12.26	17.46	75,479	5.5
1350	do.	286	Tex.	1905 (1)	8.76	91.24	5.27	11.25	8.77	2.07	4.56	3.75	1.99	13.27	3.45	.86	65.05	50.55	12.54	17.46	75,479	5.5
1351	do.	286	Cal.	1905 (1)	8.76	91.24	5.27	11.25	8.77	2.07	4.56	3.75	1.99	13.27	3.45	.86	65.05	50.55	12.54	17.46	75,479	5.5
1852	do.	286	Oreg.	1905 (1)	8.55	91.45	6.25	16.19	12.03	2.97	4.77	3.96	2.08	9.52	2.48	.01	63.27	48.45	12.01	17.56	76,690	4.8
1353	do.	286	Utah.	1904 (1)	7.99	92.01	5.34	13.81	10.77	2.53	5.01	4.16	2.19	12.92	3.36	.85	62.92	48.45	12.01	17.56	75,912	5.7
1354	do.	286	do.	1905 (1)	8.29	91.71	4.91	11.75	9.16	2.15	5.30	4.40	2.31	13.17	3.42	.84	64.87	49.95	12.39	17.70	76,517	6.9
1379	do.	286	Ariz.	1905 (1)	8.67	91.33	4.02	10.31	8.04	1.89	6.38	5.30	2.79	11.93	3.10	.77	67.36	51.88	12.87	18.32	79,197	8.3
1355	Unnamed varieties	288	Wash.	1905 (2)	7.80	92.20	4.82	10.94	8.53	2.00	6.22	4.87	2.56	13.03	3.57	.69	64.64	49.77	12.34	17.79	76,906	7.5
1356	do.	289	do.	1905 (2)	8.41	91.59	4.43	13.56	10.58	2.49	6.22	5.16	2.71	10.02	2.61	.93	65.77	50.64	12.56	18.41	79,586	6.1
1357	do.	290	do.	1905 (2)	8.24	91.76	3.71	12.81	9.99	2.35	4.41	3.41	1.79	11.39	2.96	.73	67.98	52.34	12.98	17.85	77,105	6.6
1358	do.	291	do.	1905 (2)	8.02	91.98	3.89	11.44	8.92	2.10	3.70	3.19	1.68	14.57	3.78	.94	66.40	50.40	12.68	17.33	74,917	6.9
1359	do.	291	Cal.	1905 (1)	8.54	91.46	4.00	12.94	10.09	2.37	3.84	3.19	1.68	13.92	3.62	.90	65.30	50.28	12.47	17.42	75,307	6.1
1360	Burt.	293	Kans.	1905 (2)	8.81	91.19	5.10	14.00	10.92	2.57	6.95	5.77	3.04	11.70	3.04	.75	63.84	49.16	12.19	18.17	78,549	5.8
1361	do.	293	do.	1904 (1)	8.26	91.74	5.32	12.81	9.99	2.35	6.95	5.77	2.90	11.39	2.96	.73	63.84	49.16	12.19	18.17	78,549	5.8
1362	do.	293	N. Dak.	1905 (2)	8.98	91.62	4.59	15.69	12.24	2.88	6.57	5.45	2.97	10.16	2.96	.05	62.99	48.50	12.03	18.43	79,673	5.2
1363	do.	293	Tex.	1904 (1)	7.93	92.07	4.45	13.56	10.58	2.49	6.12	4.92	2.59	12.63	3.28	.79	62.30	47.97	12.19	18.01	77,857	6.0
1364	do.	293	do.	1905 (2)	7.95	92.07	4.45	13.56	10.58	2.49	6.12	4.92	2.59	12.63	3.28	.79	62.30	47.97	12.19	18.01	78,376	5.3
1365	do.	293	Md.	1904 (1)	9.08	90.92	3.81	13.50	10.53	2.47	5.60	4.65	2.45	11.22	2.92	.72	65.87	50.72	12.58	18.22	78,705	6.1

TABLE XXXIX.—*Emmer—individual analyses.*
[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.		Dry matter.		Ash.			Protein (N x 6.25).			Fat.		Crude fiber.		Carbohydrate.			Total production value.		Nutritive ratio.
					Original...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
041	Black emmer.	2327	France...	Original...	8.97	91.08	3.88	12.00	9.00	2.11	1.47	1.04	0.55	10.72	4.72	1.17	71.93	53.95	12.38	17.21	74.399	5.6		
040	do.	2337	Md.	...	8.01	90.99	3.30	13.94	10.45	2.46	1.81	1.28	0.67	13.74	6.18	1.17	66.21	49.66	12.31	17.05	73.707	5.9		
042	do.	2337	Kans.	1905 (1)	8.25	91.75	3.60	12.62	9.46	2.22	2.88	2.04	1.07	17.89	7.87	1.95	66.21	43.76	11.35	16.59	71.718	6.1		
043	do.	2337	Tex.	1905 (1)	8.31	91.66	4.16	12.06	9.04	2.12	2.12	1.05	.55	12.54	5.52	1.13	66.76	50.21	12.45	17.01	73.534	6.1		
044	do.	2338	Kans.	1903 (1)	8.16	91.84	4.18	16.87	12.65	2.97	1.67	1.19	.63	10.33	4.51	1.37	69.15	48.56	12.04	17.02	74.269	4.4		
045	do.	2328	do.	1904 (2)	8.27	91.73	4.87	17.12	12.84	3.02	1.94	1.38	.78	11.32	4.98	1.23	69.54	52.15	12.93	17.04	73.577	4.4		
046	do.	2328	do.	1904 (2)	8.94	91.06	5.17	12.00	9.00	2.11	2.08	1.48	.78	11.21	4.93	1.22	69.54	52.15	12.93	17.04	73.654	6.2		
047	do.	2328	Nebr.	1903 (1)	8.23	91.78	4.96	12.87	9.63	2.89	1.38	1.35	.73	11.38	5.01	1.24	68.84	51.63	12.80	17.04	73.664	6.2		
048	do.	2338	do.	1903 (1)	8.35	91.65	5.09	16.37	12.28	2.89	1.72	1.22	.64	11.06	4.79	1.21	65.76	49.32	12.23	16.97	73.361	4.6		
049	do.	2338	N. Dak.	1902 (1)	8.47	91.53	3.25	13.00	9.75	2.90	1.35	1.45	.77	11.19	4.69	1.16	71.18	53.39	13.24	17.40	75.220	6.3		
050	do.	2338	do.	1905	8.49	91.51	3.74	11.25	8.44	1.98	2.05	1.46	.77	11.19	4.69	1.22	65.75	49.31	12.32	17.32	74.874	7.3		
051	do.	2338	S. Dak.	1903 (1)	8.53	91.15	3.86	18.69	14.02	3.29	1.43	1.02	.65	10.37	4.52	1.12	65.75	49.31	12.32	17.18	74.269	4.0		
052	do.	2338	Colo.	1903 (1)	8.77	91.23	4.57	12.66	9.04	2.12	1.73	1.26	.65	8.49	4.18	1.02	70.09	52.57	13.04	17.29	74.485	6.7		
053	do.	2338	Tex.	1902 (1)	9.60	90.40	4.27	14.56	10.92	2.57	1.77	1.26	.66	9.31	4.10	1.02	70.09	52.57	13.04	17.29	74.485	6.7		
054	do.	2338	do.	1903 (1)	8.70	91.30	4.09	15.00	11.25	2.64	1.76	1.25	.68	11.16	4.91	1.25	68.94	50.99	12.64	17.16	74.188	3.2		
055	do.	2338	do.	1904 (2)	8.24	91.76	4.10	14.44	10.83	2.64	1.83	1.30	.68	11.49	5.06	1.25	68.94	50.99	12.64	17.16	74.226	6.9		
056	do.	2338	Minn.	1902 (1)	10.25	89.75	4.79	11.81	8.86	2.08	1.87	1.33	.69	10.14	4.46	1.11	71.87	53.90	13.28	17.17	75.090	6.5		
057	do.	2338	do.	1903 (1)	9.65	90.35	3.67	12.56	9.42	2.21	1.85	1.31	.69	10.05	4.42	1.18	71.22	53.42	13.25	17.23	74.485	6.9		
058	do.	2338	do.	1904 (2)	8.69	91.31	4.24	11.81	8.86	2.08	1.93	1.37	.72	11.72	5.16	1.28	70.83	53.12	13.17	17.47	75.523	6.3		
059	do.	2338	Wis.	1902 (1)	7.97	92.03	2.46	13.06	9.33	2.30	1.93	1.44	.72	10.80	4.75	1.18	70.83	53.12	13.17	17.38	75.134	6.3		
060	do.	2338	Ark.	1903 (1)	8.14	91.86	3.27	12.87	9.65	2.27	2.29	1.63	.86	11.03	4.85	1.23	70.53	52.90	13.12	17.37	75.041	8.1		
061	do.	2338	Pa.	1902 (1)	8.60	91.40	2.61	10.44	7.83	1.84	2.02	1.63	.86	11.03	4.85	1.23	70.53	52.90	13.12	17.37	75.041	8.1		
062	do.	2338	do.	1903 (2)	8.85	91.15	3.17	8.63	6.47	1.52	2.02	1.43	.75	12.02	5.03	1.31	74.16	55.62	13.69	17.59	76.041	8.1		
063	do.	2338	N. Mex.	1902 (1)	9.02	90.98	3.69	12.94	9.71	2.28	1.95	1.38	.73	9.17	4.03	1.00	72.25	55.62	13.44	17.45	75.090	9.9		
064	do.	2338	Nebr.	1904 (2)	8.19	91.81	4.64	12.00	9.00	2.11	1.93	1.37	.72	10.86	4.78	1.19	70.57	52.93	13.13	17.15	74.139	6.7		

TABLE XL.—*Einkorn* — individual analyses.

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry Matter.	Ash.	Protein (N X 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
							Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1065	2433	Kans.	1905 (1)	7.86	92.14	9.82	16.25	12.19	2.86	2.14	1.52	0.80	13.15	5.79	1.44	61.64	46.23	11.46	16.56	71,589	4.5
1066	2433	S. Dak.	1905 (2)	8.78	91.22	5.69	13.75	10.31	2.42	2.18	1.55	.82	14.67	6.45	1.60	63.71	47.78	11.85	16.69	72,451	5.6
1067	2433	do.	1905 (2)	8.81	91.19	5.04	15.00	11.95	2.64	2.00	1.42	.75	13.39	5.89	1.66	64.57	48.43	12.01	16.86	72,886	5.1
1068	2433	Tex.	1905 (1)	7.91	92.09	4.72	13.69	10.27	2.41	2.43	1.73	.91	13.01	5.72	1.42	66.15	49.61	12.30	17.04	73,664	5.8

TABLE XLI.—*Wheat* — individual analyses.

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N X 5.7)			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
						Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
	Durum.	Russia.	11.02	88.98	1.78	16.87	14.17	3.33	2.25	1.42	0.75	2.40	1.13	0.28	76.56	70.50	17.50	21.86	94,501	5.3
	<i>T. vulgare</i>	do.	9.43	90.57	1.85	16.76	14.07	3.31	1.72	1.08	.57	2.45	1.15	.28	77.22	71.04	17.62	21.76	94,068	5.3
	<i>T. sativum</i>	India.	9.58	90.42	2.30	11.97	10.05	2.36	2.62	1.65	.87	3.06	1.44	.36	80.05	73.65	18.26	21.85	94,457	7.8
	Durum.	United States.	9.77	90.23	2.02	15.50	13.02	3.06	2.73	1.72	.91	2.59	1.33	.33	76.92	70.77	17.55	21.85	94,457	5.8
	N. W. spring	do.	10.11	89.89	1.85	14.02	11.78	2.77	2.24	1.41	.74	2.79	1.17	.29	79.39	73.04	18.11	21.91	94,717	6.6
	Kans. winter	do.	10.68	89.32	2.28	13.17	11.06	2.60	1.81	1.14	.60	2.79	1.31	.32	79.95	73.55	18.24	21.76	94,068	7.0
	Soft winter.	do.	10.55	89.45	2.00	11.86	9.96	2.34	1.91	1.20	.63	2.49	1.17	.29	81.77	75.24	18.66	21.92	94,760	7.9

TABLE XLII.—*Rye — individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N × 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Pro d u c t i o n value—gain in flesh.	Total.	Digestible.	Pro d u c t i o n value—gain in flesh.	Total.	Digestible.	Pro d u c t i o n value—gain in flesh.	Total.	Digestible.	Pro d u c t i o n value—gain in flesh.	Gain in flesh.	Calories.	
1069	.....	30	Md.....	1906	9.37	90.63	2.27	13.06	10.97	2.58	1.84	1.18	0.62	2.47	1.31	0.32	80.36	73.93	18.33	21.85	94,457	7.1
1070	Ivanov.....	34	Kans.....	1905 (1)	9.92	90.08	2.36	17.44	14.65	3.44	1.75	1.12	.59	2.44	1.29	.32	76.01	68.92	17.34	21.69	93,766	5.9
1071	do.....	34	do.....	1905 (1)	9.49	90.51	2.28	13.75	11.33	2.71	1.87	1.20	.63	2.66	1.41	.55	79.44	73.09	18.13	21.82	94,328	6.7
1072	do.....	34	do.....	1905 (1)	9.14	90.86	2.23	11.12	9.34	2.19	1.93	1.24	.65	2.48	1.31	.32	82.24	75.66	18.70	21.92	94,700	8.5
1073	do.....	34	do.....	1905 (1)	9.75	90.25	2.33	12.62	10.59	2.49	2.17	1.39	.73	2.38	1.26	.31	80.50	74.06	18.37	21.90	94,674	7.4
1074	do.....	34	Tex.....	1905 (1)	9.18	90.82	1.65	11.87	9.97	2.34	1.78	1.14	.60	2.23	1.18	.29	82.47	75.87	18.81	22.04	95,279	8.0
1075	do.....	34	Wyo.....	1905 (1)	8.87	91.13	2.08	10.50	8.82	2.07	1.54	.99	.52	2.17	1.15	.28	83.71	77.01	19.10	21.79	94,976	9.1
1076	Abbruzzes.....	40	Kans.....	1905 (1)	9.42	90.58	2.27	15.62	13.12	3.08	1.68	1.08	.57	2.29	1.21	.30	78.14	71.89	17.83	21.78	94,155	5.8
1077	do.....	40	Cal.....	1905 (1)	9.26	90.74	2.09	13.31	11.18	2.63	1.77	1.13	.59	2.15	1.14	.28	80.68	74.22	18.41	21.91	94,717	7.0
1085	do.....	40	do.....	1905 (1)	9.09	90.91	2.09	10.75	9.03	2.12	1.98	1.27	.67	2.16	1.14	.27	79.07	72.75	18.04	21.95	94,890	8.9
1078	do.....	40	Tex.....	1905 (1)	9.13	90.87	1.65	15.44	12.97	3.05	1.77	1.13	.59	2.07	1.10	.27	83.02	76.38	18.94	21.91	95,149	5.9
1079	do.....	40	Oreg.....	1905 (1)	8.88	91.12	3.06	12.19	10.24	2.41	1.95	1.25	.66	2.53	1.34	.33	80.27	73.85	18.32	21.72	93,895	7.6
1080	Spring.....	73	Nehr.....	1905 (1)	9.87	90.13	2.12	11.37	9.55	2.24	1.93	1.24	.65	2.39	1.27	.31	82.19	75.61	18.19	21.95	94,890	8.3
1081	do.....	73	do.....	1905 (2)	9.42	90.58	1.95	14.19	11.92	2.80	1.91	1.22	.64	2.50	1.17	.29	79.75	73.37	18.79	21.92	94,700	7.1
1082	do.....	73	do.....	1905 (1)	9.55	90.45	2.32	16.44	13.81	3.25	1.71	1.09	.57	2.22	1.18	.29	77.31	71.12	17.64	21.75	94,025	5.4
1083	do.....	73	do.....	1905 (1)	9.78	90.22	2.17	15.19	12.76	3.00	1.84	1.18	.62	2.17	1.15	.28	78.63	72.34	17.94	21.84	94,414	6.0
1084	do.....	73	do.....	1905 (1)	9.30	90.70	2.13	13.69	11.50	2.70	1.73	1.11	.58	2.16	1.14	.28	80.29	73.87	18.32	21.88	94,587	6.7

TABLE XLIII.—*Barley* — individual analyses.

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Protein (N x 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
					Total.	Digestible.	Pro duction value—gain in flesh.	Total.	Digestible.	Pro duction value—gain in flesh.	Total.	Digestible.	Pro duction value—gain in flesh.	Total.	Digestible.	Pro duction value—gain in flesh.	Gain in flesh.	Calories.	
1124	Hanna.....	226	Ariz.....	1905 (1)	11.06	7.74	1.82	2.09	1.86	0.98	4.40	1.45	0.36	79.90	73.51	18.23	21.39	92,469	10.2
1125	do.....	287	Kans.....	1905 (2)	15.44	10.81	2.54	2.09	1.86	0.98	4.46	1.47	0.36	75.11	69.10	17.14	21.02	90,869	6.2
1126	do.....	301	do.....	1905 (2)	14.31	10.02	2.63	2.13	1.90	1.00	4.42	1.46	0.38	75.79	69.72	17.20	21.00	90,783	7.5
1127	do.....	305	do.....	1905 (2)	16.30	11.20	2.63	2.14	1.90	1.00	4.63	1.53	0.38	73.87	67.96	16.53	20.86	90,178	6.6
1128	do.....	318	do.....	1905 (2)	14.75	10.32	2.43	2.07	1.84	0.97	3.94	1.35	0.33	76.10	71.01	17.36	21.09	91,172	7.3
1129	do.....	257	do.....	1905 (2)	9.01	3.56	1.18	1.98	1.76	1.03	3.90	1.35	0.48	75.44	69.40	17.21	20.78	89,832	8.2
1130	do.....	257	do.....	1905 (2)	13.12	8.92	2.16	2.20	1.96	1.03	5.77	1.90	0.47	75.65	69.60	17.26	20.86	90,178	8.5
1131	do.....	257	do.....	1905 (2)	12.75	8.57	2.01	2.04	1.82	0.96	5.87	1.94	0.48	76.62	70.39	17.46	20.91	90,394	8.9
1132	do.....	257	do.....	1905 (2)	12.81	8.97	2.11	1.93	1.72	0.90	5.21	1.72	0.43	76.78	70.63	17.52	20.96	90,610	8.5
1133	do.....	257	do.....	1905 (2)	14.04	9.89	2.31	1.83	1.63	0.86	5.98	1.97	0.49	74.90	68.91	17.00	20.75	89,702	7.6
1134	do.....	257	do.....	1905 (2)	11.37	7.96	1.87	2.00	1.78	0.94	5.50	1.81	0.45	77.66	71.45	17.72	20.98	90,696	9.7
1135	do.....	257	do.....	1905 (2)	12.63	8.83	2.07	2.00	1.64	0.86	6.06	2.00	0.50	76.93	70.77	17.55	20.84	90,221	8.6
1136	do.....	257	do.....	1905 (2)	14.44	10.11	2.24	1.91	1.70	0.89	6.20	1.98	0.49	76.14	70.04	17.37	20.87	90,521	7.3
1137	do.....	257	do.....	1905 (2)	13.62	9.53	2.32	1.74	1.55	0.81	5.67	1.87	0.46	75.60	69.55	17.20	20.76	89,743	7.9
1138	do.....	257	do.....	1905 (2)	12.25	8.57	2.01	1.91	1.70	0.89	6.04	1.99	0.49	76.43	70.31	17.44	20.83	90,048	8.9
1139	do.....	257	do.....	1905 (2)	10.84	3.30	1.22	2.00	1.78	0.94	6.46	2.13	0.53	75.37	69.34	17.22	20.68	89,400	7.0
1140	do.....	257	do.....	1905 (2)	15.50	10.50	2.47	1.79	1.59	0.93	6.10	2.01	0.50	74.17	68.24	16.92	20.68	90,066	9.8
1141	do.....	257	do.....	1905 (1)	11.31	7.92	1.86	1.98	1.76	0.93	5.53	1.82	0.47	75.53	71.32	17.69	20.73	89,789	6.2
1142	do.....	257	Tex.....	1905 (1)	16.75	11.72	2.75	2.00	1.78	0.94	5.74	1.89	0.52	72.80	66.97	16.61	20.77	89,616	8.9
1143	do.....	257	Ind. Ter.	1905 (1)	12.37	8.73	2.33	2.00	1.53	0.88	6.33	2.09	0.52	78.56	72.28	17.93	20.73	89,097	10.4
1144	do.....	257	do.....	1905 (1)	13.28	8.64	2.37	2.00	1.78	0.94	6.33	2.09	0.52	79.74	73.36	18.19	21.01	91,172	10.1
1145	do.....	257	do.....	1905 (2)	10.50	7.32	1.73	2.00	1.53	0.88	6.33	2.09	0.52	79.74	73.36	18.19	21.01	91,172	10.1
1146	do.....	257	do.....	1905 (2)	12.31	8.65	2.03	2.01	1.79	0.91	5.79	1.91	0.52	77.37	71.18	17.65	21.09	91,042	11.8
1147	do.....	353	Kans. #	1905 (1)	9.56	6.69	1.95	1.90	1.69	0.89	7.19	2.37	0.59	75.76	69.69	17.28	20.71	89,529	9.1
1148	do.....	353	do.....	1905 (1)	9.07	6.03	1.81	1.52	1.52	0.80	5.82	1.92	0.58	79.81	73.42	18.21	21.06	91,042	11.8
1149	do.....	353	Tex.....	1905 (1)	14.50	10.19	2.30	1.71	1.52	0.80	6.30	2.08	0.52	74.42	68.05	16.88	20.69	89,443	7.3
1150	do.....	353	do.....	1905 (1)	13.46	8.66	2.04	1.73	1.54	0.81	6.51	2.15	0.53	73.97	68.05	16.88	20.69	89,140	7.2
1151	do.....	353	Nebr.....	1905 (1)	12.37	8.66	2.04	1.68	1.50	0.79	6.25	2.06	0.51	76.30	70.19	17.41	21.75	91,475	7.8
1152	do.....	353	do.....	1905 (1)	13.94	9.76	2.29	1.82	1.94	1.02	4.00	1.34	0.35	76.78	70.63	17.52	21.07	91,088	6.4
1153	do.....	187	Sweden	Original....	13.94	9.76	2.29	1.82	1.94	1.02	4.00	1.34	0.35	76.78	70.63	17.52	21.07	91,088	6.4
1154	do.....	187	Kans.....	1905 (4)	16.50	11.55	2.71	2.26	2.01	1.00	4.30	1.42	0.38	74.29	70.01	17.36	21.14	91,475	7.3
1155	do.....	187	S. Dak.....	1905 (3)	14.81	10.37	2.59	2.44	1.90	1.00	4.15	1.37	0.38	74.74	68.76	17.03	21.16	91,475	6.6
1156	do.....	187	Wash.....	1903 (1)	16.12	11.68	2.65	2.23	1.78	1.17	4.30	1.42	0.35	73.96	68.04	16.87	21.24	90,960	6.3
1157	do.....	187	Cal.....	1902 (2)	9.25	6.48	1.52	1.67	1.49	0.78	5.13	1.69	0.42	81.19	73.4	18.52	21.24	91,830	12.3

1152	Klitzing	Bavaria...	Original...	8.82	91.18	2.85	11.82	8.27	1.94	1.94	1.73	.91	4.15	1.37	.34	79.34	72.90	18.08	21.27	91.956	9.4
1153	do.	Kans.	1905 (4)	9.20	90.80	2.80	13.81	11.07	2.60	1.94	1.73	.91	3.97	1.31	.32	73.40	69.42	17.22	21.05	90.999	6.7
1154	do.	S. Dak.	1905 (3)	9.20	90.80	2.87	14.09	10.29	2.42	2.03	1.81	.95	4.75	1.57	.33	73.60	69.60	17.26	21.02	90.869	7.3
1155	do.	Kans.	1903 (1)	8.92	91.08	3.05	14.00	9.84	2.31	1.92	1.71	.83	7.29	2.41	.60	73.89	67.98	16.86	20.59	89.100	7.5
1156	do.	Idaho	1903 (2)	8.92	90.55	3.18	14.00	9.84	2.31	1.92	1.71	.90	6.74	2.22	.55	74.10	68.17	16.91	20.67	89.356	7.6
1157	do.	N. Dak.	1905 (2)	8.92	91.08	3.03	13.50	10.85	2.55	2.01	1.79	.94	6.52	2.15	.53	72.91	67.10	16.64	20.60	89.313	6.7
1158	do.	S. Dak.	1902 (1)	8.74	91.20	2.89	14.19	9.93	2.38	1.65	1.61	.97	6.74	2.22	.66	72.30	66.51	16.49	20.70	87.757	7.2
1159	do.	Idaho	1904 (2)	9.02	90.98	3.52	14.44	10.11	2.37	1.72	1.53	.80	7.83	2.68	.66	72.30	65.03	16.13	20.24	87.497	6.2
1160	do.	Texas	1905 (3)	9.06	90.92	3.52	16.25	11.37	2.67	1.84	1.64	.86	8.99	2.97	.66	73.89	67.98	16.86	20.40	88.578	8.7
1161	do.	Idaho	1903 (1)	9.18	90.82	3.10	12.31	8.62	2.03	1.98	1.74	.94	6.87	2.27	.56	73.74	73.30	18.19	21.09	91.123	8.8
1162	do.	Cal.	1904 (2)	8.55	91.45	3.39	12.75	8.92	1.95	1.97	1.94	.97	6.28	2.08	.52	75.30	69.36	17.20	20.84	90.901	8.5
1163	do.	Idaho	1905 (1)	9.00	91.00	3.19	11.87	8.31	1.93	1.97	1.73	.91	6.29	2.08	.55	75.30	69.36	17.20	20.84	90.901	8.5
1164	do.	Idaho	1905 (1)	9.25	90.50	2.91	11.25	7.68	1.83	1.94	1.73	.91	6.29	2.08	.52	77.61	71.40	17.71	20.90	90.740	9.8
1165	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1166	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1167	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1168	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1169	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1170	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1171	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1172	Black Smyrna	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1173	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1174	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1175	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1176	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1177	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1178	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1179	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1180	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1181	do.	Idaho	1905 (2)	9.25	90.50	2.97	10.12	7.68	1.60	1.75	1.56	.82	6.91	2.28	.51	74.36	67.13	17.88	20.87	90.221	11.0
1182	Princess	Kans.	1905 (1)	9.00	91.00	3.14	10.31	7.22	1.70	1.81	1.61	.85	5.49	1.81	.45	79.25	72.91	18.08	21.08	91.129	10.8
1183	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1184	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1185	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1186	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1187	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1188	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1189	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1190	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1191	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1192	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1193	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1194	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1195	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1196	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1197	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1198	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1199	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1200	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1201	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1202	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1203	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1204	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1205	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1206	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1207	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1208	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1209	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1210	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1211	do.	Idaho	1905 (1)	9.33	90.67	2.96	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.38	74.18	68.24	16.92	20.80	89.918	6.4
1212	do																				

TABLE XLIII.—*Barley—individual analyses—Continued.*

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N×6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain	Total.	Digestible.	Production value—gain	Total.	Digestible.	Production value—gain	Total.	Digestible.	Production value—gain	Gain in flesh.	Calories.	
1208	Fan	255	S. Dak.	1905 (2)	9.59	90.41	3.03	14.62	10.23	2.40	1.79	1.59	0.84	5.04	1.66	0.41	75.72	69.48	17.23	20.88	90,264	8.3
1209	Marriott.	261	do.	1905 (2)	9.27	90.73	3.15	14.25	9.97	1.92	1.52	1.35	.71	7.42	2.45	.61	73.66	67.76	16.87	20.46	88,449	7.3
1210	do.	261	Tex.	1905 (1)	8.91	91.01	3.36	11.69	8.18	1.92	1.64	1.46	.77	7.14	2.36	.53	76.17	70.76	17.30	20.46	89,227	9.3
1211	Manchuria	170	S. Dak.	1905 (3)	9.58	90.42	2.39	13.25	9.27	2.18	1.65	1.65	.77	6.47	2.14	.53	76.24	70.14	17.38	20.86	90,178	8.1
1212	do.	170	do.	1904 (2)	8.87	91.33	3.27	13.62	9.53	2.24	1.51	1.34	.77	7.16	2.36	.58	74.44	68.48	16.98	20.50	88,621	7.7
1213	do.	170	Alaska.	1903	8.31	91.69	3.34	9.75	6.82	1.60	1.71	1.52	.80	7.06	2.33	.58	78.14	71.89	17.81	20.79	89,875	11.4
1214	Seselsk.	89	Kans.	1905 (4)	8.30	91.70	3.49	15.06	10.54	1.64	1.81	1.61	.85	5.76	1.90	.47	73.88	67.97	16.86	20.66	89,313	7.0
1215	Giant Winter.	30	Oreg.	1904 (2)	8.92	91.07	2.42	9.37	6.56	1.54	1.44	1.26	.67	2.23	.74	.18	72.94	77.94	16.84	21.22	93,815	12.4
1216	Hull-less	197	Wash.	1903 (1)	8.64	91.36	2.58	20.63	14.44	3.30	1.94	1.73	.91	2.81	.93	.23	73.82	67.91	16.84	21.22	91,734	5.6
1217	Hull-less Hankin.	321	Kans.	1905 (2)	9.45	90.55	2.23	15.58	10.80	2.56	1.81	1.61	.85	2.73	.90	.23	72.04	66.27	16.44	20.97	90,653	4.9
1218	Hull-less Nepal.	352	S. Dak.	1905 (2)	9.41	90.59	2.34	16.19	11.33	2.60	1.99	1.77	.93	2.67	.88	.22	76.81	70.66	17.52	21.33	92,296	7.0
1219	Mexican Beardless.	262	do.	Original.	9.30	90.70	2.89	13.66	9.14	2.13	1.87	1.66	.87	3.94	1.97	.49	76.20	70.10	17.38	20.89	90,307	8.0
1220	Arabia.	263	England.	do.	9.44	90.49	2.74	13.75	9.62	2.03	1.99	1.77	.93	4.94	1.63	.40	78.24	71.98	17.85	21.21	91,604	8.0
1221	do.	263	do.	do.	9.51	90.42	2.99	13.12	9.18	2.16	2.25	2.09	1.05	4.50	1.48	.37	76.76	70.61	17.51	21.19	91,691	8.4
1222	do.	264	do.	do.	9.46	90.54	2.63	10.37	7.26	1.71	2.11	1.88	.99	4.65	1.35	.33	80.80	74.33	18.43	21.46	92,771	11.0
1223	do.	265	do.	do.	9.44	90.56	2.63	10.37	7.26	1.71	2.11	1.88	.99	4.65	1.35	.33	80.80	74.33	18.43	21.46	92,771	11.0
1224	do.	266	do.	do.	9.38	90.62	2.94	12.06	8.44	1.98	1.59	1.42	.75	6.09	1.79	.44	74.17	68.24	16.92	20.78	89,702	5.9
1225	do.	267	Ariz.	1905 (1)	10.11	89.89	3.24	15.31	10.72	2.52	1.85	1.65	.87	5.43	1.91	.37	72.48	68.54	16.54	20.78	89,832	5.9
1226	Kans.	263	Kans.	1905 (2)	9.96	90.04	3.24	17.62	12.33	2.90	2.07	1.84	.97	4.59	1.51	.37	72.48	68.54	16.54	20.78	89,832	5.9
1227	do.	264	do.	do.	9.06	90.94	2.98	9.13	6.39	1.50	2.22	1.98	1.08	4.42	1.39	.34	81.35	74.84	18.56	21.48	92,858	12.6
1228	do.	264	Wash.	1905 (2)	9.73	90.67	3.21	12.75	8.92	2.80	2.16	1.92	1.04	4.21	1.46	.38	77.41	71.21	17.66	21.16	91,475	8.6
1229	do.	265	do.	1905 (2)	9.73	90.37	3.39	17.37	12.16	2.86	2.16	1.92	1.04	4.21	1.46	.38	77.41	71.21	17.66	21.16	91,475	8.6
1230	Kans.	265	Kans.	1905 (2)	9.65	90.35	3.17	16.69	11.68	2.74	1.95	1.74	.91	4.50	1.48	.37	73.69	67.79	16.81	20.83	89,702	5.9
1231	N. Dak.	263	N. Dak.	1902 (1)	9.19	90.89	2.67	13.81	9.67	1.93	1.91	1.61	.85	4.70	1.55	.38	76.67	70.53	17.49	21.14	91,388	7.9
1232	do.	263	do.	1903 (3)	9.19	90.81	3.14	11.62	8.13	1.67	2.25	2.01	1.05	4.60	1.52	.38	76.39	72.92	17.89	21.33	91,777	9.6
1233	do.	263	S. Dak.	1903 (2)	9.58	90.69	2.51	14.87	10.41	2.57	2.11	1.91	.81	4.45	1.47	.36	74.90	68.91	17.06	21.01	90,826	7.2
1234	do.	263	do.	1904 (2)	9.24	90.76	2.53	15.02	10.93	2.57	1.73	1.54	.81	4.87	1.41	.36	73.25	69.23	17.17	20.95	90,567	6.8
1235	do.	263	do.	1904 (3)	9.11	90.89	3.13	19.94	13.61	3.22	1.97	1.73	.92	4.48	1.48	.37	70.48	64.84	16.68	20.59	89,010	5.2
1236	do.	263	do.	1905 (3)	9.86	90.14	2.33	13.91	9.32	2.04	1.73	1.54	.81	4.32	1.43	.35	78.22	71.96	17.85	21.05	90,999	8.9
1237	do.	263	do.	1905 (4)	9.82	90.18	3.36	12.37	8.66	2.04	1.73	1.54	.81	4.32	1.43	.35	78.22	71.96	17.85	21.05	90,999	8.9
1238	Idaho.	263	Idaho.	1905 (2)	9.48	90.52	3.27	11.90	7.70	1.81	1.68	1.50	.80	4.61	1.52	.38	74.44	68.76	17.12	21.10	91,215	10.1
1239	Minn.	263	Minn.	1901 (1)	9.54	90.46	3.00	15.81	11.07	2.83	1.92	1.72	.90	4.73	1.56	.38	74.44	68.76	17.12	21.10	91,215	10.1
1240	do.	263	do.	1902 (2)	8.75	91.25	2.64	17.19	12.03	2.83	1.92	1.71	.90	4.64	1.54	.38	73.71	67.87	16.82	20.92	90,869	6.1
1241	do.	263	do.	1902 (1)	9.20	90.80	2.97	14.06	9.84	2.31	1.92	1.71	.90	4.64	1.54	.38	73.71	67.87	16.82	20.92	90,869	6.1
1242	do.	263	Cal.	1902 (1)	9.14	90.86	2.62	15.81	11.07	2.60	1.93	1.72	.90	5.21	1.72	.43	74.43	68.48	16.98	20.91	90,394	6.7

1110	do.	203	do.	1903 (1)	9.97	90.03	2.87	10.19	7.13	1.68	2.02	1.89	.95	4.70	1.57	.39	80.16	73.74	18.29	21.31	92,123 11.1
1111	do.	203	do.	1904 (3)	9.35	90.65	2.80	9.75	6.82	1.60	2.05	1.82	.96	5.23	1.73	.43	80.17	73.76	18.29	21.28	91,993 11.7
1112	do.	203	Mont.	1902 (1)	9.59	90.41	2.92	9.94	6.96	1.64	1.69	1.50	.79	4.44	1.47	.36	81.01	74.52	18.48	21.27	91,993 11.4
1113	do.	203	do.	1903 (2)	9.77	90.23	2.90	13.37	9.36	2.20	1.83	1.03	.86	4.50	1.48	.37	77.40	1.20	17.60	21.09	91,172 8.2
1114	do.	203	N. H.	1903 (3)	9.51	90.49	2.42	10.44	7.31	1.72	1.81	1.61	.85	4.64	1.53	.38	80.69	74.23	18.41	21.36	92,339 10.9
1115	do.	203	Tenn.	1901 (1)	9.38	90.62	3.07	13.00	9.10	2.14	2.21	1.97	1.04	4.52	1.49	.37	77.20	71.02	17.01	21.16	91,475 8.5
1116	do.	203	do.	1902 (1)	9.52	90.48	3.03	12.44	8.71	2.05	2.02	1.80	.95	4.96	1.64	.41	77.55	71.34	17.09	21.10	91,215 8.8
1117	do.	203	Kans.	1905 (3)	10.01	89.99	3.58	17.25	12.07	2.84	1.91	1.70	.89	4.66	1.54	.38	72.60	66.79	16.56	20.67	89,356 6.0
1118	do.	226	Iowa	1904 (1)	9.28	90.72	2.91	12.87	9.01	2.12	1.83	1.63	.86	4.62	1.52	.38	77.77	71.55	17.74	21.10	91,215 8.5
1119	do.	226	S. Dak.	1903 (1)	9.16	90.84	3.13	14.46	10.12	2.38	1.96	1.74	.91	5.03	1.66	.42	75.22	69.20	17.16	20.87	90,221 7.4
1120	do.	226	do.	1904 (2)	9.21	90.79	2.67	13.00	9.10	2.14	1.96	1.74	.91	5.03	1.66	.41	77.37	71.18	17.65	21.11	91,258 8.4
1121	do.	226	Wash.	1903 (2)	9.84	90.16	3.26	10.31	11.42	2.68	2.00	1.78	.94	4.81	1.59	.39	73.62	67.73	16.80	20.81	89,982 6.4
1122	do.	226	Texas	1905 (2)	9.24	90.76	3.02	13.62	9.53	2.24	1.92	1.71	.90	4.78	1.58	.39	76.66	70.52	17.49	21.02	90,890 8.0
1123	do.	226	Mont.	1903 (1)	9.73	90.27	3.01	12.00	8.40	1.97	2.06	1.85	.97	4.87	1.61	.40	78.04	71.79	17.80	21.14	91,388 9.2

TABLE XLIV.—*Proso—individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Protein (N × 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.			
					Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.							
1037	Red Orenburg.....	21	Kans.....	1905 (2)	10.56	89.44	3.92	12.69	6.24	1.47	3.51	2.70	1.42	8.83	6.03	1.50	71.05	60.53	15.01	19.40	83,866	11.7
1002	do.....	21	do.....	1904 (1)	8.70	91.30	3.70	13.12	6.45	1.51	3.32	2.55	1.34	7.77	5.38	1.32	72.09	61.42	15.23	19.40	83,866	11.1
1003	do.....	21	do.....	1904 (2)	8.30	91.30	3.61	17.94	8.83	2.07	3.18	2.45	1.29	9.34	6.31	1.58	65.93	56.17	13.93	18.87	81,575	7.7
1004	Iowa.....	21	Iowa.....	1903 (1)	8.67	91.33	3.43	13.87	6.82	1.60	3.00	2.31	1.22	9.38	5.55	1.38	71.57	60.98	15.03	19.32	83,520	10.5
1005	do.....	21	do.....	1904 (2)	8.71	91.29	2.78	13.44	6.61	1.55	3.33	2.50	1.35	9.29	6.34	1.57	71.16	60.63	15.03	19.50	84,298	11.0
1006	do.....	21	do.....	1904 (2)	8.96	91.04	3.62	12.62	6.21	1.46	3.77	2.90	1.53	8.01	5.47	1.36	71.98	61.82	15.21	19.56	84,568	11.9
1007	do.....	21	do.....	1905 (2)	9.06	90.94	3.65	11.06	5.44	1.28	3.52	2.71	1.43	7.99	5.46	1.35	73.78	62.86	15.59	19.65	84,947	13.7
1008	do.....	21	do.....	1905 (2)	9.30	90.70	4.85	12.50	6.15	1.45	3.26	2.51	1.32	9.71	6.03	1.64	69.68	59.36	14.72	19.13	82,669	11.6
1009	do.....	21	N. Dak.....	1904 (1)	8.44	91.56	3.71	12.37	6.09	1.43	3.54	2.72	1.43	10.87	7.42	1.84	69.51	59.22	14.69	19.39	83,823	11.9
1010	do.....	21	do.....	1905 (2)	10.93	89.07	3.32	10.94	5.38	1.26	3.36	2.58	1.36	8.72	5.96	1.48	73.66	62.76	15.56	19.66	84,990	13.9
1011	Idaho.....	21	Idaho.....	1904 (1)	8.61	91.39	3.91	11.44	5.63	1.32	2.98	2.29	1.20	9.39	6.41	1.59	72.28	61.98	15.27	19.38	83,780	13.1
1012	do.....	21	do.....	1904 (2)	8.33	91.67	3.73	11.81	5.81	1.37	2.93	2.25	1.18	9.77	6.67	1.65	71.76	61.14	15.16	19.36	83,693	12.5
1013	do.....	21	do.....	1905 (3)	9.54	90.46	3.94	11.37	5.59	1.31	3.28	2.52	1.33	9.13	6.24	1.55	72.28	61.58	15.27	19.46	84,126	13.1
1014	do.....	21	Colo.....	1903 (1)	8.58	91.42	3.42	14.81	7.79	1.71	3.43	2.68	1.39	4.58	3.13	1.78	73.76	62.84	15.58	19.46	84,126	9.9
1015	do.....	21	do.....	1904 (2)	8.24	91.76	3.35	15.81	7.78	1.83	2.99	2.30	1.21	6.65	4.54	1.13	71.20	60.66	15.04	19.21	83,045	9.0
1016	do.....	21	Okl.....	1904 (1)	8.16	91.84	3.03	10.44	5.14	1.21	3.33	2.56	1.35	8.34	5.70	1.41	74.86	63.78	15.82	19.79	85,552	14.6
1017	do.....	21	do.....	1905 (2)	9.00	90.40	3.15	12.00	5.90	1.36	3.29	2.53	1.33	9.11	6.22	1.54	72.45	61.74	15.31	19.57	84,601	12.5
1018	Red Voronezh.....	26	Nebr.....	1904 (1)	8.55	91.45	3.22	11.87	5.84	1.37	3.48	2.68	1.41	9.85	6.73	1.67	71.58	60.98	15.12	19.57	84,601	12.7
1019	do.....	26	Kans.....	1904 (1)	8.97	91.03	3.69	13.00	6.40	1.50	3.18	2.45	1.20	9.34	6.38	1.58	70.79	60.31	14.96	19.33	83,564	11.2
1020	do.....	26	do.....	1905 (2)	10.79	89.21	2.71	11.00	5.41	1.27	3.17	2.44	1.28	8.94	6.11	1.72	73.18	62.34	15.46	19.53	84,498	13.6
1021	do.....	26	Idaho.....	1904 (1)	8.15	91.85	4.50	15.25	7.50	1.76	3.02	2.32	1.22	10.50	7.17	1.78	66.73	56.85	14.10	18.86	81,532	9.2
1022	do.....	26	do.....	1905 (2)	9.41	90.59	4.82	10.00	4.92	1.16	3.09	2.32	1.22	10.03	6.55	1.70	72.13	61.45	15.24	19.32	83,520	13.9
1023	do.....	26	Okl.....	1904 (1)	8.17	91.83	4.62	16.87	8.30	1.95	2.97	2.28	1.20	9.85	6.73	1.67	65.69	55.90	13.88	18.70	80,840	8.2
1024	do.....	26	Wash.....	1905 (2)	8.37	91.63	4.78	11.81	5.81	1.37	3.12	2.40	1.16	7.92	6.94	1.72	70.13	59.75	14.82	19.17	82,742	9.0
1025	do.....	26	do.....	1904 (1)	8.90	91.10	3.20	15.94	7.84	1.84	2.88	2.21	1.26	7.09	7.44	1.85	70.50	60.60	14.89	19.32	83,520	12.3
1026	Black Voronezh.....	26	Tex.....	1904 (1)	8.17	91.83	3.44	11.37	5.87	1.38	2.97	2.28	1.20	7.58	7.18	1.82	73.91	62.97	15.02	19.71	85,206	13.3
1027	do.....	27	Nebr.....	1904 (1)	8.99	91.01	3.44	11.37	5.59	1.31	3.70	2.55	1.20	10.89	5.18	1.28	73.91	62.97	15.02	19.71	85,206	13.3
1028	do.....	27	Idaho.....	1904 (1)	8.21	91.79	3.94	11.44	5.63	1.32	3.41	2.62	1.38	7.44	5.35	1.73	73.38	62.52	15.50	19.53	84,428	13.2
1029	do.....	27	do.....	1904 (1)	8.88	91.12	4.18	11.69	5.75	1.35	3.45	2.65	1.39	10.24	6.99	1.73	70.44	60.01	14.88	19.35	83,650	12.7
1030	do.....	27	Colo.....	1904 (1)	8.47	91.53	2.95	11.69	5.75	1.35	3.38	2.60	1.37	6.76	4.02	1.51	75.22	64.09	15.89	19.76	85,422	13.0
1031	Okl.....	27	Okl.....	1904 (1)	9.13	90.87	3.17	12.87	6.33	1.49	3.18	2.45	1.29	8.90	6.08	1.51	71.88	61.24	15.19	19.43	84,212	11.6
1032	Wash.....	27	Wash.....	1905 (1)	9.32	90.68	3.84	12.00	5.90	1.89	3.19	2.45	1.29	8.61	5.88	1.46	72.36	61.65	15.29	19.43	83,996	12.4
1033	do.....	27	Tex.....	1903 (1)	8.35	91.65	3.25	16.37	8.05	1.89	3.14	2.41	1.27	8.69	5.93	1.47	68.55	58.40	14.48	19.11	82,612	8.7
1034	do.....	27	do.....	1905 (2)	9.50	90.50	3.60	12.75	6.27	1.47	3.22	2.48	1.30	8.82	6.02	1.49	71.52	60.93	15.11	19.37	83,736	11.5

TABLE XLVI.—*Maize—individual analyses.*
[Pounds per hundred pounds of dry matter.]

Lab- ora- tory No.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N $\times$ 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutri- tive ratio.
					Total.	Digest- ible.	Produc- tion value— gain in flesh.	Total.	Digest- ible.	Produc- tion value— gain in flesh.	Total.	Digest- ible.	Produc- tion value— gain in flesh.	Total.	Digest- ible.	Produc- tion value— gain in flesh.	Gain in flesh.	Calories.	
983	1906	12.98	87.02	1.56	9.69	6.98	1.64	4.13	3.68	1.94	2.19	1.27	0.31	82.43	78.31	19.42	23.31	100,769	12.6
984	1906	12.84	87.16	1.47	9.25	6.66	1.57	4.89	4.35	2.29	2.25	1.31	.32	82.14	78.03	18.35	23.53	101,720	13.4
985	1906	13.09	86.91	1.47	8.50	6.12	1.44	4.59	4.09	2.15	2.51	1.46	.36	82.93	78.78	18.54	23.49	101,547	14.6
986	1906	13.17	86.83	1.52	9.09	6.98	1.64	4.72	4.20	2.20	2.31	1.34	.33	81.76	77.67	19.26	23.42	101,287	12.6
987	1906	13.15	86.85	1.54	8.50	6.12	1.44	4.21	3.75	1.97	2.10	1.22	.30	83.65	79.46	19.71	23.36	101,245	14.5
988	1906	13.08	86.92	1.52	6.98	6.98	1.64	4.23	3.76	1.98	1.85	1.07	.26	82.69	78.55	19.48	23.36	100,985	12.6
989	1906	12.88	87.12	1.52	11.19	8.06	1.80	4.74	4.22	2.22	2.07	1.20	.30	80.48	76.45	18.96	23.37	101,028	10.8
990	1906	12.89	87.11	1.63	12.19	8.78	2.06	4.65	4.14	2.18	2.36	1.35	.33	79.20	75.24	18.66	23.23	100,423	9.8
991	1906	13.15	86.85	1.45	8.88	6.39	1.50	4.28	3.81	2.00	2.36	1.37	.34	83.03	78.87	19.50	23.40	101,158	13.9
992	1906	13.38	86.62	1.53	12.25	8.82	2.07	3.54	3.15	2.09	2.04	1.18	.29	80.62	76.59	18.99	23.01	99,472	9.6
993	1906	13.30	86.70	1.38	10.19	7.34	1.72	4.31	3.84	2.02	2.20	1.28	.32	81.92	77.82	19.30	23.36	100,985	11.9
994	1906	12.79	87.21	1.58	8.94	6.44	1.51	4.52	4.02	2.11	2.27	1.32	.33	82.69	78.55	19.48	23.43	101,287	13.8

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