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AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

W. B. BIZZELL, President

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DIVISION OF CHEMISTRY

THE COMPOSITION AND FEEDING VALUE OF WHEAT BY-PRODUCTS

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*In cooperation with School of Veterinary Medicine, A. and M. College of Texas.
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CONTENTS

BULLETIN NO. 282. NOVEMBER, 1921.

THE COMPOSITION AND VALUE OF WHEAT BY-PRODUCTS.

BY

G. S. FRAPS.

The by-products of wheat milling constitute an important group of feeding stuffs, and this Experiment Station is frequently called upon to furnish information concerning their composition and feeding value. War conditions introduced some changes into the names used in Texas for wheat by-products, making them more definite than those formerly used.

There are differences in composition and feeding value between wheat by-products sold by different mills under the same name, so that a purchaser cannot always depend upon securing the feeding value that he expects to get when buying. It is desirable both to manufacturer and to purchaser, to limit the variation in the composition of wheat by-products and other feeds as much as possible. The efforts of the Division of Feed Control Service have already reduced this trouble to a great extent, for it is the duty of the Feed Control Service to see that feeds do not fall below definite standards, so that a purchaser may depend upon a given name representing a definite minimum feeding value.

MILLING OF WHEAT.

It is our intention to give only a bare outline of the process of milling. The process varies considerably in different mills, both in the character of the machinery and the different operations. There is also a variation in the different streams of by-products which are combined into shorts, screenings, or bran; and even in the same mills, the by-products may be combined in different ways according to the price and demand for different feeds.

Wheat as it comes to the miller contains small amounts of dust, stones, chaff, and seeds other than wheat, such as corn, oats, weeds, barley, or rye. It may also contain immature grains, and sometimes balls of mud. The first process is cleaning the wheat. There are used in this process, screenings, special cylinders for barley or weed seeds, aspirators, brushes, dust collectors. Most of the impurities are either sifted out, or sifted through, or lifted out by air.

The dust and screenings from some of the machines have little value. The seeds from other machines, including the light broken wheat, are combined into screenings.

The wheat may be also washed, cleaned, dried, and conditioned. A proper amount of moisture is necessary in milling.

The wheat is scoured, and in this process the brush, the crease dirt, and some of the outer parts of the bran coat are removed as scourings. This is frequently added to the bran and in many cases is added to the shorts.

The wheat is gradually broken and the middlings (or flour-making material) are removed from the bran by five sets of corrugated steel rolls. The first pair is coarsely corrugated and set relatively far apart and the other pairs increase in fineness of corrugations and are closer

together so that the reduction in size of the middlings is gradual. After each passage through the rolls the stock is sifted and graded, the break flour being removed. The corrugated rolls gradually break out the interior of the grain and after the last pair of break rolls only the outer covering, or bran, remains. The bran is flattened out so that it does not pass through the sieves which remove the middlings and flour. Each time after passing between a pair of break rolls, the stream of stock passed to the sifters, where the coarse material is scalped off and the middlings are graded and sent to the purifiers and to the reduction rolls. The flour is taken out and sent at once toward the packer.

After the middlings from the break rollers have been graded by means of sifters, and purifiers and the flour particles removed, the middlings are reduced to flour by a number of nearly smooth steel rollers (reduction rolls) varying in distance apart according to the material to be treated. The number of sets of reduction rollers and the pressure exerted by them varies with the size of the mill. The products vary with the character of the intermediate product which is passed to the rollers. The rollers tend to flatten out some of the impurities, and at the same time the middlings are reduced to flour. The flour is sifted out by means of fine silk bolting cloth, and the residue which fails to pass through is either subjected to further reduction or sent to the by-products according as its character may or may not allow the production of further quantities of flour. Table 1 contains analysis of some mill samples.

Table 1. Analysis of some mill samples.

		Protein.	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash.
11324	White shorts—tailings from middlings	18.13	3.33	3.10	63.27	9.89	2.28
11407	White shorts from reel	16.31	3.09	2.68	66.70	9.08	2.14
11345	Shorts from tail of shorts duster	19.94	6.18	6.79	52.15	9.96	4.98
11346	Red dog—goes into shorts	18.00	4.25	3.09	62.01	9.81	2.84
11323	Middlings from first and third tailings	19.81	5.33	5.18	55.96	9.79	3.93
11312	Mixed shorts	18.72	3.40	3.78	60.34	10.81	2.95
16342	Wheat screenings	13.08	2.93	6.71	65.19	9.25	2.84
16349	Ground wheat screenings	14.48	3.31	9.34	56.10	10.48	6.29
16355	Ground and bolted wheat screenings	16.46	6.14	10.68	47.51	9.55	9.66
11403	Screenings mixed from scourer	16.38	1.94	3.35	65.71	10.18	2.44
11341	Screenings from screening separator	14.63	2.35	6.97	62.60	10.07	3.38
11401	Milling screenings	14.50	3.50	7.08	62.20	9.74	2.98
11400	Screenings from receiving separator	13.25	2.22	7.55	45.55	8.20	23.23
11402	Dust from milling separator	16.28	3.38	17.56	48.27	8.38	6.13
11398	Chaff from receiving separator	12.13	2.60	18.46	47.89	8.83	10.09
11343	Chicken feed from scourer to milling separator	14.50	2.17	4.23	65.61	10.93	2.56
11314	Screenings from first separator	16.00	2.49	5.53	63.06	10.22	2.70
11316	Screenings from second separator	15.56	1.95	4.02	65.08	11.16	2.23
11315	Dust from fan in first separator	14.00	3.23	13.60	53.98	8.99	6.20
11318	Dust from first scourer	14.82	3.39	17.12	53.09	8.44	3.14
11320	Dust from second scourer	11.07	1.97	16.38	58.71	8.65	3.22
11342	Dust from screening separator, second cleaning	10.91	1.90	22.99	45.56	8.49	11.15
11344	Dust from scourers and milling separators	12.69	0.24	13.57	60.99	9.18	3.33
11319	Screenings from second scourings	15.63	2.48	4.64	66.67	7.99	2.59
11356	Screenings from brush	14.56	3.05	5.54	62.70	11.05	3.10
11404	Dust from scourer	12.05	2.49	17.43	56.13	8.63	3.27
11365	Dust from middlings purifier and suction on roller	8.75	5.13	4.75	69.45	10.65	1.27
11364	Dust from corn purifier	10.44	2.28	14.24	60.82	9.47	2.75
11359	Dust from four scourers	7.38	1.46	13.05	64.35	10.94	2.82
11317	Screenings, first scouring	16.63	2.98	5.35	62.64	9.83	2.57
11321	Bran from bran duster	18.50	3.62	10.73	50.87	9.79	6.49
11348	Bran from duster	16.88	3.85	11.38	51.06	9.69	7.14
11360	Bran—fourth break and bran reel	15.94	4.11	9.44	52.80	11.53	6.18
11405	Pure bran	17.81	3.48	10.27	51.92	9.87	6.65
11322	Brown shorts from second scalper	18.56	5.42	6.40	55.69	9.86	4.07
11406	Brown shorts, fifth break and germ	19.19	5.50	5.23	57.37	8.53	4.18

The by-products from wheat milling come from a number of mill streams and these in turn vary with the size of the mill, and with the milling process. Millers do not always combine the same streams into the same by-products, there being some difference in opinion as to which by-products should receive certain streams. The result is a variation in character of the by-products separated. Some of the main points in the milling where the by-products come off are the trays of latter purifiers, overtails of secondary purifiers, overtails of bran-duster, overtails of dresser receiving flattened germ, overtails of last two or three reduction dressers, exhaust stive from rolls, centrifugal or other dressers, purifiers, scalpers and graders, deposits in all dust collectors. In English mills, according to Amos, the by-products are graded by sifting: broad bran, coarser than 12-mesh; ordinary bran, on 14-mesh; coarse sharps on 45-mesh; fine sharps, through 45-mesh.

DEFINITIONS OF WHEAT BY-PRODUCTS.

The definitions for wheat by-products given below have been adopted by the Texas Feed Control Service, as published in Bulletin 268, and also by the Association of Feed Control Officials of the United States, with the exception of wheat chops and recleaned wheat screenings.

Wheat Bran is the coarse outer coating of the wheat kernel as separated from cleaned and scoured wheat in the usual process of commercial milling.

Standard Middlings (*Red Shorts or Brown Shorts*) consists mostly of the fine particles of bran and of germ; but very little of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual commercial process of milling.

Gray Shorts (*Gray Middlings or Total Shorts*) consists of the fine particles of the outer bran, the inner or "bee-wing" bran, the germ, and the offal or fibrous material obtained from the "tail of the mill." The product must be obtained in the usual commercial process of flour milling.

Flour Middlings consists of standard middlings and red dog flour combined in the proportions obtained in the usual process of milling.

White Shorts or White Middlings consists of a small portion of the fine bran particles and of the germ and of a large portion of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual process of flour milling.

Red Dog Flour consists of a mixture of low-grade flour, fine particles of bran, and the fibrous offal from the "tail of the mill."

Wheat Mixed Feed (*Mill Run Wheat Bran*) consists of pure wheat bran and the gray or total shorts or flour middlings combined in the proportions obtained in the usual process of commercial milling.

Wheat Bran and Standard Middlings consists of the two commodities as defined above mixed in the proportions obtained in the usual process of commercial milling.

Screenings consists of the smaller imperfect grains, weed seeds, and

other foreign materials, having feeding value, separated in cleaning the grain.

Scourings consists of such portions of the cuticle, brush, white caps, dust, smut and such other materials as are separated from the grain in the usual commercial process of scouring.

NOTE.—If to any of the wheat by-product feeds there should be added screenings or scourings, as defined, either ground or unground, bolted or unbolted, such brand shall be so registered, labeled and sold as clearly to indicate this fact. The word "screenings" or "scourings," as the case may be, shall appear as a part of the name or brand and shall be printed in type of the same size and face as the remainder of the brand name. When the word "screenings" appears it is not necessary to show also on the labeling the word "scourings."

Recleaned Wheat Screenings shall consist of the small imperfect grains of wheat after all weed seeds and other foreign materials have been removed.

Wheat Chops is the entire berry of sound wheat, chopped.

STANDARDS FOR WHEAT BY-PRODUCTS.

The Association of Feed Control Officials of the United States has not adopted any standards for wheat by-products. Standards have been proposed by a committee of this association, and are under consideration. These are given, together with the Texas standards, in Table 2.

Table 2. Standards for wheat feeds.

	Protein	Ether extract	Crude fiber
Wheat bran—Texas	14.5	3.0	10.0
Brown shorts—Texas	15.0	3.5	6.5
Brown shorts—proposed Interstate	15.5	3.5	6.5
Gray shorts—Texas	15.0	3.5	5.5
Gray shorts—proposed Interstate	16.0	3.5	5.5
White shorts—Texas	14.5	3.0	3.5
White shorts—proposed Interstate	14.5	3.0	3.5
Wheat mixed feed—Texas	15.0	3.5	8.5
Wheat mixed feed—proposed Interstate	15.5	3.5	8.5
Standard middlings—proposed Interstate	16.0	4.5	9.0
Flour middlings—proposed Interstate	15.0	3.0	6.0
Red Dog Flour—proposed Interstate	16.0	4.5	4.0

A consideration of the above table shows that while standard middlings have the same definition as brown shorts, they would be decidedly different in chemical composition if the proposed standards are adopted. If they contain the same amount of crude fiber as is permitted by the standard, they would approach very closely to wheat bran in chemical composition. Table 3 contains some average analyses of middlings, and these analyses approach nearer to flour middlings than to standard middlings. According to Henry and Morrison's compilation, wheat middlings (standard), shorts, should average 6.0 per cent. fiber.

If people who are accustomed to middlings containing about 6 per cent. fiber are furnished middlings containing 9 per cent. fiber, which would be composed mostly of fine bran particles, they will naturally complain, as they would not secure as good feed as they expected.

Most mills furnish a better product than the above standard.

In the opinion of the writer, some of the larger mills are putting out products under the name of standard middlings which contain too much bran particles, and do not deserve the name of standard middlings. The crude fiber content of 9 per cent. appears too high and is unjust to mills which are putting out a better product, which should deserve a better name.

AVERAGE COMPOSITION OF WHEAT BY-PRODUCTS.

Until 1918, the chief wheat by-products sold in Texas were wheat bran, wheat mixed feed, and wheat shorts. Different selling prices were established in 1917, under the operation of the Federal Food Control Act, for wheat brown shorts and wheat gray shorts, so that it became necessary to establish definitions and names for some of these by-products in Texas. The term "mill-run bran" for a long time was used in Texas to designate a mixture of bran and shorts, but this term has almost fallen into disuse. There have been variations in the composition, and names of wheat by-products have not always been in accord with the requirements during the period of adjustment to the new names, but conditions in this respect are now much better.

COMPOSITION OF WHEAT BY-PRODUCTS.

The average composition of the various by-products analyzed by this division in Texas and published in Bulletins 177, 189, 216, 234, 251, and 268, of the Feed Control Service, is given in Table 3, together with some average analyses made at other stations.

Table 3. Average analyses of wheat feeds.

No. averaged		Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash
	Wheat Bran						
68	Texas 1913-14	17.78	4.03	8.31	54.67	9.99	5.22
32	Texas 1914-15	17.43	4.23	8.22	54.38	10.30	5.44
23	Texas 1915-16	17.06	3.79	7.54	56.29	10.47	4.85
15	Texas 1916-17	17.02	3.87	7.60	56.39	10.17	4.95
29	Texas 1917-18	17.01	4.07	8.86	55.58	9.06	5.42
28	Texas 1918-19	17.48	3.59	9.08	54.08	10.16	5.61
24	Texas 1919-20	16.45	3.65	8.71	55.56	10.80	5.03
80	Kansas, average 1915-1920	16.82	4.20	10.01	.....	.....	.....
56	Wisconsin 1919	14.51	4.73	10.69	.....	.....	.....
260	Minnesota 1920	14.80	5.40	10.60	.....	7.90	.....
5	Connecticut 1918	15.85	4.91	10.09	53.19	9.28	6.68
8	Connecticut 1919	15.87	4.57	9.94	53.61	9.42	6.59
31	Pennsylvania	16.51	4.80	9.31	.....	.....	.....
122	Michigan 1919	15.2	4.7	10.4	.....	.....	.....
8	Pennsylvania 1919	16.56	4.52	8.54	.....	.....	.....
	Wheat Bran and Screenings						
32	Texas 1915-16	17.13	3.95	8.15	54.01	11.38	5.38
16	Texas 1916-17	16.63	3.69	7.37	56.03	10.79	4.87
51	Texas 1917-18	16.33	4.02	9.91	53.81	9.93	6.00
76	Texas 1918-19	17.48	3.92	10.00	51.83	10.69	6.08
110	Texas 1919-20	16.00	3.68	9.94	53.55	11.03	5.80
200	Kansas 1915-20	16.83	4.15	10.29	.....	.....	.....
66	Wisconsin 1919	14.64	4.74	10.58	.....	.....	.....
31	Pennsylvania 1918	16.82	5.02	9.88	.....	.....	.....
15	Pennsylvania 1919	16.39	4.91	9.62	.....	.....	.....
7742	Henry and Morrison 1915	16.0	4.4	9.5	53.7	10.1	6.3

Table 3. Average analyses of wheat feeds—Continued.

No. averaged		Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash
	Wheat Brown Shorts						
16	Texas 1917-18	18.49	4.52	6.33	56.90	9.62	4.18
11	Texas 1918-19	18.38	4.31	6.71	55.28	10.49	4.83
11	Texas 1919-20	18.04	5.01	5.54	57.19	10.62	3.51
34	Kansas 1915-20	18.21	4.40	5.75	.....	.....	.....
	Wheat Brown Shorts and Screenings						
9	Texas 1917-18	16.97	4.28	7.00	57.04	9.90	4.81
8	Texas 1918-19	18.43	4.63	6.76	55.33	9.99	4.86
8	Texas 1919-20	17.17	4.18	6.41	57.47	10.60	4.17
24	Kansas 1915-20	17.96	4.48	7.22	.....	.....	.....
	Wheat Gray Shorts						
53	Texas 1917-18	17.76	4.25	5.95	59.22	8.89	3.93
39	Texas 1918-19	19.27	4.53	5.58	56.56	9.86	4.18
84	Texas 1919-20	17.57	4.40	5.14	58.36	10.88	3.65
234	Kansas 1915-20	18.01	4.40	5.15	.....	.....	.....
	Wheat Gray Shorts and Screenings.						
6	Texas 1917-18	17.80	4.31	6.11	57.09	10.25	4.44
12	Texas 1918-19	18.55	4.51	7.03	54.28	10.72	4.91
10	Texas 1919-20	17.16	4.35	6.74	56.82	10.59	4.34
133	Kansas 1915-20	18.18	4.46	6.42	.....	.....	.....
	Wheat White Shorts						
6	Texas 1917-18	18.98	2.98	2.90	62.34	9.91	2.89
4	Texas 1918-19	15.31	2.75	2.34	67.21	9.99	2.40
11	Texas 1919-20	15.93	2.84	2.66	65.50	11.02	2.05
47	Kansas 1915-20	17.18	3.43	3.41	.....	.....	.....
	Red Dog Flour						
44	Wisconsin 1919	15.24	3.85	2.26	.....	.....	.....
259	Henry and Morrison 1915	16.80	4.10	2.20	63.30	11.10	2.50
99	Minnesota 1920	16.30	3.90	2.60	.....	10.0	.....
	Wheat Mixed Feed						
19	Texas 1913-14	16.80	3.70	8.05	56.41	10.42	4.62
15	Texas 1914-15	17.37	4.52	8.10	54.24	10.44	5.33
16	Texas 1915-16	17.12	4.22	7.58	55.39	10.93	4.76
14	Texas 1916-17	17.25	3.69	7.37	56.03	10.79	4.87
9	Texas 1917-18	16.86	3.94	7.83	56.93	9.51	4.93
51	Texas 1918-19	18.51	4.43	8.02	53.79	10.24	5.01
16	Texas 1919-20	16.42	3.95	8.45	55.39	10.78	5.01
69	Kansas 1915-20	17.52	4.91	8.52	.....	.....	.....
8	Connecticut 1918	16.42	5.18	7.80	54.66	10.39	5.36
19	Michigan 1919	16.6	4.6	8.2	.....	.....	.....
17	Connecticut 1919	16.77	4.90	7.94	55.31	9.65	5.43
1	Maryland 1920	15.71	4.68	7.30	.....	.....	.....
8	Wisconsin 1919	15.32	4.49	4.97	.....	.....	.....
21	Minnesota 1920	16.30	5.10	7.40	.....	9.30	.....
	Wheat Mixed Feed and Screenings.						
32	Kansas 1915-20	17.37	4.24	8.31	.....	.....	.....
	Middlings.						
88	Wisconsin 1919	16.27	5.15	6.45	.....	.....	.....
6	Connecticut 1918	16.85	5.35	7.03	55.69	10.41	4.59
16	Pennsylvania 1919	17.56	5.09	5.16	.....	.....	.....
12	Connecticut 1919	18.02	4.78	5.69	57.34	9.98	4.29
115	Michigan 1919	16.90	5.10	7.50	.....	.....	.....
27	Pennsylvania 1919	18.37	4.90	5.28	.....	.....	.....
28	Pennsylvania 1919 with admixtures	17.81	5.75	7.39	.....	.....	.....
22	Pennsylvania 1919 with admixtures	17.25	5.65	6.88	.....	.....	.....
	Wheat Flour Middlings.						
182	Wisconsin 1920	16.20	6.90	5.50	.....	9.60	.....
470	Henry and Morrison	17.80	5.00	4.70	58.10	10.70	3.70

Table 3. Average analyses of wheat feeds—Continued.

No. averaged		Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash
	Wheat Middlings (Standard Shorts).						
4641	Henry and Morrison	17.40	4.90	6.00	56.80	10.50	4.40
	Standard Wheat Middlings.						
19	Wisconsin 1919	15.08	5.30	7.90	.....	.....	.....
22	Wisconsin 1920	16.11	4.82	8.47	.....	.....	.....
214	Minnesota 1920	16.40	5.60	8.30	.....	8.80	.....
	Wheat Chops.						
12	Texas 1913-14	16.63	1.73	3.16	67.67	8.96	1.85
5	Texas 1914-15	15.90	1.97	3.52	65.17	10.66	2.78
3	Texas 1915-16	16.26	1.89	3.53	65.46	10.42	2.44
2	Texas 1919-20	13.07	1.73	3.55	67.57	11.99	2.09
66	Texas 1913-14	17.39	3.99	4.08	61.19	10.05	3.30
59	Texas 1914-15	17.92	4.08	3.95	61.26	9.58	3.21
42	Texas 1915-16	17.66	4.08	4.22	60.11	10.19	3.74
18	Texas 1916-17	17.74	4.28	4.83	59.73	9.79	3.63

If the average for wheat bran is considered, it is seen that there has been a relative increase in the number of samples containing screenings, and an increase in the percentage of crude fiber present. The higher the percentage of crude fiber in any wheat by-product, the lower is its quality and feeding value. Wheat bran containing screenings always averages a higher percentage of crude fiber than wheat bran which does not contain screenings. This difference is not accounted for by the presence of the screenings, as they are not high in crude fiber (Table 1), but the bran itself must be of poorer quality. That is to say, millers who do not put screenings into the bran make bran of better quality than those who do put screenings into the bran.

An increase in the percentage of fiber in wheat mixed feed is also seen when the averages are examined. The series of analyses of the other groups is not sufficiently long to show changes in average composition.

The composition of some wheat by-products as found by other states is shown in Table 3 also. No attempt has been made to collect all possible averages. Some average analyses are also given in table from Henry and Morrison's "Feeds and Feeding." Changes in names and in methods of manufacture decrease the value of average analyses of mill feeds extending over long periods of time, and may cause such averages to be entirely misleading with respect to present-day feeds.

DIGESTION EXPERIMENTS WITH WHEAT BY-PRODUCTS.

The number of digestion experiments with wheat by-products is not as great as we might desire. Individual tests are given in Table 4.

Table 4.—Digestion experiments with wheat feeds.

Animal	Description	State	Composition						Digestion Coefficients			
			Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash	Protein	Fat	Fiber	Nitrogen free extract
Sheep	Coarse bran	Connecticut	15.30	5.40	11.10	55.10	7.00	6.1	70.2	72.1	16.1	67.2
Sheep	Spring wheat bran	Maine	16.63	5.00	11.17	53.11	7.43	6.56	75.6	41.9	68.5	73.5
Sheep	Wheat bran	Texas	16.05	3.66	10.66	54.75	8.94	5.95	82.6	84.1	44.1	80.3
Pig	Wheat bran	Minnesota	15.18	5.05	10.25	54.17	9.40	5.95	75.8	65.4	26.9	56.0
Sheep	Wheat bran	Texas	16.38	3.86	10.37	52.04	11.14	6.21	86.0	77.2	42.7	74.6
Pig	Wheat bran	Minnesota	15.18	5.05	10.25	54.17	9.40	5.95	74.4	78.1	39.1	75.0
Sheep	Wheat bran (spring)	Massachusetts	15.37	4.71	10.02	51.85	12.69	5.35	79.63	75.6	23.6	70.4
Sheep	Coarse roller process wheat bran	Maine	15.50	5.10	9.66	52.01	11.73	6.00	82.1	64.0	36.2	64.1
Steer	Western wheat bran	Maryland	17.77	6.00	9.51	48.22	13.26	5.24	82.3	54.7	25.12	74.6
Sheep	Winter wheat bran	Massachusetts	13.47	4.29	9.18	52.79	13.71	6.55	78.2	66.7	14.3	71.9
Sheep	Coarse roller process wheat bran	Maine	16.56	4.41	8.06	53.31	11.55	6.08	73.7	82.6	0	67.5
Sheep	Wheat bran (winter)	Massachusetts	14.74	3.95	8.06	55.21	13.51	5.40	78.5	60.5	56.3	70.4
Sheep	Spring wheat middlings	Maine	18.13	4.71	5.22	55.97	9.08	3.99	90.8	85.7	0	87.7
Sheep	Wheat gray shorts	Texas	19.21	5.25	4.51	58.42	8.84	3.77	82.6	95.5	0	89.5
Sheep	Wheat brown shorts	Texas	18.48	5.04	4.79	57.76	10.37	3.56	88.9	82.7	51.9	90.6
Steers	Wheat middlings	Maine	13.31	2.92	4.18	60.96	13.48	3.02	72.7	.....	0	98.6
Sheep	Wheat middlings	Massachusetts	18.31	5.30	3.07	58.95	13.06	1.30	84.79	84.9	36.3	87.8
Sheep	Wheat grain screenings	Massachusetts	15.5	4.7	7.3	57.2	11.5	3.8	62.64	90.90	0	81.83
Sheep	Wheat grain screenings	Massachusetts	15.6	7.7	9.1	54.7	8.0	4.9	80.93	86.80	0	64.55
Steer	Wheat bran (71.5%) and shorts (28.5%)	Utah	14.14	3.48	8.28	60.13	9.72	4.26	75.75	44.98	18.33	64.25
Sheep	Winter wheat mixed feed	Maine	16.13	5.20	13.33	49.94	9.30	6.10	78.0	.....	72.3	.....
Steers	Feed flour	Maine	21.38	0.72	2.25	54.83	17.86	2.96	79.1	.....	.....	75.5
Sheep	Wheat white shorts	Texas	16.01	2.52	1.10	69.53	9.87	0.97	92.1	86.7	50.0	98.5
Sheep	Wheat white shorts	Texas	16.52	2.54	1.45	67.25	10.81	1.43	88.0	91.5	33.5	98.9
Sheep	No. 2, wheat middlings	Connecticut	18.7	5.8	9.6	52.5	8.4	5.0	76.5	88.9	29.9	73.5
Sheep	Wheat brown shorts	Texas	20.2	5.8	6.2	54.2	9.1	4.5	89.3	83.6	70.7	83.4
Sheep	Wheat middlings (very fine fancy)	Maine	20.1	4.0	5.7	57.0	11.1	3.1	78.9	85.1	0	82.6
Sheep	Durum wheat	South Dakota	12.41	2.57	3.06	68.26	12.00	68.26	28.1	65.0	39.8	92.0
Sheep	White winter wheat meal	Massachusetts	11.48	1.90	2.08	70.68	12.20	1.66	81.8	64.4	0	93.5
Sheep	Red wheat meal	Massachusetts	8.71	2.45	2.61	72.42	12.57	1.68	67.1	80.0	0	92.5
Sheep	Cracked wheat	Texas	13.11	1.69	3.35	70.76	9.34	1.75	90.3	86.4	88.2	96.2
Sheep	Whole wheat	Texas	13.50	1.66	2.74	68.32	12.02	1.76	92.2	91.0	0	78.4
Pig	Ground wheat	Maine	14.18	2.17	2.83	67.67	10.95	2.20	70.0	60.0	30.0	74.0
Pig	Cracked wheat	Minnesota	14.18	2.17	2.83	67.67	10.95	2.20	80.0	70.0	60.0	83.0
Pig	Shorts	Minnesota	13.75	4.90	8.35	60.09	10.12	2.79	76.0	.....	98.0	88.0
Pig	Shorts	Minnesota	13.75	4.90	8.35	60.09	10.12	2.79	71.0	.....	25.0	85.0

When we consider the table, we find the digestibility is lowest for wheat bran, highest for wheat white shorts. The amount of crude fiber is an indication of the digestibility that should be expected. Table 5 contains the average composition and digestibility of wheat by-products used in the experiments given in Table 4. Sufficient experiments with wheat middlings containing 9 per cent. crude fiber have not been made, but the single experiment made shows that this feed is nearer in composition and feeding value to wheat bran than to wheat shorts. Details of some of the experiments given in the above table made at the Texas Experiment Station have not yet been published.

Table 5. Average composition and digestion coefficients of feeds used in digestion experiments with rumin ants.

	Number averaged	Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash	Digestion Coefficients			
								Protein	Fat	Fiber	Nitrogen free extract
Wheat bran	12	15.68	4.71	9.86	53.06	10.81	5.95	78.1	68.6	32.7	70.4
Wheat middlings and brown shorts	3	19.7	5.2	7.2	54.2	9.5	4.2	81.6	85.9	16.9	79.8
Wheat middlings	5	18.5	4.64	4.35	58.41	10.97	3.13	83.9	87.2	17.6	90.8
Wheat meal	5	11.82	2.05	2.77	70.09	11.63	1.71	81.5	77.4	25.6	90.5
Wheat white shorts	2	16.27	2.53	1.28	68.39	10.34	1.20	90.1	89.1	41.8	98.7
Wheat screenings	2	15.6	6.2	8.2	56.0	9.8	4.4	71.8	88.5	0	73.2
Feed flour	1	21.4	0.7	2.3	54.8	17.9	3.0	79.1	.....	.....	75.5

PRODUCTION COEFFICIENTS OF WHEAT BY-PRODUCTS.

The production coefficients of wheat by-products have been calculated by the methods described in Bulletin 185 (Fraps' Principles of Agricultural Chemistry, 1917, p. 433) and are presented in Table 6. In order to ascertain the production value of a feed in terms of fat, it is merely necessary to multiply the constituents of the feed by the proper production coefficients, and add up the product. The production coefficients here presented are calculated from the digestion experiments given in Tables 3 and 4.

Table 6. Production coefficients for wheat feeds.

Calculated Factors		In terms of fat				Factor	Factor for digestible protein	In terms of therms			
		Protein	Ether extract	Crude fiber	Nitrogen free extract			Protein	Fat	Crude fiber	Nitrogen free extract
Wheat chops or meal		.192	.463	.064	.226	1.00	.815	.823	1.984	.274	.968
Wheat white shorts or low grade flour, or by-products 0–0.20–1 fiber		.212	.533	.010	.247	1.00	.901	.908	2.283	.043	1.058
Wheat white shorts or by-products 2.01–3.5 fiber		.204	.526	.010	.237	1.00	.869	.874	2.253	.043	1.015
Wheat gray shorts, of by-products 3.5–5.5 fiber		.186	.494	.041	.194	0.95	.839	.799	2.116	.176	.831
Wheat brown shorts, or by-products 5.51–6.5 fiber		.183	.480	.041	.188	0.93	.829	.784	2.056	.176	.805
Wheat mixed feed, or by-products 6.5–8.5 fiber		.163	.437	.036	.170	.85	.815	.698	1.872	.154	.728
Wheat middlings, or by-products 8.5–9.5 fiber		.145	.376	.010	.140	.77	.798	.621	1.611	.043	.600
Wheat bran, all varieties, chiefly over 9.5 fiber		.142	.316	.008	.136	.77	.785	.608	1.354	.034	.583
Wheat screenings		.157	.492	.0	.153	.93	.718	.673	2.108	.0	.656
Average of experiments:											
Wheat bran	12	.142	.316	.008	.136	.77	.781	.608	1.354	.034	.583
Wheat middlings and brown shorts	3	.163	.437	.036	.170	.85	.816	.698	1.872	.154	.728
Wheat middlings	5	.183	.485	.041	.190	.93	.839	.784	2.078	.176	.814
Wheat meal	5	.192	.463	.064	.226	1.00	.815	.823	1.983	.274	.968
Wheat white shorts	2	.212	.533	.105	.247	1.00	.901	.908	2.283	.450	1.058
Wheat screenings	2	.157	.492	.0	.153	1.00	.718	.673	2.108	.0	.656

The productive value of feeds may also be stated in terms of therms, the heat unit proposed by Dr. Armsby, of the Pennsylvania Experiment Station. To convert fat into therms it is necessary to multiply the productive value expressed as fat by 4.284. Table 5 also contains the production coefficients for wheat by-products expressed as therms.

Since wheat by-products do not have full value in feeding, it is necessary to make correction by multiplying by a factor. The factor applied for this purpose is given in column headed "factor."

FEEDING VALUE OF WHEAT BY-PRODUCTS.

Using the production coefficients given in the preceding table, and the average composition of some of the wheat by-products, we have calculated the feeding values as expressed by the digestible protein, and the productive values, with the results given in Table 7. The productive value is expressed in terms of both fat and therms. These figures represent our best present knowledge with respect to the comparative values of wheat by-products.

Table 7 Assumed average and minimum composition and feeding value of wheat products.

	Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash	Digestible protein	Productive value	
								As Fat	As Therms
Wheat bran—assumed average	16.0	3.8	8.5	55.7	10.0	6.0	12.5	11.6	49.5
Wheat bran—minimum guarantee	14.5	3.0	10.0	55.5	11.0	6.0	11.3	10.9	47.0
Wheat bran—low grade	14.5	3.0	13.0	52.5	11.0	6.0	11.3	10.6	45.4
Wheat bran and screenings—assumed average	16.0	3.8	10.0	53.2	11.0	6.0	12.5	11.3	48.4
Wheat bran—minimum guarantee	14.5	3.0	10.0	55.5	11.0	6.0	11.3	10.9	47.0
Wheat brown shorts—assumed average	18.4	4.5	6.3	56.1	10.5	4.2	15.3	16.8	71.7
Wheat brown shorts—minimum guarantee	15.0	3.5	6.5	60.3	10.5	4.2	12.4	16.4	70.1
Wheat gray shorts—assumed average	17.5	4.3	5.3	58.9	10.0	4.0	14.7	17.8	75.8
Wheat gray shorts—minimum guarantee	15.0	3.5	5.5	62.0	10.0	4.0	12.6	17.5	74.6
Wheat white shorts—assumed average	16.0	2.6	2.6	66.5	10.0	2.3	13.9	20.4	87.5
Wheat white shorts—minimum guarantee	14.5	3.0	3.5	66.5	10.0	2.5	12.6	20.3	87.3
Wheat mixed feed—assumed average	16.8	4.0	7.8	55.9	10.5	5.0	13.7	14.3	61.5
Wheat mixed feed—minimum guarantee	15.0	3.5	8.5	57.5	10.5	5.0	12.2	14.0	60.0
Standard middlings—assumed average	15.5	5.1	8.0	56.4	10.5	4.5	12.6	14.7	64.2
Standard middlings—minimum guarantee	16.0	4.5	9.0	55.5	10.5	4.5	12.8	12.1	52.3
Flour middlings—assumed average	17.5	4.8	5.0	57.7	10.5	4.5	14.7	17.8	75.9
Flour middlings—minimum guarantee	15.0	3.0	6.0	61.0	10.5	4.5	12.4	16.3	69.6
Red Dog flour—assumed average	16.7	4.0	2.3	63.5	11.0	2.5	15.1	20.6	88.4
Red Dog flour—minimum guarantee	16.0	4.5	4.0	63.0	10.5	2.0	13.4	18.4	78.8
Wheat chops or meal—assumed average	12.4	2.1	2.2	70 8	10.5	2.0	10.1	19.5	83.5
Wheat mill screenings, ground—assumed average	15.6	2.3	5.3	62.7	10.5	3.6	11.2	14.2	60.8

CHECKING PRODUCTIVE VALUES BY FEEDING TESTS.

Feeding tests, when conducted by some systems, may be used to check the productive values of feeds, and the calculated productive values, expressed either in terms of therms or fat, may be tested by the feeding experiments and adjusted, if need be. In making these tests, it is necessary to use one feed as a standard or measuring rod, and to assume values for maintenance requirements. We have used the values given in Armsby's "Nutrition of Farm Animals," pages 711-712, for the maintenance requirements in the calculations here presented.

EFFECT OF GRINDING ON PRODUCTIVE VALUE OF WHEAT.

Bulletin 144, Nebraska Experiment Station, gives a comparison of soaked whole wheat, soaked ground wheat, soaked whole wheat and tankage, and ground whole wheat and tankage, on 10 hogs per lot, 84 days. No analyses were given, so average productive values for wheat given in this bulletin were used.

Table 8. Comparison of productive values of whole wheat and ground wheat.

	Whole wheat	Whole wheat and tankage	Ground wheat	Ground wheat and tankage
Weight at beginning, pounds	136	138	137	139
Average weight, W	171	184	187	195
Daily gain each pig, G	0.84	1.09	1.19	1.32
Ration daily, wheat, pounds	4.96	5.30	5.27	5.56
Tankage	0	.26	0	.27
Productive value of ration, therms, T	4.155	4.627	4.413	4.841
Maintenance requirement, W × .0103 = M	1.761	1.895	1.926	1.950
Productive balance, T–M=B	.....	.....	2.487	2.891
Gain by 1 therm, G÷B=K	.....	.....	0.478	0.456
Productive value of gain, G÷K=L	1.761	2.392	.....	.....
Total furnished by ration, L+M=O	3.522	4.287	.....	.....
Percentage of calculated, O÷T×100 (Average 88.8)	84.7	92.8	.....	.....

Table 8 shows how the results are calculated to secure the comparative productive values of whole and ground wheat. One therm productive value in ground wheat produces 0.478 pound gain in weight; so 0.84 pound gain with whole wheat should require 0.84 divided by 0.478 or 1.761 therms. Adding the maintenance requirements, 1.761 therms, makes a total of 3.522 therms produced by the ration, which is 84.7 per cent. of the calculated value. In the same way we find the whole wheat and tankage produced 92.8 per cent. of the calculated value, or an average of 88.8. This is distinct from the effect of grinding on the appetite of the animal. (The animals ate more of the ground wheat than the whole wheat; hence they had a greater excess over maintenance which could be used for productive purposes.)

Comparison of Corn, Wheat, and Middlings.—The Ohio Experiment Station reports, in Bulletin 268, feeding tests with lots of pigs, feeding 9 parts ground corn, or ground wheat, or middlings with 1 part tankage, and middlings alone for 91 days.

Table 9. Composition and productive value of feeds used in the Ohio experiments.

	Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash	Total productive value fat	Total productive value therms
Ground corn	9.50	1.55	2.50	74.03	11.12	1.40	19.36	82.94
Ground wheat	13.06	0.80	2.69	69.82	11.50	2.13	18.83	80.67
Middlings	15.62	1.94	3.39	65.37	11.55	2.13	19.74	84.57
Tankage	61.79	10.04	3.70	0.81	6.75	16.92	18.46	79.08

The chemical analyses of the feeds are given in this bulletin and we have calculated the productive values from the factors given in this bulletin and Bulletin 185. The results are in Table 9.

Table 10. Comparison of productive values of ground corn, ground wheat and middlings, from Ohio experiments.

	Corn 9, Tankage 1	Wheat 9 Tankage 1	Middlings 9 Tankage 1	Middlings alone
Average weight, pounds, W	174	190	181	179
Daily gain per pig, pounds, G	1.57	1.59	1.52	1.44
Ration daily, pounds	5.74	6.09	5.66	5.27
Productive value of ration, therms, T	4.755	4.884	4.755	4.554
Maintenance requirement, W×H=M	1.788	1.954	1.860	1.848
Productive balance, T—M=B	2.967	2.930	2.895	2.706
Gain by 1 therm, G÷B	0.529	0.542	0.525	0.532

A comparison of the results is given in Table 10. The gain in weight caused by one therm excess over maintenance is practically the same for corn and tankage, middlings and tankage, and middlings alone, and about 2.5 per cent. better for wheat and tankage. According to this experiment, the productive values calculated for these feeds are relatively correct for hogs, though calculated from digestion experiments with ruminants.

Comparison of Wheat and Corn.—Missouri Bulletin 136 compares ground wheat and ground corn on hogs using wheat alone, corn alone, wheat and corn, wheat and tankage and corn and tankage. Analyses of the feeds were not made in 1913 but were made in 1914, and the analyses and calculated productive values are given in Table 11. As the feeds were near the average in composition, we assumed them to be the same both years.

Table 11. Feeds used in 1914, Missouri Experiments, Bulletin No. 136.

	Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash	Total productive value fat	Total productive value therms
Ground wheat	13.92	1.89	2.36	67.83	12.43	1.57	19.03	81.52
Ground corn	10.13	4.08	2.10	69.57	12.82	1.30	19.80	84.82
Tankage	52.18	10.70	1.47	2.10	9.17	24.38	16.80	71.97

Calculations of the results of the experiment are given in Table 12. In these experiments, wheat produces larger gains per therm than does corn. It is necessary to use one or the other as a standard, and wheat was selected, the average of the gains produced by wheat and by wheat and tankage in each period and each experiment being used as a basis for the comparison of the other lots.

Table 12. Calculations of Missouri experiments.

	Wheat	Corn 5, Wheat 5	Wheat 5, Corn 5, Tankage 1	Wheat 10, Tankage 1	Corn 10, Tankage 1	Corn
1913—78 days.						
Average weight, pounds, W	120.9	114.4	131.2	135.7	111.7	112.4
Daily gain, G	1.04	0.94	1.33	1.40	0.82	0.81
Productive value ration, therms, T	3.898	4.078	4.498	4.413	3.427	3.599
Maintenance requirement, therm, W×H=M	1.41	1.338	1.469	1.520	1.307	1.315
Productive value, T—M=B	2.488	2.740	3.029	2.893	2.120	2.284
Gain by 1 therm, G÷B=K	.418	.343	.439	.483	.386	.354
Average, 1+4=R	.450	.....	.....	.....	.....	.....
Maintenance per 100 pounds, therms, H	.....	.0117	.0112	.0112	.0117	.0117
Value of gain, therm, G÷R=L	.....	2.089	3.000	.....	1.822	1.860
Maintenance, therm, M	.....	1.338	1.469	.....	1.307	1.315
Found value of ration, therm, M+L=O	.....	3.427	4.469	.....	3.129	3.115
Calculated value of ration, T	.....	4.078	4.498	.....	3.427	3.599
Per cent found of calculated, O÷T×100	.....	84.0	99.4	.....	91.3	86.6
1913—42 Days.						
Average weight, pounds, W	181.8	171.9	211.1	217.4	160.7	157.4
Daily gain, G	0.96	0.98	1.32	1.28	0.82	0.63
Productive value of ration, therm, T	5.184	5.612	6.513	6.555	4.670	4.627
Maintenance requirement, therm, W×H=M	1.873	1.771	2.111	2.109	1.719	1.684
Productive balance, T—M=B	3.311	3.8411	4.402	4.446	2.951	2.943
Gain by 1 therm, G÷B=K	.289	2.55	.239	.292	.278	.214
Average, 1+4=R	.291	.....	.....	.....	.....	.....
Maintenance per 100 pounds, therms, H	.0103	.0103	.0100	.0097	.0107	.0107
Value of gain, therm, G÷R=L	.....	3.367	4.536	.....	2.818	2.165
Maintenance, therms, M	.....	1.771	2.111	.....	1.719	1.684
Found value of ration, therms, M+L=O	.....	5.138	6.647	.....	4.537	3.849
Calculated value of ration, T	.....	5.612	6.513	.....	4.670	4.627
Per cent found calculated, O÷T×100	.....	91.6	102.1	.....	97.2	83.2
1914—78 Days.						
Average weight, W	157.7	155.0	160.9	166.2	161.3	152.1
Daily gain, G	1.35	1.28	1.42	1.57	1.45	1.20
Productive value ration, therms, T	5.012	5.184	5.483	5.549	5.484	5.184
Maintenance requirement, therm, W×H=M	1.687	1.569	1.722	1.778	1.726	1.627
Productive value, T—M=B	3.325	3.525	3.761	3.791	3.758	3.557
Gain by 1 therm, G÷B=K	.406	.363	.377	.414	.385	.334
Average, 1+4=R	.410	.....	.....	.....	.....	.....
Maintenance per 100 pounds, therm, H	.0107	.0107	.0107	.0107	.0107	.0107
Value of gain, therm, G÷R=L	.....	3.122	3.463	.....	3.537	2.927
Maintenance, therm, M	.....	1.659	1.722	.....	1.726	1.627
Found value of rations, therm, M+L=O	.....	4.781	5.185	.....	5.263	4.554
Calculated value of ration, T	.....	5.184	5.483	.....	5.484	5.184
Per cent found of calculated, O÷T×100	.....	92.2	94.6	.....	96.0	87.8
1914—42 Days.						
Average weight, W	243.2	232.3	248.3	262.9	252.6	219.0
Daily gain, G	1.45	1.29	1.66	1.68	1.65	0.92
Productive value ration, therm, T	5.869	6.126	7.368	7.197	7.454	5.869
Maintenance requirement, therm, W×H=M	2.286	2.184	2.334	2.471	2.374	2.059
Productive value, T—M=B	3.583	3.942	5.038	4.726	5.080	3.810
Gain by 1 therm, G÷B=K	.404	.329	.329	.355	.323	.241
Average 1+4=R	.380	.....	.....	.....	.....	.....
Maintenance per 100 pounds, therms, H	.0094	.0094	.0094	.0094	.0094	.0097
Value of gain, therms, G÷R=L	.....	3.394	4.367	.....	4.341	2.420
Maintenance, therms, M	.....	2.184	2.334	.....	2.374	2.059
Found value of ration, therm, M+L=O	.....	5.578	7.001	.....	6.715	4.479
Calculated value of ration, T	.....	6.126	7.368	.....	7.454	5.869
Per cent found of calculated, O÷T×100	.....	91.1	95.0	.....	90.1	76.3
Average	.....	89.7	97.8	.....	93.7	83.5

Corn fed alone produced for each therm fed 76.3 to 87.8 per cent. (average 83.5 per cent) per therm fed in wheat. Corn fed alone is a poor feed, since the animal does not eat enough to make good gains.

Corn 10 parts to tankage 1 part produces from 90.1 to 97.2 per cent. of the calculated, average 93.7. In the Ohio experiments described

above, corn and wheat were equal when fed with tankage. It is possible that the corn fed in this experiment contained more water, and so may have had a lower production value than we have assumed.

Corn and wheat, equal parts, produced gains 84.0 to 92.2 per cent. of the calculated, with an average of 89.7.

Corn, wheat, and tankage gave 94.6 to 102.1 per cent. of the calculated, with an average of 97.8.

Comparison of Whole Wheat, Wheat Screenings, Whole Barley and Whole Oats on Sheep.—Montana Bulletin 59 contains a comparison of these feeds on lambs and on wethers. Snow and rain interfered with getting exact weights of the hay fed, and no analyses of the feeds were reported. Hence, it is necessary to assume average composition. Results of this work are calculated in Table 13.

Table 13. Montana experiments on Sheep.

	Wethers					Lambs				
	Wheat screenings	Whole wheat	Whole oats	Whole barley	Whole mixed grains equal parts	Whole screenings	Whole wheat	Whole oats	Whole barley	Mixture
Average weight per sheep, pounds, W	129.30	131.30	129.34	128.30	130.72	69.67	68.17	69.51	68.42	69.26
Average daily gain, pounds, G	.190	.219	.202	.204	.187	.256	.219	.246	.234	.231
Clover eaten, per day, per head, pounds, R	3.69	3.83	3.82	3.82	3.86	1.77	1.78	1.82	1.87	1.80
Grain eaten, S	.625	.625	.625	.625	.625	.62	.62	.62	.62	.62
Productive value clover, R×.362=C	1.336	1.386	1.382	1.382	1.397	.641	.644	.659	.677	.652
Productive value wheat, S ×.753=Z	.....	.471	.....	.....	.....	.....	.467	.....	.....	.....
Productive value ration (therms) C+Z=T	.....	1.857	.....	.....	.....	.....	1.111	.....	.....	.....
Maintenance requirements, W ×H=M	.959	.974	.960	.952	.970	.650	.636	.649	.638	.646
Productive balance, T—M=B	.....	.883	.....	.....	.....	.....	.475	.....	.....	.....
Maintenance per 100 pounds, H	.00742	.00742	.00742	.00742	.00742	.00933	.00933	.00933	.00933	.00933
Therms per 1 pound gain, B÷G=K	.....	4.031	.....	.....	.....	.....	2.169	.....	.....	.....
Value of gain, therms, G ×K=L	.766	.883	.814	.822	.753	.556	.475	.534	.508	.501
Value of ration to sheep, M+L=O	1.725	1.857	1.774	1.774	1.723	1.206	1.111	1.183	1.146	1.147
Productive value of grain, O—C=X	.389	.471	.392	.392	.326	.565	.467	.524	.469	.495
Productive value 100 pounds grain, X÷S×100	62.24	75.36	62.72	62.72	52.16	91.13	75.33	84.52	75.74	79.84
Calculated by Armsby (ground)	.....	.....	67.5	89.9	.....	.....	.....	67.5	89.9	.....
Calculated Texas (ground feed) Bulletin 170	.....	.....	61.7	82.2	.....	.....	.....	61.7	82.2	.....

The results of the two series of experiments do not agree. Screenings compared with whole wheat, which was taken as the standard for the calculations, have 50 per cent. more productive value fed to lambs than to wethers, oats have about 30 per cent. more, and barley about 20 per cent. more. The mixture is too low with the wethers, but nearly right with the lambs. Possibly the experiment with the wheat on the lambs is too low, which makes too high the other gains compared with it. The whole oats with the wethers have nearly the same value as ground oats as given in Bulletin 170, but 89 per cent. of the value calculated by Armsby. The whole barley, fed to the wethers, has 69.8 per cent. of the value of barley chops as calculated by Armsby and 76.3 per cent. as calculated by us (Bulletin 170). The screenings have a productive value of 62.2 therms per 100 pounds in the experiment with the wethers, compared with 60.8 calculated by us in Table 7.

USE OF WHEAT BY-PRODUCTS IN FEEDING.

Lindsey (Massachusetts Bulletin 94) compared dried brewers grain with wheat bran on cows. When fed 26.2 pounds corn silage and about 12.4 pounds blue-grass hay with 3.0 pounds gluten feed, and 4.3 pounds dried brewers grains, the cows produced an average of 21.4 pounds of milk containing 1.1 pounds butter fat. When 4.4 pounds of the wheat bran replaced the 4.3 pounds brewers grains, the cows gave 20.8 pounds milk with 1.1 pounds butter fat. The brewers grain gave slightly more milk than the wheat bran.

According to Bulletin 170 of this Station, brewers grain contains 19.3 digestible protein and 12.9 pounds productive value, compared with 12.5 pounds digestible protein and 12.0 pounds productive value for wheat bran. In this particular experiment, the effects of the wheat bran are about what one would expect from the productive value.

According to Henry and Morrison, Hills of the Vermont Station, on substituting alfalfa for the same weight of wheat bran, found a loss of 3 to 6 per cent. in milk flow caused by the substitution. Mairs of the Pennsylvania Station reported a loss of about 5 per cent. by substitution. Lindsey at the Massachusetts Station secured similar results. According to these experiments, alfalfa meal would have a lower feeding value than wheat bran. In Bulletin 170 we estimate the productive value in fat of alfalfa meal to be 10.9, wheat bran 12.0.

At the Illinois Experiment Station, Bulletin 146, a ration of 30 pounds corn silage, 6 pounds clover hay, 6 pounds corn meal were fed to cows, in addition to 8 pounds of wheat bran. The production was 23.8 pounds of milk and 1.0 pounds fat. When 8 pounds alfalfa hay was used in the same ration in place of the wheat bran, the production was 24.4 pounds milk and 0.98 pound of fat. This test is contradictory to the experiments with alfalfa meal mentioned above, as it gives alfalfa hay the same feeding value for milk production as wheat bran. Alfalfa hay has a somewhat lower production value than alfalfa meal, and the average productive value is calculated by us at 8.2 in terms of fat, in Bulletin 170.

Wheat bran is light and bulky and contains some fiber. It has special properties which make it desirable to feed at special times, but on account of the high demand it is sometimes a more expensive feed

than other feeding stuffs. It may be used to some extent for young animals, especially in the case of cows or sheep which are just beginning to eat. It has a laxative action, which is less marked when used continuously, and gives good results when fed to horses, once or twice a week in a mash made with scalding water. It is a good feed for breeding animals, and in this respect both its laxative action and its content of protein and phosphorus are valuable. It contains too much fiber to be a good feed for fattening pigs. Bran is sometimes mixed with other feeds when sheep or cattle are started on fattening rations.

Middlings and shorts are useful for hogs of all ages, while bran is too bulky. Some grades of middlings contain such a quantity of bran particles that they have only a low value for hogs. When fed to hogs, shorts or middlings are best used along with feeds low in protein, such as corn, milo, kafir, or barley. They are relished by dairy cows. They are liable to cause colic when fed alone to horses, so that they should be fed mixed with other feeds more bulky in character. Any heavy or pasty feed is liable to cause colic in horses.

SIFTING TEST OF WHEAT BY-PRODUCTS.

The study of the composition and quantity of the siftings secured from various wheat by-products has been carried on for several years with the object of using this method for checking the names under which the feeds were sold. In preliminary work, sifters of 10, 14, 20, 28, 35, 48, and 65 meshes to the inch were used, but this number of siftings was found too large for ordinary use. A study of the preliminary work made it appear probable that the use of sifters of 14, 20, and 48 mesh would prove more satisfactory. There is still some question whether a 28-mesh sieve would not be better than the 20-mesh.

Table 14. Composition of Siftings.

		Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash
16422	On sifter 28, (22235) Wheat gray shorts and ground wheat screenings	17.00	3.78	10.54	52.52	9.99	6.17
16423	On sifter 35 " " " " " " "	17.78	4.01	7.91	55.98	9.57	4.75
16424	Through sifter 35 " " " " " " "	18.62	3.43	3.75	60.99	9.94	3.27
16429	On sifter 20, (22217) Wheat shorts and screenings	18.12	4.82	9.39	53.19	8.53	9.95
16430	On sifter 35 " " " "	19.62	4.63	7.51	54.13	8.95	5.16
16421	Through sifter " " " "	19.25	3.99	3.74	59.68	9.82	3.52
16592	On sifter 28, (22295) Wheat gray shorts	18.72	3.10	6.71	56.56	9.85	5.06
16571	On sifter 35 " " "	20.28	2.47	3.15	61.68	8.98	3.44
16568	Through sifter 35 " " "	17.94	2.00	1.50	66.55	10.04	1.97
16588	On sifter 28, (22270) Wheat gray shorts	19.76	4.64	6.29	54.86	9.38	5.07
16590	On sifter 48 " " "	18.27	3.70	4.44	60.27	9.68	3.64
16586	Through sifter 48 " " "	15.58	2.60	.....	.....	8.76	.....
16410	On sifter 20, (22252) Wheat gray shorts and screenings	20.69	4.95	7.07	50.55	11.16	5.58
16413	On sifter 35 " " " " " "	19.31	4.35	6.96	54.65	9.82	4.91
16407	Through sifter 35 " " " " " "	17.18	3.63	4.11	60.80	10.63	3.65
16785	On sifter 28, (22469) Wheat gray shorts	17.52	4.23	9.32	53.29	9.66	5.98
16784	On sifter 35 " " "	17.43	4.89	6.56	57.67	9.19	4.26
16786	Through sifter 35 " " "	18.56	4.07	2.43	63.05	9.86	2.03
16790	On sifter 20, (22434) Wheat gray shorts and ground wheat screenings	17.65	5.50	10.73	47.07	11.55	7.50
16791	On sifter 35 " " " " " " " " "	17.51	4.47	9.69	49.56	13.24	5.53
16792	On sifter 48 " " " " " " " " "	18.93	3.65	.....	.....	3.65	.....
16787	Through sifter 48 " " " " " " " " "	18.37	3.03	4.07	60.66	9.95	3.96
16796	On sifter 35, (22426) Gray wheat shorts	19.37	4.05	5.81	59.50	9.05	2.22
16793	On sifter 48 " " "	15.45	2.48	1.90	68.75	9.45	1.97
16794	On sifter 65 " " "	14.27	1.85	1.09	70.72	10.57	1.48
16795	Through sifter 65 " " "	13.89	1.73	.64	72.89	9.86	.99
16921	On sifter 48, (22637) Wheat gray shorts	.....	2.65	8.26	.....	12.62	4.41
16922	On sifter 65 " " "	16.00	2.68	3.76	65.37	9.40	2.79
16923	Through sifter 65 " " "	14.62	2.10	1.14	73.04	7.67	1.43
16583	On sifter 28, (22407) Wheat brown shorts and ground wheat screenings	21.34	4.71	7.33	.....	9.94	.....
16580	On sifter 48 " " " " " " " " "	19.63	3.86	6.14	54.20	10.79	5.38
16582	Through sifter 48 " " " " " " " " "	17.27	2.89	2.58	64.10	10.36	2.80
17775	On sifter 35, (17752) Wheat brown shorts	20.18	5.43	6.58	53.80	9.15	4.86
17779	On sifter 48 " " "	20.02	5.73	6.63	54.05	8.87	4.70
17780	Through sifter 48 " "	19.60	6.34	4.50	55.98	9.25	4.33
17776	On sifter 28, (17753) Wheat brown shorts	21.12	5.11	6.39	53.41	9.19	4.78
17777	On sifter 35 " " "	19.40	6.23	6.56	54.20	8.83	4.78
17778	Through sifter 35 " " "	18.83	6.53	5.16	55.85	9.54	4.09
17722	On sifter 35, (17410) Wheat brown shorts	21.90	5.77	7.20	50.13	10.17	4.83
17723	On sifter 48 " " "	18.91	5.49	7.08	54.27	9.72	4.53
17724	Through sifter 48 " " "	17.88	3.72	2.34	63.12	10.43	2.51
16169	On sifter 20, (21504) Wheat brown shorts	18.80	4.75	10.53	50.59	8.58	6.75
16164	On sifter 28 " " "	19.97	5.04	9.14	49.94	9.94	6.34

Table 14. Composition of Siftings—Continued.

		Protein	Ether extract	Crude fiber	Nitrogen free extract	Water	Ash
16166	On sifter 35 (21504) Wheat brown shorts	20.22	5.18	8.52	50.25	9.96	5.87
16165	On sifter 48 " " "	20.65	5.11	6.05	53.49	9.77	4.93
16168	On sifter 65 " " "	19.70	4.46	3.54	58.44	9.93	3.93
16167	Through sifter 65 " " "	18.84	3.56	1.88	62.34	10.09	2.29
17722	On sifter 28, (17410) Wheat brown shorts	21.90	5.77	7.20	50.13	10.17	4.83
17723	On sifter 48 " " "	18.91	5.41	7.08	54.27	9.72	4.53
17724	Through sifter 48 " " "	17.88	3.72	2.34	63.12	10.43	2.51
16401	On sifter 28, (22396) Wheat mixed feed and screenings	16.87	4.32	9.87	52.39	9.76	6.79
16399	On sifter 35 " " " " "	19.32	4.37	8.34	52.75	9.81	5.41
16400	Through sifter 35 " " " " "	20.70	2.58	3.68	59.27	10.51	3.26
16585	On sifter 14, (22326) Wheat mixed feed	16.00	4.39	10.20	52.54	10.32	6.55
16584	On sifter 28 " " "	18.93	4.53	9.48	49.37	11.42	6.27
16589	On sifter 48 " " "	19.88	3.81	8.16	53.27	9.72	5.16
16587	Through sifter 48 " " "	20.44	2.96	4.09	.....	9.16	.....

Table 14 shows the chemical composition of a number of siftings, which were grouped according to the amount and the appearance of the siftings. All the siftings analyzed are not included in the table. (In the making of these groupings it was attempted to bring together the siftings which were apparently alike.)

An examination of this table shows a tendency for the protein and fat to decrease with the fineness of the siftings. This is not always the case, as sometimes the protein increases or remains nearly stationary. However, it is generally the case.

The crude fiber always decreases with the fineness of the siftings, usually abruptly. The extent of the decrease depends upon the character of the feed, although the finest siftings are usually low in crude fiber.

Table 15. Crude fiber content of siftings.

		On 10	On 14	On 20	On 28	On 35	On 48	On 65	Thru
22491	Wheat white shorts	.....	.....	.....	.....	7.48	1.99	.....	1.76
22375	Standard wheat shorts	.....	.....	11.41	.....	11.01	10.06	.....	7.63
22364	Gray wheat shorts	.....	.....	.....	7.70	.....	5.28	.....	1.94
22206	Wheat gray shorts	.....	.....	.....	.....	.....	6.08	.....	2.78
22343	Wheat gray shorts	.....	.....	.....	7.07	.....	5.06	.....	2.34
22352	Wheat gray shorts	.....	.....	7.34	4.47	4.07	.....	.....	2.84
22209	Wheat gray shorts	.....	.....	.....	10.13	6.35	.....	.....	3.42
22295	Wheat gray shorts	.....	.....	.....	.....	3.15	.....	.....	1.50
22235	Wheat gray shorts and ground wheat screenings	.....	.....	.....	10.54	7.91	.....	.....	3.75
22217	Wheat shorts and screenings	.....	.....	9.39	.....	7.51	.....	.....	3.74
22295	Wheat gray shorts	.....	.....	.....	6.71	3.15	.....	.....	1.50
22270	Wheat gray shorts	.....	.....	.....	6.29	.....	4.44	.....	.....
22252	Wheat gray shorts and screenings	.....	.....	7.07	.....	6.96	.....	.....	4.11
22469	Wheat gray shorts	.....	.....	.....	9.32	6.56	.....	.....	2.43
22434	Wheat gray shorts and ground wheat screenings	.....	.....	10.73	.....	9.69	.....	.....	4.07
22426	Gray wheat shorts	.....	.....	.....	.....	5.81	1.90	1.09	.64
22637	Wheat gray shorts	.....	.....	.....	.....	.....	8.26	3.76	1.14
22407	Wheat brown shorts and ground wheat screenings	.....	.....	.....	7.33	.....	6.14	.....	2.58
17752	Wheat brown shorts	.....	.....	.....	.....	6.58	6.63	.....	4.50
17753	Wheat brown shorts	.....	.....	.....	6.39	6.56	.....	.....	5.16
17410	Wheat brown shorts	.....	.....	.....	.....	7.20	7.08	.....	2.34
22396	Wheat mixed feed and screenings	.....	.....	.....	9.87	8.34	.....	.....	3.68
22326	Wheat mixed feed	.....	10.20	.....	9.48	.....	8.16	.....	4.09
22447	Wheat mixed feed	.....	9.53	.....	7.48	.....	4.54	.....	1.25
22358	Wheat bran	.....	.....	9.51	.....	8.12	.....	.....	.....
22254	Mixed bran and wheat screenings	10.30	.....	9.98	.....	5.84	.....	.....	.....
22395	Wheat bran and screenings	.....	.....	10.10	.....	9.76	.....	.....	5.53
22412	Wheat bran and screenings	.....	10.71	.....	.....	8.07	.....	.....	4.01
22417	Wheat bran and ground wheat screenings	.....	11.53	.....	10.97	.....	.....	.....	9.10
22344	Wheat bran and screenings	.....	.....	.....	10.34	8.49	.....	.....	.....

Table 15 is a survey of the crude fiber content of the siftings shown in Table 14, and brings out more clearly the fiber relations. The siftings marked "through" in some cases passed through a 65-mesh sieve, in others a 48-mesh, and in others a 35-mesh. This can be seen on reference to the table. The crude fiber in almost all "through" siftings is less than 5 per cent. Four of the twenty-six "through" siftings shown in Table 15 contain more than 5 per cent. fiber. Two of these come from wheat bran. In most cases the through siftings contain 3 per cent. or less of crude fiber.

Table 16. Crude fiber content of feed and percentage of siftings.

	Name	Crude fiber	Siftings, per cent				
			14	20	48	Thru	14 and 20
22491	Wheat white shorts	2.68	.3	5.6	45.6	47.9	5.9
22683	Wheat white shorts	3.10	.1	0	11.2	89.0	.1
21587	Wheat white shorts	1.71	0	0	35.8	64.1	0
25521	Wheat white shorts	1.16	0	0	36.4	64.4	0
24881	Wheat white shorts	1.20	0	0	10.6	89.6	0
25638	Wheat white shorts	2.76	0	0	2.4	99.2	0
25337	Wheat white shorts	3.03	0	.8	43.6	57.6	0
25325	Wheat white shorts	3.13	0	0	30.0	71.6	0
24737	Wheat white shorts	3.27	1.2	1.2	7.2	87.2	2.4
24649	Wheat white shorts	2.42	0	0	29.6	70.4	0
24641	Wheat white shorts	1.87	0	0	18.8	82.8	0
24881	Wheat white shorts	1.20	0	0	10.6	89.6	0
24749	Red Dog Flour	.74	0	0	0	100.0	0
24708	Wheat white shorts	3.12	0	0	0	100.0	0
22421	Wheat white shorts	3.71	0	0	64.2	35.5	0
24930	Wheat white shorts	5.08	.8	4.8	58.4	37.2	5.6
22694	Rich white shorts	5.60	.3	9.3	75.5	15.0	9.6
22637	Wheat gray shorts	3.27	0	0	16.5	82.9	0
23825	Wheat gray shorts	1.79	0	0	2.8	96.8	0
22659	Wheat gray shorts	2.95	0	0	20.5	78.9	0
22657	Wheat gray shorts	2.12	1.3	4.3	40.1	56.0	5.6
22426	Wheat gray shorts	1.28	0	.4	35.0	66.1	.4
22697	Wheat gray shorts	2.20	0	.3	73.1	26.9	.3
24340	Wheat gray shorts	1.56	0	0	8.0	92.0	0
22344	Wheat gray shorts	1.41	0	0	87.6	12.8	0
25504	Wheat gray shorts	1.50	0	0	64.8	35.6	0
25315	Wheat gray shorts	2.16	0	0	41.6	59.6	0
25430	Wheat gray shorts	2.52	0	0	9.2	92.4	0
24631	Wheat gray shorts	3.13	.4	.4	59.2	40.0	.8
24757	Wheat gray shorts	2.61	0	0	33.2	68.0	0
23843	Wheat gray shorts	5.40	0	1.2	63.1	37.7	1.2
23857	Wheat gray shorts	4.97	0	0	25.7	74.3	0
23868	Wheat gray shorts and screenings	5.39	0	4.9	61.8	33.3	4.9
22343	Wheat gray shorts	5.23	1.2	8.4	71.1	19.3	9.6
22295	Wheat gray shorts	5.08	.2	5.1	80.9	13.8	5.3
21592	Wheat gray shorts	5.18	4.4	9.7	64.7	20.9	14.1
22270	Wheat gray shorts	5.45	.7	6.9	73.1	19.4	7.6
23651	Wheat gray shorts	4.20	0	.4	66.1	33.5	.4
22999	Wheat gray shorts	4.98	.4	2.0	49.2	46.4	2.4
24312	Wheat gray shorts	3.85	0	1.8	49.6	46.2	1.8
24953	Wheat gray shorts	4.71	.8	5.4	67.4	25.9	6.2
24330	Wheat gray shorts and screenings	5.48	0	1.2	64.4	34.4	1.2
24337	Wheat gray shorts	3.59	.8	2.4	39.8	57.6	3.2
25618	Wheat gray shorts	3.54	0	0	22.8	78.4	0
24811	Wheat gray shorts	3.86	1.6	3.6	40.8	56.0	5.2
25590	Wheat gray shorts	3.91	0	1.6	44.8	54.4	1.6
24849	Wheat gray shorts	3.93	0	3.2	49.2	48.8	3.2
25549	Wheat gray shorts	4.33	0	4.8	75.6	19.6	4.8
25020	Wheat gray shorts	4.50	1.6	11.2	57.2	31.6	12.8
25041	Wheat gray shorts	4.63	.4	6.4	52.4	41.6	6.8
24872	Wheat gray shorts	4.77	0	0	50.0	51.2	.....
24849	Wheat gray shorts	3.93	0	3.2	49.2	48.8	3.2
24811	Wheat gray shorts	3.86	1.6	3.6	40.8	56.0	5.2
24685	Wheat gray shorts and screenings	4.91	2.4	2.4	65.2	30.4	4.8
24654	Wheat gray shorts	4.26	.4	.4	26.8	72.4	.8
24872	Wheat gray shorts	4.77	0	0	50.0	51.2	0
25420	Wheat gray shorts	4.80	0	1.6	53.6	46.4	1.6
25159	Wheat gray shorts	4.80	0	5.6	59.6	34.8	5.6
25068	Wheat gray shorts	4.89	4.0	7.6	48.4	30.0	11.6
25600	Wheat gray shorts	4.93	0	5.2	60.0	35.6	5.2
25704	Wheat gray shorts	4.98	0	0	52.4	48.8	.....
25568	Wheat gray shorts	5.02	0	2.8	66.0	32.8	2.8
25689	Wheat gray shorts	5.07	1.2	5.2	58.8	35.6	6.4
25338	Wheat gray shorts and screenings	5.17	1.0	5.2	64.0	30.8	6.2
25291	Wheat gray shorts	5.37	4.0	7.6	59.6	29.6	11.6
25100	Wheat gray shorts	5.37	.8	5.6	60.0	33.6	6.4
25377	Wheat gray shorts	5.40	2.0	4.4	66.4	28.8	6.4
25527	Wheat gray shorts and screenings	5.48	.....	7.2	68.4	26.0	7.2
23816	Wheat gray shorts	6.27	1.2	4.9	79.3	14.6	6.1
23865	Wheat gray shorts	5.93	1.2	6.5	54.4	37.9	7.7
22382	Wheat gray shorts	6.32	5.4	17.1	60.0	18.7	22.5
22364	Wheat gray shorts and (flour middlings)	5.73	.8	24.4	59.9	14.9	25.2
22469	Wheat gray shorts	5.83	1.3	7.2	54.1	37.3	8.5
23637	Wheat gray shorts	5.66	.4	2.5	79.8	17.3	2.9
22979	Wheat gray shorts	6.18	0.8	4.8	67.6	24.4	5.6
24308	Wheat gray shorts	5.70	0	3.2	54.8	37.0	3.2
24940	Wheat gray shorts	6.20	4.7	13.7	61.1	20.4	18.4
25206	Wheat gray shorts	6.13	0	2.6	72.3	25.5	2.6
25261	Wheat gray shorts	6.63	.8	12.2	64.9	22.2	13.0

Table 16. Crude fiber content of feed and percentage of siftings—Continued.

	Name	Crude fiber	Siftings, per cent				
			14	20	48	Thru	14 and 20
22686	Wheat gray shorts	5.57	1.9	4.7	43.5	49.9	6.6
25287	Wheat gray shorts	5.58	0	6.8	67.2	27.2	6.8
24836	Wheat gray shorts	5.61	.8	10.0	51.6	38.0	10.8
24982	Wheat gray shorts	5.45	.4	12.8	50.4	30.0	13.2
25431	Wheat gray shorts	5.75	6.8	2.4	69.6	29.6	9.2
24836	Wheat gray shorts	5.61	.4	10.0	51.6	38.0	10.4
24824	Wheat gray shorts	6.15	.4	2.4	68.4	28.8	2.8
24793	Wheat gray shorts (standard shorts)	6.03	1.2	6.4	63.6	30.0	7.6
24611	Wheat gray shorts	6.05	3.6	6.0	67.6	22.8	9.6
25185	Wheat gray shorts	6.36	.4	6.5	62.6	30.9	6.9
25282	Wheat gray shorts and ground wheat screenings	5.89	.4	8.0	60.0	33.2	8.4
25002	Wheat gray shorts	5.91	0	2.8	73.6	24.8	2.8
25351	Wheat gray shorts and screenings	5.96	3.2	9.6	58.4	30.0	12.8
24793	Wheat gray shorts (standard shorts)	6.03	1.2	6.4	63.6	30.0	7.6
24933	Wheat gray shorts	6.08	.8	3.2	74.0	22.8	4.0
24824	Wheat gray shorts	6.15	.4	2.4	68.4	28.8	2.8
25479	Wheat gray shorts	6.17	0	4.0	70.0	27.2	4.0
25654	Wheat gray shorts	6.19	0	0	64.4	34.4	0
25653	Wheat gray shorts	6.21	0	0	77.2	24.4	0
25183	Wheat gray shorts	6.36	0	6.1	63.6	30.1	6.1
25086	Wheat gray shorts	6.46	18.0	11.6	36.0	34.8	29.6
25364	Wheat gray shorts	6.50	1.2	10.0	61.2	28.4	11.2
22235	Wheat gray shorts and ground wheat screenings	7.15	2.8	12.8	63.1	20.9	15.6
22252	Wheat gray shorts and ground screenings	6.69	2.5	12.6	76.1	8.5	15.1
23844	Wheat gray shorts	6.58	0	3.6	67.7	28.7	3.6
22419	Wheat gray shorts	6.74	2.9	7.1	79.3	11.4	9.0
21558	Wheat gray shorts	7.02	1.1	11.4	66.9	20.4	12.5
23801	Wheat gray shorts	7.89	.8	4.1	52.9	42.2	4.9
22951	Wheat gray shorts and screenings	6.78	.4	5.6	58.8	33.6	6.0
22997	Wheat gray shorts and screenings	6.75	0	1.2	62.6	36.2	1.2
24024	Wheat gray shorts	6.83	1.2	8.4	62.4	26.4	9.6
24677	Wheat gray shorts and screenings	6.97	4.8	6.8	61.6	26.8	11.6
24634	Wheat gray shorts	6.84	1.2	3.2	58.8	37.2	4.4
24903	Wheat gray shorts	6.64	0	8.4	67.2	24.4	8.4
24921	Wheat gray shorts and screenings	6.69	.4	3.2	67.2	30.4	3.6
24735	Wheat gray shorts	6.79	.4	7.2	75.2	18.4	7.6
24762	Wheat gray shorts	6.21	2.0	5.6	72.0	22.0	7.6
24710	Wheat gray shorts and screenings	7.88	0	1.2	72.8	26.8	1.2
25219	Wheat gray shorts	7.77	5.2	16.0	55.7	23.2	21.2
25272	Wheat gray shorts	7.98	0	1.6	65.6	33.3	1.6
24547	Wheat gray shorts and screenings	7.76	.8	4.8	66.8	22.6	5.6
25000	Wheat gray shorts and screenings	6.52	4.4	10.4	52.0	34.4	14.8
25003	Wheat gray shorts and screenings	6.54	.8	13.2	60.8	25.6	14.0
25462	Wheat gray shorts	6.63	0	3.2	57.2	41.2	3.2
24903	Wheat gray shorts	6.64	0	8.2	67.2	24.4	8.4
25004	Wheat gray shorts and screenings	6.65	.8	11.6	70.4	18.0	12.4
25060	Wheat gray shorts (soft and screenings)	7.10	2.0	10.4	60.0	28.0	12.4
25272	Wheat gray shorts	7.98	0	1.6	65.6	32.7	1.6
25457	Wheat gray shorts	8.03	1.2	3.2	76.4	21.2	4.4
22434	Wheat gray shorts and ground wheat screenings	9.01	4.0	16.7	68.4	10.3	20.7
23800	Wheat brown shorts and screenings	5.42	.6	4.8	46.6	42.6	5.4
17410	Wheat brown shorts	4.79	0	1.2	54.2	44.2	1.2
21589	Wheat brown shorts	4.72	7.6	8.8	56.6	26.7	16.4
25021	Wheat brown shorts	5.19	1.2	5.6	56.8	38.0	6.8
22407	Wheat brown shorts and ground screenings	5.57	.7	15.1	61.1	22.9	15.8
22484	Wheat brown shorts	6.36	0	13.6	82.2	4.2	13.6
23577	Wheat brown shorts	6.17	.4	4.5	71.2	23.9	4.9
24656	Wheat brown shorts and screenings	6.16	.4	4.0	60.4	37.2	4.4
24733	Wheat brown shorts	5.57	0	.8	56.8	42.8	.8
25103	Wheat brown shorts	6.29	0	20.0	88.0	11.2	20.0
25001	Anchor wheat brown shorts	6.16	.4	4.0	73.6	23.2	4.4
21510	Wheat brown shorts	7.64	.9	12.1	74.4	12.3	13.0
21504	Wheat brown shorts	7.20	2.1	4.9	69.8	22.9	7.0
22522	Wheat brown shorts	7.13	0	1.7	67.1	33.6	1.7
24798	Wheat brown shorts and screenings	7.91	4.4	12.8	70.4	12.8	17.2
24638	Wheat brown shorts	7.25	.4	4.8	71.6	23.2	5.2
25321	Wheat brown shorts	7.83	10.8	8.8	57.6	23 2	19.6
25109	Wheat brown shorts	7.84	1.2	4.8	68.4	26.4	6.0
24798	Wheat brown shorts and screenings	7.91	4.4	12.8	70.4	12.8	17.2
25326	Wheat brown shorts and screenings	8.12	4.0	15.2	69.2	12.4	19.2
22258	Wheat brown shorts	8.57	32.4	23.3	37.2	7.0	55.7
24727	Wheat mixed feed	3.74	8.4	12.4	44.8	34.4	20.8
22447	Wheat mixed feed	5.67	25.6	11.7	30.0	22.6	37.3
24880	Wheat mixed feed	5.86	27.6	10.4	45.2	17.2	38.0
24738	Wheat mixed feed	4.64	20.8	12.8	39.2	26.8	33.6
24880	Wheat mixed feed	5.86	27.6	10.4	45.2	17.2	38.0
25150	Wheat mixed feed	6.10	38.8	12.4	34.0	14.8	51.2
25519	Wheat mixed feed	6.15	26.4	8.8	35.2	30.8	35.2
25089	Wheat mixed feed	6.49	41.2	10.4	24.8	24.0	51.6

Table 16. Crude fiber content of feed and percentage of siftings—Continued.

	Name	Crude fiber	Siftings, per cent				
			14	20	48	Thru	14 and 20
22228	Wheat mixed feed	7.62	27.4	17.9	45.1	10.9	45.3
22485	Wheat mixed feed	6.53	31.4	13.0	29.1	26.5	44.4
23806	Wheat mixed feed and screenings	7.91	30.8	10.8	41.7	17.2	41.6
24265	Wheat mixed feed	7.89	18.4	12.0	46.8	20.0	30.4
22283	Wheat mixed feed	8.10	17.1	2.5	52.9	27.5	19.6
24867	Wheat mixed feed	7.19	28.4	12.0	42.4	16.8	40.4
24862	Wheat mixed feed	7.29	34.4	12.4	32.0	21.2	46.8
24640	Wheat mixed feed	8.29	26.8	10.4	38.0	24.4	37.4
24895	Wheat mixed feed	7.83	32.0	12.8	38.0	17.2	44.8
25022	Wheat mixed feed	6.68	51.2	10.4	30.0	9.6	61.6
25146	Wheat mixed feed	6.91	53.2	11.6	29.6	5.6	64.8
25295	Wheat mixed feed	7.11	26.4	10.8	36.0	26.8	37.4
24867	Wheat mixed feed	7.19	28.4	12.0	42.4	16.8	40.4
24862	Wheat mixed feed	7.29	34.4	12.4	32.0	21.2	46.8
25296	Wheat mixed feed	7.52	52.0	10.0	24.0	16.0	62.0
24895	Wheat mixed feed	7.83	32.0	12.8	38.0	17.2	44.8
24992	Wheat mixed feed	8.02	54.8	15.2	23.2	6.8	70.0
25057	Wheat mixed feed and screenings	8.18	32.0	10.8	38.0	19.6	42.8
25030	Wheat mixed feed and screenings	8.42	18.0	11.2	57.6	14.8	29.2
24869	Wheat mixed feed and screenings	9.45	44.0	12.0	34.4	9.6	56.0
24865	Wheat mixed feed with mill run screenings	8.51	28.8	10.0	44.4	16.8	38.8
24864	Wheat mixed feed and rice bran	9.65	32.0	10.0	40.4	18.0	42.0
24688	Wheat mixed feed	8.75	38.0	12.4	36.0	14.0	50.4
24626	Wheat mixed feed	9.09	15.6	13.2	56.4	14.8	28.8
24702	Wheat mixed feed	9.39	49.6	7.6	30.0	14.0	57.2
24369	Wheat mixed feed	9.62	55.6	16.8	25.6	2.8	72.4
25051	Wheat mixed feed	8.58	40.8	11.6	33.2	15.6	52.4
25303	Wheat mixed feed	8.86	45.2	12.4	32.0	10.4	57.6
25490	Wheat mixed feed	8.89					
25126	Wheat mixed feed	8.95	40.4	14.4	28.4	18.0	54.8
25392	Wheat mixed feed and screenings	9.04	38.8	16.6	33.8	11.3	55.4
25528	Wheat mixed feed	9.45	56.0	9.6	26.8	8.8	65.6
24974	Wheat mixed feed and corn bran	9.95	49.6	12.4	28.4	11.2	62.0
23961	Wheat mixed feed and screenings	8.94	26.0	14.4	43.8	14.4	40.4
21509	Wheat mixed feed	9.96	12.3	21.5	60.9	4.9	33.8
21254	Wheat mixed feed	9.15	28.5	14.2	47.2	9.7	42.7
22283	Wheat mixed feed	8.10	17.1	2.5	52.9	27.5	19.6
22326	Wheat mixed feed	9.02	21.5	20.7	46.2	11.5	42.2
23624	Wheat mixed feed	9.39	2.8	4.8	68.7	23.7	7.6
22396	Wheat mixed feed and screenings	8.90	35.3	14.9	37.4	12.3	50.2
23853	Wheat mixed feed	10.10	2.0	4.4	56.1	37.5	6.4
23852	Wheat mixed feed	9.70	23.6	15.2	44.8	16.4	38.8
21528	Wheat mixed feed and screenings	8.94	24.9	16.9	47.3	10.4	41.8
22423	Wheat mixed feed and screenings	9.60	24.3	19.3	49.0	7.1	43.6
24294	Wheat bran	6.05	14.8	10.4	58.0	15.6	25.2
23650	Wheat bran	7.26	22.9	23.4	42.6	11.1	46.3
23560	Wheat bran	8.16	8.0	8.4	61.2	22.4	16.4
22414	Wheat bran	8.38	10.2	22.8	60.7	6.4	33.2
22358	Wheat bran	8.05	25.7	24.3	44.4	4.8	51.0
25279	Wheat bran	7.43	20.6	19.8	55.2	4.0	40.4
24890	Wheat bran	7.29	49.6	9.2	28.0	13.2	58.8
25548	Wheat bran	7.60	50.8	19.6	27.6	2.0	70.4
24890	Wheat bran	7.79	49.6	9.2	28.0	13.2	58.8
25672	Wheat bran	8.89	26.4	10.8	46.0	18.0	37.2
25084	Wheat bran	9.38	57.6	20.0	19.6	3.6	77.6
22681	Wheat bran	10.25	44.1	19.5	28.7	7.5	63.5
22422	Wheat bran	9.05	21.1	28.1	46.7	4.0	49.2
22358	Wheat bran	8.05	25.7	24.3	44.4	4.8	50.0
22993	Wheat bran	9.23	34.4	15.2	42.4	6.4	49.6
25455	Wheat bran	10.18	48.4	18.4	30.0	3.2	66.8
25306	Wheat bran	10.61	4.44	24.0	31.6	.8	68.4
25433	Wheat bran	10.68	58.8	13.6	24.4	4.8	72.4
24919	Wheat bran	11.27	77.6	14.0	8.0	1.2	81.6
25466	Wheat bran and screenings	4.84	24.0	10.4	34.0	32.4	34.4
22474	Wheat bran and ground wheat screenings	8.35	28.4	23.1	40.3	8.4	51.5
25244	Wheat bran and screenings	9.23	32.8	16.0	46.8	5.6	48.8
24309	Wheat bran and screenings	9.97	37.6	15.2	29.6	8.4	52.8
24369	Wheat bran and screenings	9.89	55.6	16.8	25.6	2.8	72.4
25518	Wheat bran and screenings	8.97	44.4	14.0	33.2	9.6	58.4
25573	Wheat bran and screenings	9.01	46.8	16.0	35.2	3.2	62.8
25080	Wheat bran and screenings	9.47	58.8	14.8	21.2	5.2	73.6
25569	Wheat bran and screenings	9.69	64.4	10.4	25.2	1.6	74.8
22406	Wheat bran and ground wheat screenings	10.88	48.2	15.8	31.2	4.8	64.0
23652	Wheat bran and ground wheat screenings	10.01	51.4	17.2	27.8	3.6	68.6
22344	Wheat bran and ground screenings	9.36	45.3	20.8	30.0	3.6	66.1
22269	Wheat bran and ground screenings	9.83	55.4	19.7	19.6	5.3	75.1
22253	Wheat bran and ground screenings	10.85					
22339	Wheat bran and ground screenings	10.93	66.5	15.8	16.3	1.4	22.3
22395	Wheat bran and ground screenings	9.30	29.82	20.22	41.37	8.24	50.54

Table 16. Crude fiber content of feed and percentage of siftings—Continued.

	Name	Crude fiber	Siftings, per cent				
			14	20	48	Thru	14 and 20
22325	Wheat bran and screenings	10.27	55.1	16.5	18.9	9.5	61.6
22327	Wheat bran and screenings	9.82	29.0	22.8	40.3	7.6	51.8
22412	Wheat bran and screenings	8.70	40.4	15.6	33.9	9.1	56.0
22274	Mixed bran and ground screenings	10.58	32.3	19.4	38.2	10.1	51.7
22305	Wheat bran and ground screenings	10.85	49.0	22.6	19.6	7.6	71.6
22639	Wheat bran and screenings	10.28	32.2	14.9	41.4	11.5	47.1
23621	Wheat bran and screenings	11.06	48.4	22.8	27.6	1.2	71.2
22346	Wheat bran and screenings	9.66	63.5	16.7	17.1	2.6	80.2
24691	Wheat bran and screenings	10.39	76.0	11.2	8.8	4.6	87.2
25395	Wheat bran and screenings	11.42	41.9	19.3	35.1	4.5	61.2
24926	Wheat bran and screenings	11.39	40.7	16.6	34.1	8.0	57.3
25042	Soft winter wheat mill run bran	10.90	52.0	16.4	25.6	6.0	68.4
22688	Wheat bran and screenings	10.29	48.2	14.6	29.7	6.4	62.8
25437	Wheat bran and screenings	10.02	48.8	20.0	23.6	8.4	68.8
25455	Wheat bran and screenings	10.18	48.4	18.4	30.0	3.2	66.8
25381	Wheat bran and screenings	10.26	69.6	15.6	14.0	2.4	85.2
24999	Wheat bran and screenings	10.29	39.6	24.0	33.6	3.6	63.6
25054	Soft wheat bran	10.39	79.2	13.2	8.8	.8	92.4
25346	Wheat bran and screenings	10.48	54.8	13.6	30.0	3.2	68.4
25306	Wheat bran	10.61	44.4	24.0	31.6	.8	68.4
25332	Wheat bran and screenings	10.65	78.0	9.2	10.0	3.6	87.2
25433	Wheat bran	10.68	58.8	13.6	24.4	4.8	72.4
25288	Wheat bran and screenings	10.69	50.4	20.0	26.8	4.0	70.4
24919	Wheat bran	11.27	77.6	14.0	8.0	1.2	91.6
25352	Wheat bran and screenings	11.24	48.8	17.6	29.2	4.4	76.4
23005	Wheat bran and screenings	10.61	48.8	22.4	26.0	1.2	71.2
24983	Pure wheat shorts	6.25	.4	12.8	62.4	24.8	13.2
22254	Mixed bran and wheat screenings	8.37	41.0	17.8	33.4	6.0	58.8
24905	Shorts with screenings	7.31	3.2	13.2	57.2	26.4	16.4
24247	Mixed bran and screenings	7.35	41.0	10.2	32.2	16.3	51.2
25247	Bran, shorts and screenings	8.30	34.8	13.6	36.0	16.0	48.4
25055	Wheat bran, shorts and screenings	8.36	.4	11.2	61.2	28.0	11.6
24622	Bran, shorts and screenings	8.98	36.8	14.0	33.6	17.6	50.8
25444	Bran, shorts and screenings mixed	8.67	24.4	12.0	47.6	17.2	36.4
22375	Standard wheat shorts	10.35	0	6.2	85.1	8.7	6.2
22328	Wheat bran, shorts and screenings	8.82	48.2	15.8	31.2	4.8	64.0
25009	Wheat bran, shorts and screenings	11.54	22.8	16.4	45.6	15.6	39.4
22696	Mixed bran	13.07	45.8	21.4	47.5	3.3	67.2

Table 16 shows the crude fiber content and the siftings secured from a number of wheat by-products and arranged according to the names under which they were sold. These names are not always correct.

Table 17. Number of samples in the groups given.

On 14 Sieve. Per cent	0-1	1.1-3	3.1-5	5.1-10	10.1-20	20.1-30	30.1-40	40.1-50	50.1-60	Over 60			Total
Wheat white shorts and screenings	16												17
Wheat gray shorts and screenings	74	25	9	3	1								112
Wheat brown shorts and screenings	12	3	3	1	1		1						**21**
Wheat mixed feed and screenings		2		1	6	17	12	7	6				51
Wheat bran and screenings				1	2	10	6	20	12	9			60
On 20 Sieve. Per cent	0-5	5.1-10	10.1-15	15.1-20	20.1-30	Over 30.1							Total
Wheat white shorts and screenings	15	2											17
Wheat gray shorts and screenings	61	35	12	3	1								112
Wheat bran, shorts and screenings	10	3	4	3	1								21
Wheat mixed feed and screenings	4	6	32	7	2								51
Wheat bran and screenings		4	15	26	15								60
On 14 and 20 Combined. Per cent	0-5	5.1-10	10.1-20	20.1-30	30.1-40	40.1-50	50.1-60	60.1-70	70.1-80	Over 80			Total
Wheat white shorts and screenings	14	3											17
Wheat gray shorts and screenings	50	37	19	5	1								112
Wheat brown shorts and screenings	6	5	9				1						21
Wheat mixed feed and screenings		2	2	3	11	16	10	6	1				51
Wheat bran and screenings			1	2	3	7	11	16	13	7			60
On 48 Sieve. Per cent	0-10	10.1-20	20.1-30	30.1-40	40.1-50	50.1-60	60.1-70	70.1-80	Over 80.1				Total
Wheat white shorts and screenings	4	4	2	2	2	1	1	1					17
Wheat gray shorts and screenings	4	1	4	4	12	27	41	16	2				112
Wheat brown shorts and screenings				1	1	5	6	6	2				21
Wheat mixed feed and screenings			12	16	16	5	2						51
Wheat bran and screenings	5	7	22	11	11	10	3	2					60

Through. Per cent.	0–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	Over 90			Total
Wheat white shorts and screenings	.....	1	.....	2	1	1	2	2	5	3	.....	.....	17
Wheat gray shorts and screenings	1	13	39	30	10	8	2	4	1	3	.....	.....	112
Wheat brown shorts and screenings	2	5	8	3	3	.....	.....	.....	.....	.....	.....	.....	21
Wheat mixed feed and screenings	9	28	11	3	.....	.....	.....	.....	.....	.....	.....	.....	51
Wheat bran and screenings	51	7	1	1	.....	.....	.....	.....	.....	.....	.....	.....	60

On 48 and Through Combined. Per cent.	0–5	5.1–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	90.1–95	Over 95	Total
Wheat white shorts and screenings	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	14	17
Wheat gray shorts and screenings	.....	.....	.....	.....	.....	.....	.....	.....	6	20	25	61	112
Wheat brown shorts and screenings	.....	.....	.....	.....	.....	1	.....	.....	.....	9	4	7	21
Wheat mixed feed and screenings	.....	.....	.....	1	5	12	16	8	4	2	2	.....	51
Wheat bran and screenings	.....	3	5	10	19	13	5	3	1	1	.....	.....	60

Table 17 shows the number of samples arranged by groups, and is a survey of Table 16. For example, with wheat gray shorts, 74 samples contained less than 1 per cent. of siftings on the 14-mesh sieve, and 61 less than 5 per cent. on the 20-mesh sieve. Thirteen samples of wheat bran gave 70 to 88 per cent. siftings on the 14- and 20-mesh sieves combined.

Table 18. Percentage distribution of siftings of various feeds.

On 14 Mesh.	0–1	1.1–3	3.1–5	5.1–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	Over 60.1	
Wheat white shorts and screenings	94.11	5.88	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat gray shorts and screenings	66.07	22.32	8.04	2.68	.89	.....	.....	.....	.....	.....	.....
Wheat brown shorts and screenings	57.14	14.29	14.29	4.76	4.76	.....	4.76	.....	.....	.....	.....
Wheat mixed feed, shorts and screenings	.....	3.92	.....	1.96	11.77	33.34	23.53	13.73	11.77	.....	.....
Wheat bran and screenings	.....	.....	.....	1.67	3.33	16.67	10.00	33.34	20.00	15.00	.....

On 20 Mesh.	0–5	5.1–10	10.1–20	20.1–30	Over 30						
Wheat white shorts and screenings	88.23	11.76	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat gray shorts and screenings	54.47	31.25	10.71	2.68	.89	.....	.....	.....	.....	.....	.....
Wheat brown shorts and screenings	47.62	14.29	19.05	14.29	4.76	.....	.....	.....	.....	.....	.....
Wheat mixed feed and screenings	7.84	11.77	62.75	13.73	3.92	.....	.....	.....	.....	.....	.....
Wheat bran and screenings	.....	6.67	25.01	43.34	25.01	.....	.....	.....	.....	.....	.....

On 14 and 20 Mesh Combination.	0–5	5.1–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	Over 80.1	
Wheat white shorts and screenings	82.35	17.65	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat gray shorts and screenings	44.65	33.04	16.97	4.46	.89	.....	.....	.....	.....	.....	.....
Wheat brown shorts and screenings	28.57	23.81	42.86	.....	.....	.....	.....	.....	.....	.....	.....
Wheat mixed feed and screenings	.....	3.92	3.92	5.88	21.57	31.38	9.61	11.77	1.96	.....	.....
Wheat bran and screenings	.....	.....	1.67	3.33	5.00	11.67	18.34	26.67	21.67	11.67	.....

On 48 Mesh.	0–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	Over 80.1		
Wheat white shorts and screenings	23.53	23.53	11.77	11.77	11.77	5.88	5.88	5.88	.....	.....	.....
Wheat gray shorts and screenings	3.57	.89	3.57	3.57	10.71	24.11	36.61	14.29	1.79	.....	.....
Wheat brown shorts and screenings	.....	.....	.....	4.76	4.76	23.81	28.57	28.57	9.52	.....	.....
Wheat mixed feed and screenings	.....	.....	23.53	31.38	31.38	9.81	3.92	.....	.....	.....	.....
Wheat mixed bran and screenings	8.34	11.67	36.67	18.34	16.67	5.00	3.33	.....	.....	.....	.....

Table 18. Percentage distribution of siftings of various feeds—Continued.

Through.	0–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	Over 90.1	
Wheat white shorts and screenings	.....	5.88	.....	11.76	5.88	5.88	11.76	11.76	29.41	17.65	.....
Wheat gray shorts and screenings	.89	11.61	34.82	26.79	8.93	7.14	1.79	3.57	.89	2.68	.....
Wheat brown shorts and screenings	9.52	23.81	38.10	14.29	14.29	.....	.....	.....	.....	.....	.....
Wheat mixed feed and screenings	17.65	54.91	21.57	5.88	.....	.....	.....	.....	.....	.....	.....
Wheat bran and screenings	85.02	11.67	1.67	1.67	.....	.....	.....	.....	.....	.....	.....

On 48 and Through Combined.	5.1–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	90.1–95	Over 95.1
Wheat white shorts and screenings	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.65	82.35
Wheat gray shorts and screenings	.....	.....	.....	.....	.....	.....	.....	5.36	17.86	22.32	54.47
Wheat brown shorts and screenings	.....	.....	.....	.....	4.76	.....	.....	.....	42.85	19.05	33.34
Wheat mixed feed and screenings	.....	.....	1.96	9.80	23.53	31.38	15.69	7.84	3.92	3.92	.....
Wheat bran and screenings	5.00	8.34	1.67	31.67	21.67	8.34	5.00	1.67	1.67	.....	.....

Table 18 gives the percentage of each group. Wheat white shorts left less than 1 per cent. when sifted on a 14-mesh sieve in 94.1 per cent. of the samples. Wheat gray shorts left less than 1 per cent. on the 14-mesh sieve in 66 per cent. of the samples, and less than 3 per cent. in 88 per cent.

Table 19. Crude fiber in siftings and amount of siftings.

		Crude fiber, per cent					Siftings, per cent			
		Original	On 14	On 20	On 48	Thru 48	On 14	On 20	On 48	Thru 48
24929	Wheat gray shorts	3.12	10.91	10.65	6.72	1.07	3.2	1.9	20.2	75.4
24953	Wheat gray shorts	4.71	.....	6.85	4.94	1.20	0.8	5.4	67.4	25.9
25206	Wheat gray shorts	6.13	.....	.....	7.19	2.35	0	2.6	72.3	25.5
24940	Wheat gray shorts and screenings	6.24	8.82	8.24	7.08	1.20	4.7	13.7	61.1	20.4
25185	Wheat gray shorts	6.36	.....	10.25	8.09	3.07	.4	6.5	62.6	30.9
25261	Wheat gray shorts and screenings	6.63	.....	9.75	7.64	2.18	.8	12.2	64.9	22.2
24921	Wheat gray shorts and screenings	6.69	.....	9.90	7.85	2.22	.4	6.0	63.8	28.6
24905	Wheat shorts and screenings	7.31	9.94	9.57	7.19	3.59	5.2	16.5	61.5	16.5
24247	Mixed bran and screenings	7.35	10.25	9.75	7.48	3.65	41.0	10.2	32.2	16.3
25279	Wheat bran	7.43	8.89	8.70	7.45	1.53	20.6	19.8	55.2	4.0
25219	Wheat gray shorts	7.77	11.07	10.66	8.70	2.07	5.2	16.0	55.7	23.2
25272	Wheat gray shorts	7.98	.....	.....	8.57	6.61	0	1.6	65.6	33.3
25212	Wheat shorts and screenings	8.14	10.39	10.78	7.37	4.20	25.5	10.8	46.9	16.5
25244	Wheat bran and screenings	9.23	10.24	10.56	8.89	3.40	65.8	9.6	17.2	6.6
25042	Soft winter wheat mill run bran	10.90	11.62	12.74	11.10	6.65	52.0	16.4	25.6	6.0
24926	Wheat bran and screenings	11.39	10.80	10.50	9.92	7.96	40.7	16.6	34.1	8.0
25395	Wheat bran and screenings	11.42	12.08	10.89	11.38	6.99	41.9	19.3	35.1	4.5

Table 19 again shows the chemical composition of a number of siftings. All of the siftings which went through the 48-mesh sieve contain less than 4.5 per cent. fiber with the exception of one sample of wheat gray shorts originally containing 7.98 per cent. crude fiber, and three samples of wheat bran. The crude fiber content of the siftings on the 48-mesh sieve are less than 9 per cent. with the exception of wheat bran. The material on the 20-mesh sieve is in almost all cases high in fiber, and corresponds nearly to wheat bran in composition. This is likewise the case with the crude fiber in the siftings on the 14-mesh sieve.

An examination of the various tables here presented shows a considerable variation in the amount of the siftings from feeds of the same name, and also in their chemical composition, especially in the crude fiber. A study of the table shows that the sifting test would be of assistance in the examination of wheat products. It was shown by Bisbee at the meeting of the Association of Official Agricultural Chemists November, 1920, that sifting tests in combination with the determination of the crude fiber content could be used to distinguish between wheat middlings and ground wheat bran.

The sifting requirements described below are based upon the tables just presented. If a feed does not conform to these requirements in Texas, it should be considered as deficient, especially if the chemical analysis agrees with the sifting tests. If there is a disagreement between the chemical analysis and the sifting test, the chemical analysis

Table 20. Sifting tests for wheat by-products.

	Not more than		Not less than	
	On 14 mesh	On 14 and 20 mesh	On 48 mesh	Thru 48 mesh
Wheat white shorts, standard	1	5	.....	60
Conformity name, per cent	94.1	82.4	.....	70.5
Less than 3.5 per cent fiber, conformity	89.7	89.7	.....	72.3
Wheat gray shorts, standard	3	10	40	20
Conformity name, per cent	88.4	77.8	88.4	87.4
3.5–5.5 per cent fiber, per cent, conformity	85.3	83.2	87.5	87.5
Wheat brown shorts, standard	5	20	50	.....
Conformity name, per cent	85.7	100	90.5	.....
5.5–6.5 per cent fiber, per cent, conformity	76.8	78.8	82.5	.....
Wheat mixed feed, standard	40	60	20	10
Conformity name, per cent	75.5	86.3	100	82.3
6.5–8.5 per cent fiber, per cent conformity	66.7	93.5	100	84.7

should have the more weight, as the feeding value depends upon the chemical analysis which does not necessarily depend upon the fineness of material. It could not be expected that the siftings in all cases would coincide with these groups, for some of the feeds may be incorrectly named.

Table 20 shows the suggested sifting standards for wheat by-products. Wheat white shorts should as a rule contain less than 1 per cent. material on a 14-mesh sieve, and 94 per cent. of the samples examined conform to this requirement. There should be less than 5 per cent. on the 14-and 20-mesh sieve combined, and 82 per cent. of the samples conform to this requirement. Wheat white shorts should contain not less than 60 per cent. material which should pass through a 48-mesh sieve, and 70 per cent. of the samples examined conform to this requirement.

The wheat by-products were also arranged in groups according to the crude fiber content of the original feed, and the siftings tabulated. Table 21 shows the percentages of samples which fall into each of the groups named.

Table 21. Percentage of siftings in groups given.

	0–1	0.1–3	3.1–5	5.1–10	10.1–20	20.1–30	30.1—40	40.1–50	50.1–60	Over 60.1
On 14										
Less than 3.50 per cent crude fiber	89.65	6.90	3.45	.....	.....	.....	.....	.....	.....	.....
3.51–5.50 per cent crude fiber	66.66	18.75	6.25	4.17	2.08	2.08	.....	.....	.....	.....
5.51–6.50 per cent crude fiber	57.69	13.46	5.77	3.85	5.77	9.62	1.92	1.92	.....	.....
6.51–8.50 per cent crude fiber	24.36	15.38	10.26	3.85	8.97	14.10	10.26	6.41	6.41	.....
8.51–10.0 per cent crude fiber	1.62	1.62	1.62	.....	3.25	24.35	19.48	29.21	12.98	6.49
Over 10.1 per cent crude fiber	.....	4.55	.....	.....	.....	9.09	4.55	40.91	18.18	22.73

	0–5	5.1–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	Over 80.1
On 14 and 20 Combined Mesh Sieve.										
Less than 3.50 per cent crude fiber	89.65	10.34	.....	.....	.....	.....	.....	.....	.....	.....
3.51–5.50 per cent crude fiber	45.83	37.49	10.41	4.17	2.08	.....	.....	.....	.....	.....
5.51–6.50 per cent crude fiber	30.77	25.00	23.08	5.77	9.62	1.92	3.85	.....	.....	.....
6.51–8.50 per cent crude fiber	14.10	14.10	23.08	8.97	6.41	19.23	7.69	5.13	1.28	.....
8.51–10.0 per cent crude fiber	.....	3.25	.....	3.25	11.36	21.10	24.35	12.98	19.48	4.87
Over 10.1 per cent crude fiber	.....	4.55	.....	.....	9.09	.....	4.55	45.45	13.64	22.73

	0–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	90.1–100
Through										
Less than 3.50 per cent crude fiber	.....	3.45	3.45	6.90	3.45	10.34	13.79	17.24	20.69	20.69
3.51–5.50 per cent crude fiber	.....	12.50	14.58	35.41	18.75	12.50	.....	6.25	.....	.....
5.51–6.50 per cent crude fiber	1.92	23.08	46.15	25.00	3.85	.....	.....	.....	.....	.....
6.51–8.50 per cent crude fiber	15.38	35.90	35.90	10.26	2.56	.....	.....	.....	.....	.....
8.51–10.0 per cent crude fiber	58.43	40.58	1.62	.....	.....	.....	.....	.....	.....	.....
Over 10.1 per cent crude fiber	86.36	9.09	4.55	.....	.....	.....	.....	.....	.....	.....

	0–10	10.1–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	90.1–100
On 48										
Less than 3.50 per cent crude fiber	24.14	17.24	17.24	13.79	13.79	13.79	3.45	3.45	3.45	.....
3.51–5.50 per cent crude fiber	2.08	.....	6.25	4.17	25.00	27.08	25.00	8.33	2.08	.....
5.51–6.50 per cent crude fiber	.....	.....	3.85	7.69	5.77	25.00	36.54	17.31	3.85	.....
6.51–8.50 per cent crude fiber	.....	.....	11.54	12.82	12.82	16.67	29.49	16.67	.....	.....
8.51–10.0 per cent crude fiber	.....	12.98	22.72	24.35	30.84	3.25	4.87	.....	1.62	.....
Over 10.1 per cent crude fiber	18.18	4.55	40.91	18.18	13.64	18.18	.....	.....	.....	.....

BRAN IN RED DOG FLOUR.

Since the above was written, the second annual report of the Division of Feed Inspection, Minnesota State Dairy and Food Commission, has been received, in which Halverson makes a study of the milling of wheat, and presents some tests from a different point of view. He attempted to separate the bran material from the flour material by grinding, and sifting several times through an 80-mesh sieve, until no more floury or germ material passed through. He separated bran particles from red dog flour and middlings in a similar way, and proposes this method to ascertain the per cent. of bran particles in red dog flour, and uses it to ascertain which streams of by-products should not go into the red dog flour. He also proposes to use the ratio of protein to ash for the same purpose. "As long as the ash is equal to, or greater than the fiber, the product has a tolerable amount of bran in it. If the ash is less than the fiber it is advisable to separate, regrind, determine the exact amount of bran, and decide on the legality of the sample."

COMPOSITION OF SCREENINGS.

It is well known that the composition of screenings varies to a very great extent. The physical examination of a number of samples of screenings collected for the purpose of investigation is given in Table 22, and the chemical analysis in Table 23.

Table 22. Physical examinations of wheat screenings.

	Wheat whole or broken	Speltz and oats	Cob, straw, chaff	Cheat weed seed	Corn whole or chops	Millet or broken wheat	Corn or oats	Milo
6727	69.80	8.95	3.15	1.45	15.65	.....	.....	.....
6734	88.55	2.80	1.50	4.45	2.70	.....	.....	.....
6735	98.05	1.95	.....	.....	.....	.....	.....	.....
6736	63.05	.....	15.30	.....	20.20	1.45	.....	.....
6737	57.50	.....	14.45	5.25	.....	.....	.....	22.05
6746	95.75	1.30	1.90	1.05	.....	.....	.....	.....
6769	97.95	1.30	.50	.....	.....	.25	.....	.....
6902	64.35	24.30	5.45	5.90	.....	.....	.....	.....
6915	49.60	17.30	23.90	1.10	3.00	5.10	.....	.....
6917	80.15	1.30	11.95	.95	5.65	.....	.....	.....
6919	18.00	52.70	20.20	.....	9.10	.....	.....	.....
6930	99.75	.....	.25	.....	.....	.....	.....	.....
6932	99.60	.....	.20	.20	.....	.....	.....	.....
6935	97.65	.80	1.35	.20	.....	.....	.....	.....
6938	92.75	1.45	3.35	1.90	.55	.....	.....	.....
6940	81.20	14.95	3.70	.15	.....	.....	.....	.....
6951	91.60	3.90	3.85	.65	.....	.....	.....	.....
6995	86.65	10.45	2.75	.15	.....	.....	.....	.....
10783	71.65	18.90	8.35	1.00	.....	.....	.....	.....
10790	92.80	4.25	2.00	0.95	.....	.....	.....	.....
10791	90.50	7.65	1.20	0.65	.....	.....	.....	.....
10797	99.33	0.65	.....	.....	.....	.....	.....	.....
10805	97.80	1.10	1.10	.....	.....	.....	.....	.....
198	78.25	20.05	.....	1.70	.....	.....	.....	.....
10199	87.65	.....	8.20	3.15	.....	.....	.....	.....
10667	78.05	.....	.....	.....	.....	20.95	.....	1.00
10668	77.70	.....	1.15	23.15	.....	.....	.....	.....
10669	96.30	.....	.....	3.70	.....	.....	.....	.....
10670	85.35	2.45	4.60	7.60	.....	.....	.....	.....
10671	90.90	.....	.....	1.8	.....	.....	7.30	.....
10672	61.35	5.35	8.55	16.75	.....	.....	8.00	.....
10673	79.35	1.10	3.30	16.25	.....	.....	.....	.....
10674	74.85	.....	0.80	7.80	.....	.....	15.90	.65
10675	68.97	7.55	1.60	1.43	.....	.....	20.45	.....
10676	37.48	.....	7.35	52.22	.....	.....	2.40	.55
10677	94.65	.....	1.00	1.55	.....	.....	2.80	.....
10678	46.25	.....	.25	2.75	.....	.....	.....	50.75
10679	81.95	.....	.....	.40	.....	.....	17.65	.....
10680	91.70	.....	.....	2.60	3.40	.....	2.30	.....

The screenings are all from flour mills, and do not include any elevator screenings. The amount of whole and broken wheat in them varies from 18.15 per cent. to 99.70 per cent. The quantity of chaff and oats in them varies from 0 to 52.7 per cent. The amount of cob, straw, and chaff varies from 0 to 23.9. Weed seed varies from 0 to 52.22. One sample contained 22.05 per cent. milo.

On account of the great variation in the composition of screenings it is difficult to say what should be the average composition. A consideration of the table shows, however, that the screenings have feeding value, since they consist largely of wheat, corn, oats, or milo. The presence of whole weed seed is objectionable, and the screenings should be ground in order to destroy their germinating power.

The screenings here discussed are mostly from comparatively small mills, and have not been re-treated, as in the case with the screenings from some of the larger mills. They are also different from elevator screenings, probably containing less weed seed.

Table 23. Composition of wheat mill screenings, per cent.

	Protein	Fat	Crude fiber	Nitrogen free extract	Water	Ash
6917 Wheat screenings	16.43	2.06	6.11	61.95	8.57	4.88
6919 Wheat screenings	12.53	3.10	2.48	58.62	8.79	4.48
..... Wheat screenings	25.03	6.53	3.21	52.48	9.05	3.70
6932 Wheat screenings	16.25	1.52	3.46	67.44	9.46	1.87
6935 Wheat screenings	15.20	1.69	5.48	65.65	9.50	2.40
6940 Wheat screenings	16.70	2.16	6.74	60.71	10.97	2.72
6995 Wheat screenings	16.62	2.07	5.22	64.81	8.64	2.64
6727 Wheat screenings	14.50	2.16	6.09	58.60	10.72	7.93
6734 Wheat screenings	16.81	2.31	5.72	61.97	10.07	3.12
6735 Wheat screenings	16.78	1.66	3.44	65.92	10.14	2.06
6737 Wheat screenings	14.93	1.55	3.84	53.98	15.50	10.60
6902 Wheat screenings	14.97	2.04	7.07	63.87	8.81	3.24
10667 Wheat screenings	15.32	2.21	2.93	66.55	10.44	2.55
10668 Wheat screenings	12.41	2.33	4.48	68.29	9.62	2.87
10669 Wheat screenings	14.13	1.97	3.41	69.00	9.22	2.27
10670 Wheat screenings	16.96	3.86	5.47	62.84	7.77	3.09
10671 Wheat screenings	15.78	1.87	3.02	68.25	8.78	2.30
10672 Wheat screenings	13.18	2.35	5.94	65.00	10.13	3.40
10673 Wheat screenings	14.66	1.96	5.72	63.04	11.42	3.20
10674 Wheat screenings	13.71	2.36	4.43	67.46	9.27	2.77
10675 Wheat screenings	15.90	2.64	5.50	61.62	11.19	3.15
10676 Wheat screenings	12.54	1.81	6.54	65.49	10.10	3.51
10677 Wheat screenings	16.80	1.95	4.11	64.77	9.81	2.56
10678 Wheat screenings	11.58	2.30	3.01	69.23	9.25	4.63
10679 Wheat screenings	14.46	2.29	2.52	67.76	10.81	2.17
10680 Wheat screenings	16.49	1.92	4.28	65.14	9.57	2.60
10783 Wheat screenings	14.69	2.40	8.09	60.24	8.92	5.66
10790 Wheat screenings	15.24	2.00	5.54	63.76	10.29	3.17
10791 Wheat screenings	18.25	1.93	4.17	64.26	8.78	2.61
10796 Wheat screenings	15.54	2.05	4.40	66.96	8.42	2.63
10797 Wheat screenings	16.61	1.92	3.40	66.37	9.55	2.15
10805 Wheat screenings	18.79	2.07	3.25	63.20	10.25	2.44
10929 Wheat screenings	17.07	4.38	9.05	52.68	7.36	9.46
10198 Wheat screenings	17.94	2.38	4.24	65.12	8.29	2.03
10199 Wheat screenings	15.33	2.21	7.78	61.01	9.75	3.92
Average	15.67	2.32	5.32	63.43	9.64	3.62

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SUMMARY AND CONCLUSIONS.

This bulletin discusses the chemical composition and feeding value of wheat by-products. The definitions and standards adopted by the Texas Feed Control Service are given, together with standards proposed by the Association of Feed Control Officials of North America.

A standard of 9 per cent. fiber for wheat middlings would permit a large percentage of bran particles in this product, and be unjust to mills making a better product.

The composition, digestibility, and production coefficients of wheat by-products are given. Feeding tests made at other experiment stations are used to check the calculated productive values of some of the feeds.

Whole wheat alone had 84.7 per cent. of the calculated productive value of ground wheat, and whole wheat and tankage had 92.8 per cent. of the productive value of ground wheat and tankage calculated from feeding tests on hogs at the Missouri Station.

The calculated productive values of corn, wheat, and middlings agree well with the productive values calculated from feeding experiments with pigs at the Ohio Experiment Station.

The use of wheat by-products in feeding is discussed briefly.

Sifting tests are studied for the purpose of using them in detecting the adulteration or misbranding of wheat by-products. Suggested standards for sifting tests are given. Sifting tests must be considered in connection with the chemical analysis.

The composition of a number of samples of wheat screenings is given.