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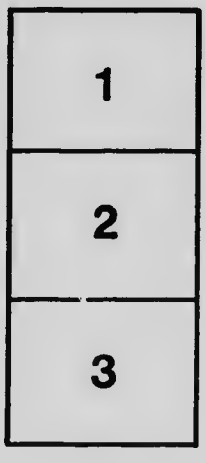

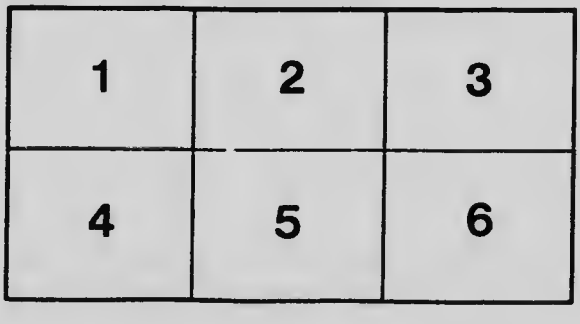

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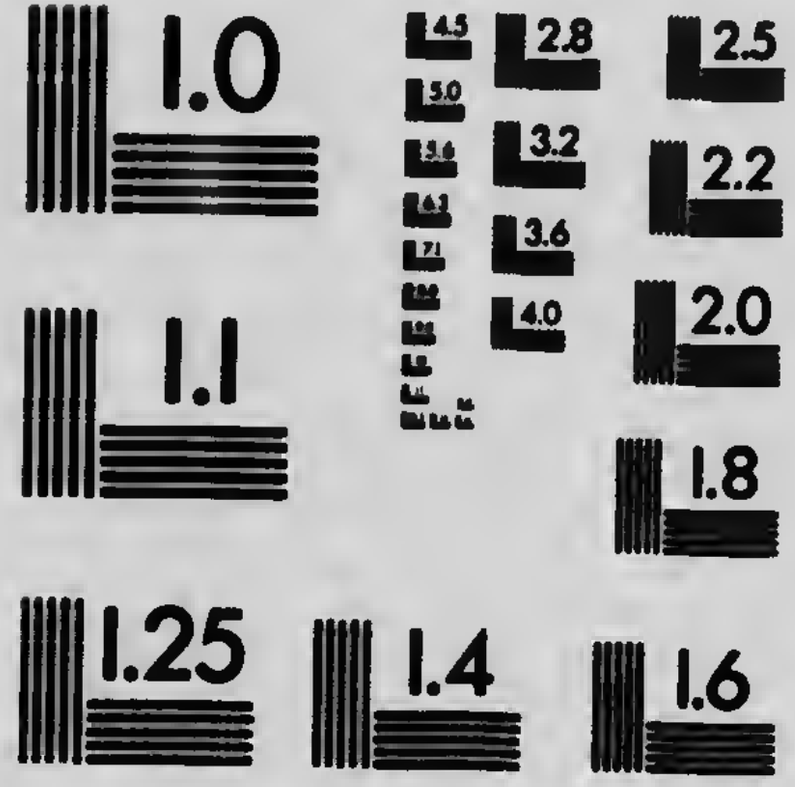

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BULLETIN 138

FEE
'05

Ontario Agricultural College and Experimental Farm

THE COMPOSITION OF ONTA IO FEEDING--STUFFS.

By W. P. GAMBLE, B.S.A., Lecturer in Chemistry.

The animal body is made up mainly of four classes of substances—water, ash or mineral matter, nitrogenous matter, and fat. The proportions in which these four classes of substances occur depend mainly upon the age of the animal, its treatment, and the purpose for which it is kept. The components of the body are continually breaking down and being consumed. To keep the animal in a healthy condition there must be a constant supply of new material. If this is lacking or insufficient, hunger and finally death result. To keep up this supply is one of the chief uses of food, but in addition to this, the food supplies the heat of the body, and at the same time furnishes energy, which enables the animal to move the muscles and do work external and internal. Furthermore, foods also supply immature animal with material wherewith to build up the tissues of the body.

It will, therefore, be seen that to supply food in the right proportion to meet the requirements of the animal, without a waste of food nutrients, constitutes scientific feeding, and it is by carefully studying the composition of feeding stuffs and the requirements of animals that a great deal of information may be obtained which will be of inestimable value to the practical agriculturist.

Realizing the importance of such a study the author of this bulletin wrote to all the proprietors of flour, oat, pea, and starch mills in the Province, requesting them to send us samples of their by-products. Besides the sample obtained in this way we collected a large number of similar by-products from other sources. These feeding-stuffs were carefully analysed, and the tabulated results will appear in their proper places.

Before we examine the results of our analyses, however, let us understand the meaning of the terms used by chemists to designate the various components of a fodder.

(1). Protein (nitrogenous material) is the name commonly given to a class of substances which furnish the materials for the building up of lean flesh, blood, skin, muscles, brain, nerve, hair, horn, wool, etc., and for these purposes protein is absolutely essential in the food of animals. The animal cannot grow, nor can it long exist without constantly renewed supplies of protein in its food. Moreover, the animal is totally unable to create protein. It is true that animals can produce blood protein, brain protein, flesh protein, and milk protein, but only by appropriating and transforming the protein of plants. Protein in some form is an essential constituent of all food.

(2). Fat (or ether extract) is the portion of the food which is dissolved from the water-free substance by ether, benzine, gasoline, etc. It is a very important component of feeding stuffs on account of its high value for the production of fat, energy, and heat.

(3). Crude fibre is a term applied to a group of substances that are of limited value to the feeder, because not only are they largely indigestible, but what is still more important, they often render the rest of the food less digestible by protecting it from the action of digestive fluids.

(4). Ash is the inorganic portion of feeding stuffs. Some of the foods richest in protein are also rich in ash material, and are, therefore, of high manurial value. The ash is also of great importance in the food of young and growing animals, as it furnishes the constituents from which the bone is built up.

(5). Soluble carbohydrates (or nitrogen-free-extract) is that portion of the food which is dissolved by boiling it with dilute acids and alkalies. It consists mainly of starches and sugars. When taken into the system nitrogen-free-extract forms fat or is oxidized to produce heat and energy.

(6). Moisture. However dry a feeding stuff may appear, it always contains a considerable amount of moisture which can be driven out by heat. A high water content in a concentrated feeding-stuff is a decided detriment: first, because it diminishes the percentage of actual food material, and, second, because it causes the food to mould or turn sour sooner than if less moisture were present.

In addition to the chemical analysis, the samples that we collected were subjected to careful microscopic examination, so far as time permitted. The chemical analysis alone gives valuable information as to the total quantities of important food materials contained in the feeding stuff. But as will be noticed in the following tables, certain by-products vary considerably in composition, according to the character of the season, methods of manufacture, etc., and unless they are decidedly abnormal in composition it is impossible to say with any certainty whether they have been adulterated or not. Since, however, foreign material can be readily seen under the microscope, the combined chemical and microscopic examination is almost certain to detect any adulteration. It is gratiying to know, on account of the importance and wide use made of these materials, that the quality of the samples in most cases examined has been found to be quite up to the average. The only adulterants we were able to detect were particles of flour, whole wheat screenings, and oat bran, which under the conditions of manufacture might be expected to be present.

The tables which we are about to examine show how great are the differences in composition between different kinds of feeding-stuffs. Take, for example, the percentage of protein in cotton seed meal and compare it with that in corn bran, or even with that of some of the oat

feeds. The cotton seed meal, as will be shown, is a very concentrated food, while the amount of protein in corn, bran, and such substances is very low. Protein is the most expensive component of a feeding stuff and as has been stated, a considerable amount of it is absolutely indispensible to growth.

Hay, ensilage, corn, and roots, raised on the farm form the basis, and make up the bulk of the food for live stock, and supply all the starch, sugars, and fat required. They are, however, deficient in digestible protein, and if the quantity of digestible protein in a food is too small the animals produce less beef or milk than they would with a proper supply of protein. Furthermore, when protein is deficient the other food components (starch, fat, etc.) of the ration are in excess of the animal's capacity for assimilating them, and are, therefore, to some extent wasted. These, in part, pass out of the body, incompletely digested, and, unlike protein, give little value to the manure. In purchasing by-products or commercial feeds to supplement farm-grown crops, the keepers of live stock should bear in mind that the value of the food depends to a large extent on the quantity of digestible protein which it contains.

The tables referred to will aid in the selection of food of highest nutritive value. It must be remembered, however, that the tables give the total amounts of nutrients found by chemical analysis in the different feeding-stuffs, while only that portion of the food which is digested is of direct use to the animal.

The processes of digestion in the case of ruminant animals are carried on somewhat as follows: The food is taken into the mouth, where it is masticated and mixed with saliva, a secretion of the glands of the mouth. The saliva acts feebly upon the starch of the food converting portions of it to sugar. The masticated food then passes through the gullet to the stomach, where it is subjected to the action of the gastric juice. From the stomach the undigested food passes through the pyloric orifice into the intestines, where it is further acted upon by the pancreatic secretion, and portions of the starch, protein, and other components of the food are dissolved or emulsified. The dissolved nutrients are absorbed from the alimentary canal, and, in the form of chyle, pass into the blood, and finally serve to nourish and sustain the body. This portion is said to be digested and assimilated, and from it alone the animal is nourished.

The digestibility of different foods, however, varies markedly; and, moreover, the digestibility of the same food varies under different conditions. But under average conditions the digestibilty of the commoner foods has been roughly determined, and the practical feeder must make a study of such data before the figures giving the composition of different foods can be of much use to him. He should also investigate the whole question of digestibility in an independent manner, so as to be prepared to judge wisely in any given case.

We give the results of our analysis, with brief comment thereon :

FOODS ANALYZED.	Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Ash.	Soluble Carbohydrates.
Pea Meal.						
1. Pea meal from solid peas—	27.13	6.17	2.11	7.21	2.67	54.71
2. Dried pea meal obtained from splitting process..	26.87	8.69	2.45	3.21	2.20	56.58
3. Pea meal—W. Thompson'.	16.97	9.95	1.24	6.86	2.61	62.37
4. Crushed peas—Thorp....	27.12	10.23	2.01	7.23	3.70	49.71
5.—Pea meal—Tillson	22.50	11.5	1.53	6.82	2.33	55.25
6. Pea meal, 1902.....	20.29	12.64	2.71	8.43	3.01	52.92
7. Pea meal, 1903.....	25.16	14.79	1.93	6.51	2.87	51.74
8. Pea meal, 1903.....	20.11	11.65	1.21	10.09	3.26	53.68
Average	23.27	10.34	1.90	7.04	2.83	54.62
Pea Hulls or Pea Bran.						
1. Pea hulls.....	7.12	8.12	0.83	56.52	2.23	25.18
2. Tillson's pea bran.....	9.56	7.09	2.99	49.10	2.88	27.87
3. Thompson's pea bran.....	12.00	7.93	0.55	51.35	2.88	22.29
4. Ground pea bran—J Wilson	15.66	7.35	3.54	25.25	3.08	45.12
5. Pea bran—Tillson & Co. ..	8.12	5.96	2.37	47.32	2.78	33.45
6. Pea bran—Murton.....	9.06	8.23	2.52	44.79	3.27	32.13
7. Pea bran, 1902.....	9.57	7.24	1.42	30.53	3.26	38.98
8. Pea bran, 1902....	10.21	6.53	0.46	24.27	3.59	54.94
9. Pea bran, 1902:	9.08	5.41	0.30	52.63	2.98	29.60
10. Pea bran, 1903.....	7.49	9.75	0.33	54.24	2.60	25.59
11. Pea bran, 1903....:	8.35	6.23	0.37	48.33	2.55	34.17
12. Pea bran, 1903.....	11.42	8.57	0.60	31.69	3.05	44.67
13. Pea bran, 1903.....	12.90	8.72	2.43	18.93	2.87	54.15
Average.....	10.04	7.51	1.44	42.07	2.92	36.01
Mixed Chop.						
1. Rye 1-5 Oats—R. Harvey.	12.71	13.48	5.95	4.44	5.39	58.03
2. Wheat ½ Oats—R. Harvey.	13.53	10.11	5.26	9.92	6.59	54.59
3. Rye, Oats, Wheat—Equal parts—R. Harvey.....	13.41	11.52	5.39	7.29	6.71	55.68
4. Oats, Wheat, Barley and Buckwheat—R. Harvey...	1[illegible]	13.15	3.55	10.24	6.39	52.88
5. Grain Meal (Peas and Oats.)	:	9.53	4.32	14.21	3.59	47.69
6. Mixed Chop (March 26,'03)	9.37	9.95	2.97	5.65	1.48	70.58
7. Farmel	9.75	8.50	4.10	9.98	3.35	64.32
8. Oats and Corn	8.50	12.56	2.95	18.71	2.01	55.27
9. Oat Chop, 1902.....	9.87	10.36	4.75	9.73	3.54	61.75
10. Oat Chop, 1902.....	10.24	9.27	5.32	8.72	3.27	63.13
11. Oat Chop, 1902.....	8.37	11.01	5.62	9.54	2.99	62.47
12. Oat Chop, 1902	14.79	10.39	4.96	10.36	3.21	56.29
13. Oat Chop, 1902.....	11.01	8.65	8.84	9.75	2.25	64.50
14. Oat Chop, 1903.....	12.87	13.42	5.30	9.31	2.64	56.46
15. Oat Chop, 1903.....	9.36	12.96	5.24	9.50	2.37	60.57
16. Peas and Oats, 1903.....	14.37	12.27	5.42	12.67	3.79	51.48
17. Peas and Oats, 1903.....	15.29	10.85	4.26	12.12	2.98	54.50
18. Peas and Oats, 1903.....	11.98	1[illegible]16	4.79	14.98	4.62	50.47
19. Peas and Oats, 1903.....	20.25	10.21	3.81	11.58	3.75	50.40
20. Peas, Oats, and Wheat, 1903	16.75	11.72	[illegible]79	12.25	6.61	47.88
21. Peas, Oats, and Wheat, 1903	12.60	13.69	.25	20.16	5.83	43.47
Average.....	12.81	11.27	4.61	11.00	3.96	56.35

Pea Meal.

A glance at the foregoing table shows a variation of from 16.97 to 27.13 per cent. of protein. The average percentage of protein in the eight samples is 23.27, which is practically 3 per cent. above the average of four samples recorded by American authorities. The samples of pea meal forwarded by Mr. Thompson, of London, contained a very considerable amount of hulls. To this cause alone we attribute the low protein content of this sample. It is nevertheless possible that the fact that peas were badly damaged by the weevil may have had something to do with the low percentage of protein.

If we are to select food, taking protein as the standard, pea meal would stand very high on our list of concentrated feeding-stuffs. As peas are grown to a limited extent on many farms in our Province, such meal could scarcely be called a commercial feeding-stuff; nevertheless, we have included pea meal under this general heading, because there are certain sections in Ontario where peas are not grown to any extent, and in such localities feeders are dependent upon manufacturers or dealers for their supply of pea meal.

As will be seen in the above table of composition, pea meal would make an excellent food to supplement some of our home grown fodder. Besides showing a very high protein content, pea meal also contains a fair percentage of fat and soluble carbohydrates. The relative percentage of crude fibre is moderately low. Moreover, from digestion experiments carried on by this Station, we are led to believe that the crude fibre of pea meal is digested to a far greater extent than is the crude fibre of some of the by-products which will be noted later on.

Pea Bran or Hulls.

Thirteen samples of pea bran were analysed. With the exception of one sample, obtained from J. Wilson, the protein content varied from seven to thirteen per cent. The high protein content of Mr. Wilson's sample was, no doubt, due to the fact that it contained quantities of fine pea meal or dust. Such a sample of pea bran would make a very excellent supplement to our coarse cattle foods. The percentage of crude fibre in most cases is very high. I may state, however, that we fed three sheep for a period of one month on pea hulls alone. At the end of the experiment the sheep were weighed, and it was found that they weighed exactly the same as at the beginning of the feeding period. The digestibility of the different constituents of the pea hulls was at the same time tested, and the results obtained go to show that the digestion co-efficient of the crude fibre of the pea bran was 69; i. e., for every hundred pounds of crude fibre fed 69 pounds were digested. From these facts we are led to believe that the feeding value of pea bran is greater than the low protein content would indicate. It must not be gathered from this that we would recommend this food in preference to those richer in protein.

On the contrary, farmers and dairymen should always aim at securing a fair quantity of protein in any food which is meant to supplement a ration of corn fodder, hay, ensilage, or other home grown feeds. Pea bran, however, is not entirely useless, and might, under certain conditions, serve as a useful component in a maintenance diet.

Mixed Chop.

In the twenty-one samples of chop analysed the percentage of protein was found to vary between 8.37 and 20.66. The average protein content of these samples was 12.81 per cent. A glance at the table will show that what is ordinarily called chop may be a mixture of various grains grown on the farm. The mixture of oats and corn shows a low protein content when compared, for example, with peas and oats. The practical conclusion to be drawn from this fact is that the feeder should, other conditions being equal, select the richer of the two to supplement a ration made up largely of hay, ensilage, and roots, more especially if this ration be intended for dairy cows.

The above table of composition shows that chop is valuable food; and where the average farmer has an abundance of such food at his disposal it would be folly for him to purchase many of the by-products at present sold without any guarantee as to their composition. Furthermore, experiments conducted by Professor Day on fattening steers appear to indicate that a ration containing a rather wide nutritive ratio will give more economical gains than one possessing a relative narrow nutritive ratio. For fattening purposes, therefore, we believe that chop, such as mentioned in the foregoing table, would supply all the nitrogenous material necessary. If, however, the production of milk were the object, then it might be advisable to select a food containing a greater quantity of protein.

Wheat Middlings.

Upon inspecting the analyses of the samples of middlings, recorded in this Bulletin, the reader will be struck by the uniformly low percentage of moisture. The average percentage of moisture recorded by American chemists is approximately two per cent. higher than that found in the twenty-one samples analyzed in our laboratory. I may state that as soon as these samples arrived in our laboratory they were at once placed in bottles with ground glass stoppers to prevent any evaporation of moisture, and in every case extreme care was exercised in determining accurately the moisture content of the samples. The fact that any sample of food contains a low per centage of moisture is of great importance to the feeder, inasmuch as, other things being equal, he obtains a larger amount of nutritive material in a food containing a low percentage of moisture than he would if the moisture content were even one per cent. higher.

FOODS ANALYZED	Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Ash.	Soluble Carbo-hydrates.
Wheat Middlings.						
1. Thorp's Mid[illegible]	15.75	8.70	3.99	4.91	3.[illegible]	63.07
2. Middlings—[illegible]	15.94	9.12	4.40	3.96	3.92	62.66
3. Middlings—Goldie [illegible], Ayr	16.26	10.28	3.26	[illegible] 70	3.65	62.85
4. Middlings—Frontenac Co	17.66	8.29	4.10	3.91	4.25	61.79
5. Middlings	15.43	10.53	3.03	4.48	4.12	62.41
6. Middlings	13.79	9.70	2.71	4.28	3.86	65.66
7. Middlings	16.45	9.42	4.89	2.93	3.79	62.52
8. Middlings	16.62	10.52	4.25	3.25	3.85	61.51
9. Middlings	16.65	10.75	3.99	5.40	4.20	59.01
10. Middlings	15.46	11.21	3.65	2.72	4.00	62.96
11. Middlings	16.32	9.69	4.60	3.99	3.47	61.93
12. Middlings	12.73	9.73	2.99	8.62	3.61	62.32
13. Middlings	12.97	11.75	3.62	8.50	3.20	59.96
14. Middlings	13.47	10.62	3.75	3.78	3.12	65.26
15. Middlings	15.65	10.40	3.00	3.21	3.05	64.69
16. Middlings	17.10	8.62	4.11	2.50	4.04	63.63
17. Middlings	15.32	9.77	4.00	5.42	3.79	61.70
18. Middlings	17.25	10.02	3.65	5.00	4.21	59.87
19. Middlings	14.33	11.51	3.97	2.92	3.50	63.77
20. Middlings	17.12	12.05	5.52	2.45	3.20	59.66
21. Middlings	14.80	9.35	4.69	3.29	3.60	64.27
Average	15.54	10.10	3.92	4.26	3.72	62.46
Wheat Bran.						
1. Bran, T. E. Simpson—Merlin	15.00	7.86	4.20	8.58	6.29	58.07
2. Bran, Goldie Milling Co. Ayr	13.75	11.11	3.70	7.36	2.90	61.17
3. Bran from Fall Wheat	14.56	9.19	3.20	10.59	6.05	56.41
4. Bran from Manitoba Wheat	13.50	12.23	4.50	7.04	5.62	57.11
5. Bran, Frontenac Milling Co.	17.53	11.71	3.11	8.41	5.09	54.15
6. Wheat bran—Guelph	14.87	8.55	3.62	9.54	6.31	57.11
7. Wheat bran—Tillson & Co.	16.87	11.00	3.62	9.54	6.31	52.66
8. Bran—Meyer's Milling Co.	15.25	12.24	4.43	9.21	5.20	53.67
9. Bran	14.21	9.75	3.10	7.20	5.40	60.34
10. Bran	14.30	10.43	3.91	9.96	2.20	59.20
Average	14.99	10.40	3.74	8.74	5.14	56.99
Low Grade Flour.						
Low grade flour—T. E. Simpson	12.99	8.71	2.25	0.29	1.51	74.25
Flour—T. E. Simpson, Merlin.	9.85	13.37	4.85	0.49	1.93	61.51
Low grade flour—R. Harvey	13.00	10.97	3.65	0.53	2.21	69.64
Average	11.94	11.02	3.58	0.44	1.88	71.13
Thorp's crushed wheat	13.73	7.92	2.59	3.[illegible]	1.62	70.82
Shorts.						
1. Shorts—R. Harvey	15.60	8.59	3.99	3.32	3.91	64.59
2. Shorts—Pembroke Mill Co.	16.16	9.37	4.55	5.93	5.08	58.91
3. Shorts—T. E. Simpson	16.25	11.37	5.02	5.51	4.52	57.33
4. Shorts—Frontenac Mill Co.	16.06	8.21	4.26	3.31	3.95	64.21
Average	16.01	9.38	4.46	4.52	4.37	61.26

A few samples analysed showed an abnormally high percentage of crude fibre. A microscopic examination of these samples revealed the presence of considerable quantities of wheat bran. I may say that these samples were obtained on the market so that their source could not be traced. Samples Nos. 12 and 13 indicate almost as much crude fibre as is found in pure wheat bran, which rarely runs over ten per cent. In samples of pure wheat middlings, the percentage of crude fibre usually varies between 2.50 and 6 per cent. We are glad to say, on account of the widespread use of wheat middlings, that the samples examined were entirely free from corn bran or other adulterants of like character.

Wheat Bran.

In the above table the percentage composition of ten samples of wheat bran shows a variation of from 13.50 to 17.53 per cent. of protein, and from 3.10 to 4.50 per cent. of fat. It will be noticed that some of the samples of bran analysed were obtained from fall wheat, others from Manitoba spring wheat, and still others are not designated. Every sample of bran was of good quality, and contained no adulterants which could be detected other than a few particles of broken wheat.

Wheat bran is probably one of our best known by-products. It contains protein, fat, ash, and soluble carbohydrates in such proportion as to make it an exceedingly valuable component of a dairy ration. Only two samples of the ten analysed showed less than 14 per cent. of protein. If the percentage of protein falls much below 14 per cent., the chances are that the bran has been mixed with something of inferior quality. In the mentioned case, however, no adulterant could be detected.

Low Grade Flour.

Three samples of low grade flour were analysed. These show an average of 11.94 per cent. of protein, as well as 3.58 per cent. of fats, and 71.13 per cent. of soluble carbohydrates. For some reason the quantity of protein in sample No. 2 falls considerably below the average. It will be noticed that the percentage of moisture is much higher than in samples 1 and 3. As stated in the introduction, a high moisture content in a feeding-stuff is a decided detriment, in that it not only decreases the actual amount of food components present, but it also favors the growth of moulds, and these hasten the decomposition of valuable food materials.

The results of experiments at some of the American Stations furnish evidence that the amount of soluble carbohydrates and fat is very greatly reduced by the action of moulds. In the case of bread as much as 75 per cent. of the dry matter was lost. This loss was noted chiefly in the carbohydrates. In other experiments with peanut cake the fat content

was reduced by mould from 12 to less than 1 per cent. While the writer does not mean to state that the percentage of moisture noticed in sample No. 2 is sufficient to cause such serious loss as that just mentioned, yet the amount of moisture is sufficient to warrant a note of warning on this point. It might also be added that is some cases farmers sustain very serious losses in valuable food materials through improper attention to the ground chop and corn meal. In all cases where the new grains are ground, especially if the grains be soft, the chop should be spread out in some convenient bin or floor in order that the excess of miosture may have a chance to evaporate. In this way the loss resulting from the development of moulds or bacteria may be eliminated or checked to a great extent.

The samples of flour designated as "low grade," although not suitable for bread-making purposes, could be advantageously and economically used as food for pigs. It must be remembered, however, that flour is a very heavy food, and unless it is fed along with some other feeding-stuff of a lighter character, there is danger that the digestive apparatus of the pig may become clogged. Because of this danger, greater care must be observed in feeding pigs on a ration of milk and flour than in feeding milk and middlings, as the latter food contains quantities of bran, which lighten a food very effectively.

Only one sample of crushed wheat was examined. This sample is of very good quality, and would make an excellent substitute for shorts in a ration for young pigs.

Shorts.

The figures in the above table show an average of 16.01 per cent. of protein, 4.46 per cent. of fat, and 61.26 per cent. of soluble carbohydrates This by-product possesses very high feeding value. It might be used to advantage in supplementing a ration low in protein, provided the animals could be induced to eat it readily. For young pigs, or breeding sows this by-product makes an excellent feed. The young pigs eat it readily and thrive admirably on a ration of shorts and skim milk. In the estimation of many practical feeders this is one of our most valuable by-products, although not equal to low grade flour for fattening hogs.

Beeswing.

This by-product is the outside layer of the wheat hull, and is, therefore, a special form of bran. This bran is removed from the wheat (which has been previously moistened with cold water), by the action of a cylinder running at a high rate of speed against an outside case. In this process the kernel of the wheat remains unbroken.

A glance at the analysis is sufficient to show us that this by-product contains a larger amount of crude fibre than does our average bran.

Again, we note that the average amount of protein in ordinary bran is approximately fifteen per cent., while in the by-product under discussion the protein content drops to less than ten per cent., which is slightly above the minimum allowable percentage of protein in any feed. The least quantity of protein that any food should contain is 7 per cent. That is to say, it is doubtful if any feed with less than 7 per cent. of protein is a wise purchase unless under exceptional circumstances. Even average cob meal contains nearly 8 per cent. protein. Experiments have shown that, as a rule, when the quantity of protein present in a feed falls below 7 per cent, its place is taken by crude fibre, consequently the purchaser does not receive any greater amount, if as much, of the more digestible forms of carbohydrates than if the protein were furnished. The by-product at present under discussion proves to be quite a marked exception to the general rule. In a series of digestion experiments which we have conducted with this food, we have found that not only is there a very high percentage of digestible soluble carbohydrates present, but the crude fibre also possesses a high digestion co-efficient. It must also be remembered in this connection that in the samples of Beeswing examined we found more than 7 per cent. of protein.

Cotton Seed Meal.

This by-product in the manufacture of cottonseed oil contained in the following manner : The hull of the cottonseed is removed, the kernel is then cooked and subjected to pressure to remove the oil. The residue (cotton seed cakes) is then pulverized.

The five samples examined were fairly constant in composition. Cottonseed meal is rich in protein, and contains also a high percentage of ether extract or fat.

This by-product must be used with caution, as calves and pigs have been killed by continued use of this food. In the case of milch cows a few pounds per day may be fed, but many owners of live stock regard it as very dangerous food to place at the disposal of the ordinary hired man, because carelessness in regard to the number of pounds of this by-product fed will very quickly result in serious derangement of the digestive organs of the animals. Furthermore, in a ration for young pigs it has been frequently noticed that if cottonseed meal be used to balance a ration of these animals, the animals are apparently poisoned thereby. For the average feeder, therefore, the advice would be to leave cottonseed meal out of a ration intended for these animals.

Cotton Seed Hulls.

Four samples of cotton seed hulls were analyzed. As will be noticed, the percentage of protein is very low. Average percentage 4.45. The percentage of crude fibre is very high. This by-product is not recommended as a cattle food, as it contains a very low percentage of protein

FOODS ANALYZED	Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Soluble Carbo-hydrates.	Ash.
Beeswing.						
1. Beeswing—P. McIntosh ...	9.36	7.21	0.47	19.56	2.01	61.39
2. Beeswing, 1903	2.23	7.42	0.39	18.76	2.12	61.08
3. Beeswing, 1903.....	9.20	6.17	0.38	16.25	2.73	65.27
Average	9.60	6.93	0.41	18.19	2.29	62.58
Ground Cotton Seed Meal.						
1. Cotton Seed Meal	44.61	2.68	14.49	6.14	7.00	25.08
2. Cotton Seed Meal	44.17	7.42	14.31	3.35	6.90	23.83
3. Cotton Seed Meal	43.65	8.65	13.98	5.70	7.10	20.92
4. Cotton Seed Meal	44.10	4.43	14.69	5.63	7.31	26.84
5. Cotton Seed Meal	44.37	6.51	10.75	3.05	6.23	25.09
Average	44.18	5.94	13.65	4.78	6.91	24.54
Cotton Seed Hulls.						
1. Cotton seed hulls.....	5.14	9.51	1.37	49.32	2.21	32.45
2. Cotton seed hulls.....	3.98	10.21	1.16	45.17	1.89	37.59
3. Cotton seed hulls.....	4.98	9.58	1.31	46.37	2.34	35.42
4. Cotton seed hulls.....	3.72	9.63	1.39	45.53	2.19	37.54
Average.....	4.45	9.73	1.31	46.60	2.16	35.75
Linseed Meal.						
1. Oil Cake—G. Oil Cake Co.	32.81	9.45	7.42	10.96	6.10	33.26
2. Linseed Meal.....	31.37	9.17	7.26	11.33	6 47	34.40
3. Oil Cake—Sample A.....	31.37	9.17	7.26	11.33	5.49	35 38
4. Oil Cake—Sample B.....	33.94	10.38	7.33	11.57	6.28	30.50
5. Flax Seed Meal—W. Hewer.	23.87	4.90	11.76	6.10	5.41	47.96
6. Linseed Meal.....	32.65	9.90	7.55	12 26	5.83	31.81
7. Oil Cake (1903).....	32.60	8.43	8.20	10.93	5.97	33.87
8. Oil Cake (1903).....	31.51	9.90	7.42	11.60	6.25	33.32
9. Oil Cake (1903).....	31.96	10.47	7.12	11.20	6.46	32.79
10. Linseed Meal.....	30.27	8.93	3.61	8.93	4.73	43.53
11. Linseed Meal.....	27.31	10.15	8.23	10.62	5.62	38.07
12. Linseed Meal.....	26.54	7.64	4.32	12.17	6.01	43.32
13. Linseed Meal.....	29.12	9.21	4.46	9.39	5.93	41.89
Average.....	30.41	9.06	7.07	10.64	5.89	36.93
Gluten Meal.						
1. Maize Gluten—Wilson....	15.00	6.51	3.73	6.65	1.80	66.31
2. Gluten Meal.....	24.36	2.24	7.97	5.13	0.77	59.53
3. Gluten Meal.....	31.50	9.43	8.73	1.27	0.68	49.39
4. Gluten Meal.....	28.65	8.79	6.84	1.43	0.84	53.45
5. Gluten Meal.....	16.23	6.31	7.02	5.64	0.39	64.41
6. Gluten Cake	19.27	10.82	5.21	5.93	0.64	58.13
7. Gluten Cake.....	22.37	4.73	9.23	4.72	1.58	57.37
8. Gluten Meal.....	29.65	7.61	6.27	3.65	0.89	51.93

FOODS ANALYZED.	Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Ash.	Soluble Carbo-hydrates.
Gluten Meal.						
9. Gluten Meal	30.90	5.12	10.22	5.81	0.92	47.03
10. Gluten Meal	27.35	5.43	15.00	1.29	1.25	49.68
11. Gluten Meal	21.73	9.64	8.83	4.31	0.68	54.81
12. Gluten Meal	18.59	8.23	7.21	6.27	0.75	58.95
13. Gluten Meal	17.65	5.61	7.42	6.15	0.83	62.34
14. Gluten Meal	34.74	6.91	5.71	2.00	0.37	50.27
15. Gluten Meal	19.57	7.54	8.31	1.82	0.57	62.19
16. Gluten Meal	25.44	8.25	14.68	4.61	0.62	46.30
17. Gluten Meal	25.86	4.64	10.21	1.52	0.92	56.85
18. Gluten Meal	19.73	9.10	10.62	5.98	1.15	53.42
19. Gluten Meal	27.34	8.85	9.21	1.05	0.68	52.87
20. Gluten Meal	29.63	8.06	8.25	2.25	0.72	51.09
21. Gluten Meal	28.70	5.92	10.12	2.93	0.50	51.83
22. Gluten Meal	34.90	6.87	6.91	1.07	0.74	49.51
Average	24.96	7.12	8.54	3.70	0.83	54.85
Gluten Feed.						
1. Gluten Feed	27.73	11.59	3.06	6.97	0.21	50.44
2. Gluten Feed	27.51	6.33	8.91	8.25	1.19	47.81
3. Gluten Feed	24.87	11.50	7.23	4.49	0.26	51.65
4. Gluten Feed	23.75	9.42	6.44	6.82	1.63	51.94
5. Gluten Feed	25.75	5.45	6.13	5.73	0.85	56.09
6. Gluten Feed	28.34	9.55	4.21	6.15	0.89	50.86
7. Gluten Feed	26.43	10.15	8.23	7.36	0.42	47.41
8. Gluten Feed	26.21	5.42	7.52	5.75	0.87	54.23
9. Gluten Feed	22.98	8.63	6.82	6.50	0.93	54.14
10. Gluten Feed	27.37	10.45	12.18	3.92	0.56	45.52
11. Gluten Feed	23.58	8.43	8.40	5.17	0.72	53.70
12. Gluten Feed	26.79	9.27	9.61	3.99	0.64	49.70
13. Gluten Feed	23.21	6.23	9.82	4.25	1.14	54.85
14. Gluten Feed	25.92	9.47	12.65	5.42	0.62	45.92
15. Gluten Feed	24.61	6.42	7.73	6.49	0.43	54.32
16. Gluten Feed	26.81	8.62	5.23	6.83	0.92	51.59
17. Gluten Feed	24.32	8.94	3.66	6.62	1.61	54.85
Average	25.65	8.61	7.52	5.92	0.82	51.47
Corn Chop.						
1. Corn Chop—T. E. Simpson.	11.07	8.79	4.76	3.10	1.18	71.10
2. Thorp's Crushed Corn	11.28	10.66	4.34	2.08	1.39	70.25
3. Corn Chop, 1902	9.58	11.32	4.37	2.35	1.73	70.65
4. Corn Meal, 1902	10.32	12.16	5.16	1.25	1.24	69.87
5. Corn Meal, 1902	8.61	10.34	5.03	1.37	1.00	73.65
6. Corn Meal, 1902	9.28	9.31	3.25	2.18	1.20	74.78
7. Corn Meal, 1902	9.54	4.20	3.21	2.60	0.98	79.47
8. Corn Meal, 1903	6.54	11.71	4.71	1.85	1.98	73.21
9. Corn Meal, 1903	7.32	11.15	4.44	1.46	1.76	73.87
10. Corn Meal, 1903	10.05	8.43	5.45	1.11	1.54	73.42
Average	9.36	9.80	4.47	1.93	1.40	73.04

and fat. Moreover, the crude fibre is not only largely indigestible, so that the digestive juices of the animal do not extract much nutriment from it, but, what is still more important, crude fibre renders the rest of the food less digestible by protecting it from the action of the digestive fluids. This by-product is, therefore, practically worthless, and to the average farmer it would be dear at any price. For, not only is the quantity of protein extremely small, but by far the larger percentage of carbohydrates exists in a very indigestible form. To move these indigestible ingredients from one part of the alimentary canal to another necessitates the expenditure of energy. Thus we see that energy derived from a digestible portion of a ration may be used up in eliminating the indigestible portions from the system. Materials such as cotton seed hulls which contain large quantities of crude fibre in a highly indigestible form are, therefore, a decided detriment to a ration.

Linseed Meal.

This product is the residue left after extracting the oil from flaxseed with naphtha, benzine, or a similar solvent of oily matter. In the extraction of linseed oil by the old process the flaxseed was subjected to pressure. The new process admits of more perfect removal of the oil from the seed; therefore, linseed meal obtained from the "new process," as a rule, contains more protein and less fat than the "old process" meal.

The thirteen samples of linseed meal examined are all of "new process" manufacture. The table of composition shows an average of 30.41 per cent. of protein in the thirteen samples examined. Linseed meal is therefore, a highly concentrated food, and may be used in moderate quantities to correct the deficiency of protein in some of our home-grown feeding-stuffs. As this meal also contains a high percentage of crude fat, it may have a beneficial mechanical effect in rendering the passage of the other components of a ration through the alimentary canal less difficult.

Linseed meal has been advocated as a component of a ration for milch cows, and many of our most intelligent dairymen have fed it with good success. It is also claimed that a small quantity of linseed meal fed in a ration to horses will give these animals a glossy coat, which is an indication of a thrifty condition.

There are two kinds of linseed cake or meal, the one containing the hulls of the seed and the other the decorticated meal. The analysis in the foregoing table represents the composition of thirteen samples of the latter food. As a component of a ration for all kinds of animals, it is one which in the experience of a great number of practical feeders has given good results. Some feeders object to the use of this food, because when mixed with water it has a sticky consistency. This, however, should not be a serious objection if the results obtained from the use of this food indicate greater value than those obtained from the use of other by-products.

Gluten Meal.

Gluten meal is the residue, or part of the residue, from the manufacture of starch and glucose. The process of manufacture consists essentially in the separation, first, of the germ and hull from the starch and gluten; and second the final separation of gluten from the starch. The residue may, therefore, consist either of three products, a mixture of gluten, germ, and hulls, a mixture of any two of these components, or any single component. In any case, however, the by-products are parts of the original corn, but when prepared for the market they differ from it and from each other in the amount of food constituents, and also in appearance.

The entire residue called "gluten feed" is of a bright yellow color: and is of a much more bulky character than corn meal. The increased bulk is due to the presence of a larger proportion of bran in the gluten feed. Gluten by itself is distinguished by a high content of protein and a deeper yellow color. This product is commonly called gluten meal.

The twenty-two samples analysed were either secured on the market, or forwarded to us by farmers in Ontario. The figures show quite a wide variation in composition. It will be observed, however, that the protein content is high and the percentage of crude fibre is correspondingly low.

It was noted in a previous part of this bulletin that certain foods rich in protein are also rich in ash material. The result of our work shows that an exception is formed by concentrated feeds, which are by-products, where the seeds are treated with large quantities of water. (Note the example in the above table.) Such a food should be fed with caution to young stock that consume but little roughage and require a liberal supply of ash material for the formation of bone.

Gluten Feed.

Gluten feed, like gluten meal, is a by-product in the manufacture of starch and glucose from Indian corn. The waste products are relatively much richer in oil and protein than is corn.

A great many dairymen are vey well satisfied with this feed. It contains a fair amount of protein, and hence is a very useful material to supplement home-grown foods.

Corn Chop.

Ten samples of corn chop were analysed. The figures in the above table show a variation of from 6.54 to 11.28 per cent. of protein. Comparing the average percentage composition of corn chop with that of wheat middlings, we note that the figures show a very slight difference

the fat content of these two feeding-stuffs. The average protein content is, however, about 5 per cent. higher in the case of middlings. The percentage of crude fibre is much the same in both middlings and corn meal. Another matter which the practical agriculturist has to consider in feeding young and growing animals is the quantity of ash, or bone forming material, which a food may contain. In comparing the average percentage of ash in wheat middlings with that of corn the figures reveal a vey marked difference in favor of the wheat middlings.

It has been said in another part of this bulletin, that the ash constituents of a feeding-stuff are of great importance to young and growing animals. The fact that gluten meal and such by-products contain a low percentage of ash has also been mentioned. These products, however, are used by comparatively few of our farmers. Corn meal, on the other hand, is used very extensively in certain parts of Ontario; therefore a few facts concerning the quantity and quality of the ash of corn meal as compared with the ash material required by the animal body may not be out of place. The complaint has often been heard that hogs fed on corn alone have weak bones. The reason for this is very apparent when we consider the amount of ash required by these animals for the building up of the bone, with the percentage of ash indicated in the foregoing table, which is 1.4 per cent., or 1.4 pounds in 100 pounds of the corn meal. Of this 1.4 pounds .032 of a pound is lime and .67 of a pound is phosphoric acid. *Now, according to Professor Henry of Madison, Wis., 534 pounds of corn will produce 100 pounds of gain. And since this amount of corn contains 7.47 pounds of ash, of which .69 per cent. is phosphoric acid and lime, there is only .051 pounds of the principal bone-forming materials supplied to the growing hog. Now, let us consider the requirements of the hog. His increase in weight is 100 pounds, of which, according to Lawes and Gilbert, 2.9 per cent. is ash. Of this 99.0 per cent. is bone ash. From these figures it is apparent that in 100 pounds gain 2.87 pounds of bone ash has been formed, of which 97.25 per cent. is made up of lime and phosphoric acid, or 2.79 pounds of lime and phosphoric acid are necessary under normal conditions to supply the ash material necessary for 100 pounds of growth. Therefore, if corn meal be fed alone there will be a deficiency of 2.70 pounds of the necessary ash constituents of bone. Hence, it is not surprising that animals fed on such a ration are weak boned.

What has been said regarding the ash material required for the building up of the bone in the case of the growing hog is, in the main, true of all young and growing animals. Such animals require from five to seven per cent. of ash in their food, and of this about 97.0 per cent. should be lime and phosphoric acid. Therefore when corn is fed to young animals it should be mixed with other foods containing a much higher percentage of ash in order that the bone forming material of these animals may be furnished in sufficient quantity.

*Iowa Agriculturist, April, 1904.

FOODS ANALYZED.	Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Ash.	Soluble Carbo-hydrates.
Corn Bran.						
Corn Bran—P. McIntosh	11.81	8.32	2.98	11.02	1.35	64.52
Corn Bran—Tillson & Co	8.75	7.12	3.73	15.89	1.40	63.11
Corn Bran, 1903	8.21	5.42	1.01	16.32	0.99	68.05
Corn Bran, 1902	7.42	4.21	1.25	19.54	1.54	66.04
Corn Bran, 1902	7.00	4.79	1.13	18.60	0.71	67.77
Average	8.64	5.97	2.02	16.27	2.20	65.90
Corn Ensilage.						
1. Ensilage, Jan. 17, 1903	9.63	5.48	2.32	31.55	6.16	44.86
2. Ensilage, barn silo, Jan. 29.	10.06	7.35	2.00	32.82	6.54	41.23
3. Ensilage, dairy silo, Jan. 31.	10.50	10 21	2.55	27.65	5.59	43.40
4. Ensilage, dairy silo, Feb. 6.	10.65	9.65	2.42	33.20	5.89	38.19
5. Silage, air-dried, Feb. 21st	10.87	10.62	2.31	35.40	5.91	34.89
6. Silage, air-dried, Mar. 7th dairy	10.92	10.92	2.04	34.27	6.23	35.62
7. Silage, air-dried, Mar. 19th dairy	11.01	10.63	2.00	33.60	6.80	35.96
Average	10.52	9.26	2.25	32.64	6.16	39.17
Corn of 1903, Percentage as Calculated in Water-Free Substance.						
1. Green Corn, 1903	10.43	.....	2.78	27.37	6.81	52 61
2. Field Cured Corn, 1903	10.04	.....	1.31	32.64	5.15	50.86
3. Silage, 1903	9.91	.....	2.73	24.35	7.49	55.52
4. Silage, 1903	8.53	.....	2.91	31.52	5.92	51.12
5. Silage, 1903	7.49	.....	2.85	34.20	6.20	49.26
6. Silage	8.21	.....	2.89	30.27	7.01	51.62
7. Green Corn, 1903	9.99	.....	2.37	33.26	6.44	47.94
8. Field Cured Corn, 1903	9.49	.....	1.41	36.83	4.94	47.33
9. Silage, 1903	9.22	.....	2.65	27.18	8.05	52.90
Average	9.26	.....	2.43	30.85	6.44	51.02
Oat Hulls or Oat Bran.						
1. Oat Bran—P. Stuart	6.04	8.24	1.30	25.13	1.21	58.08
2. Oat Hulls, 1903	5.43	8.97	0.27	31.65	6.52	47.16
3. Oat Hulls, 1903	3.91	10.84	0.21	35.44	5.43	44.17
4. Oat Hulls, 1903	2.26	9.38	0.69	32.50	4.47	50.70
5. Oat Hulls, 1903	7.59	8.72	0.54	28.64	6.10	48.41
6. Oat Bran—Tillson & Co	8.44	4.07	0.53	31.25	4.96	50.75
7. Oat Bran—D. R. Ross	7.13	9.59	5.11	30.22	5.85	42.00
8. Ground Oat Hulls	11.88	7.85	0.76	27.48	2.63	49.40
9. Oat Hulls—Martin Bros	6.50	9.59	0.89	15.34	7.93	59.75
10. Ph. 44 Oat Bran	7.70	4.10	1.92	36.15	3.80	46.33
Average	6.74	8.07	1.16	29.38	4.90	49.75

Corn Bran.

What has been said regarding oat hulls holds true, in a general way, of corn bran. This by-product bears to corn the same relation that bran and oat hulls bear to wheat and oats. Corn bran possesses a very low feeding value, but unless added to a feed in large quantities it is not objectionable. If, however, large quantities of such material be mixed with some of our more concentrated by-products, the mixture is worth less money than a concentrated by-product not so adulterated. If the corn bran be sold as a by-product pure and simple, then the buyer has no one but himself to blame if the results obtained from feeding such food prove unsatisfactory. The intelligent feeder of live stock will have very little to do with materials which, like this feed, contain less than 9 per cent. of protein, because most farms produce enough course fodder to supply material of such low grade. It is very true that foods of this general character are sold at a lower price per ton than wheat bran, middlings, gluten meal, and linseed meal, but it should be remembered that a ton of linseed meal contains almost four times as much protein as was present in this feed, and when considered from this standpoint, it may be found that that which seems to be cheapest at the time is really the least economical in the end.

Corn Grown 1902.

Seven analyses of corn ensilage show an average of 10.52 per cent. of crude protein in the air-dried food. The object of making these several analyses was to study the chemical changes which take place in the protein compounds of corn in the silo. This table does not show any column for amide compounds, but I may say that our work, so far as we are able to judge from present results would indicate that a certain amount of the proteid bodies revert to a lower form during the process of fermentation. The figures on the above table would indicate that the corn in the dairy silo in 1902 was of quite constant composition.

Analysis of Corn of 1903, Percentage Calculated in Water Free Substance.

The reader will be at once impressed with the fact that whatever be the food value of green corn or corn ensilage, it possesses but a very low percentage of protein. The nine samples analysed in our laboratory show an average of only 9.26 per cent. in water-free substance. Bearing in mind what has been said in the introduction regarding the value of protein in the food of our farm animals, it is apparent that the intelligent feeder must supplement a ration, consisting largely of green corn or ensilage, with a certain amount of a more nitrogenous food.

Oat Hulls or Oat Bran.

This product is obtained by removing the outer shell of the oat grain. The oats are first kiln dried and are then run through a pair of stones. The product is then run over a wire screen and all the dust is screened out. The kernel and hulls are then passed through a fan which removes the hull and leaves the kernel.

The figures in the above table show a wide variation in the composition of oat hulls. In discussing the value of cotton seed hulls we pointed out the poor economy of feeding a product which contains a high percentage of crude fibre. A glance at the foregoing table shows that oat hulls contain a considerable quantity of crude fibre. This fact would at once convince us that this by-product possess a very low feeding value. But in sections where cattle are fed large quantities of corn meal, oat hulls or similar food-stuffs may exercise a beneficial mechanical effect, in that the food is made lighter and more easily digested.

Oat Dust.

In the manufacture of oat-meal or rolled oats the grain is first kiln dried and then passed through a stone to remove the hulls. The product is then passed over a screen and the dust removed. This dust is largely composed of a layer which lies between the kernel of the oat and the hull. Small particles of the broken oat also pass through the screen and these are included in what is termed oat dust.

"Oat dust is not, as has been stated on several occasions, simply dirt and rubbish; on the contrary it is a pure by-product of the oat." Of course, the writer does not mean to claim that it would be impossible to mix an inferior grade of feed with the dust from the oat, and represent the mixture to be pure oat dust. But the combined chemical and microscopic examinations of twenty-three samples of this by-product failed to detect in a single case any foreign material other than finely divided particles of oat hulls, which under the method of manufacture can scarcely be looked upon as adulterant.

Comparing the average composition of oat dust with that of wheat bran, we note that the average quantity of protein in the latter feed is considerably lower than that in the bran. Therefore, if we take the quantity of protein and fat as the standard of purchase,—and it can hardly be denied that such is the correct standard, since materials containing considerable protein are the only ones suitable as additions to the feeding material of the farm,—wheat bran must be regarded as a much more valuable material than oat dust.

The objection might be raised that the purchaser is not getting the carbohydrates in the high-grade material that he would get in some of our lower grade feeds (oat dust for example); but it must be remembered that the feeding materials of the farm usually contain an abundance of carbohydrates. To such an extent is this true, indeed, that home grown

Foods Analyzed.	Crude Protein.	Moisture.	Ether Extract.	Fibre.	Ash.	Soluble Carbohydrates.
Oat Dust.						
1. Flavelle's Oat Dust, 1900 ..	9.78	6.60	5.73	18.16	4.50	55.23
2. Tillson's Oat Dust.....	10.97	7.17	5.53	22.60	6.23	47.50
3. Oat Dust—D. R. Ross	13.00	10.05	4.17	16.75	5.37	50.66
4. Oat Dust, 1902	9.37	10.57	4.57	13.25	3.21	59.03
5. Oat Dust, 1902.....	10.25	9.63	3.65	9.63	5.48	61.45
6. Oat Dust, 1902.....	7.62	13.21	4.25	10.67	6.62	57.63
7. Oat Dust, 1902..	11.54	8.20	2.97	8.75	4.71	63.83
8. Oat Dust, 1903.....	6.75	10.58	3.77	13.73	4.29	61.08
9. Oat Dust, 1903.....	12.63	7.21	5.61	25.25	6.08	43.22
10. Oat Flour—D. R. Ross....	13.56	6.92	5.95	6.71	4.60	62.26
11. Sutherland's Fine Meal....	19.30	5.34	5.79	12.20	2.52	54.90
12. Sutherland's Black Dust...	10.43	7.71	3	13.91	6.41	59.25
13. Oat Dust, Tillsonburg	13.85	5.05	3	18.25	3.28	54.24
14. Oat Dust—Meyer's Mill Co.	11.07	11.11	3	5.15	5.95	61.89
15. Oat Dust—P. Stuart	16.37	7.60	4	6.73	4.05	59.36
16. Oat Dust—Tillsonburg.....	16.62	12.10	3	7.15	4.15	46.23
17. Oat Dust—J. Wilson, Fergus	13.06	14.39		11.23	2.98	51.44
18. Oat Dust—R. Martin Bros..	14.22	12.0	3	7.21	2.42	59.54
19. White Oat Dust.....	14.42	12.13	3	5.80	1.90	59.72
20. Mill Dust, 1903.....	8.52	9.53	1	15.53	3.91	58.30
21. Mill Dust, 1903.....	8.95	13.61	1.54	29.14	3.47	41.29
22. Pearl Oat Dust.....	11.99	13.35	5.21	4.10	1.85	63.50
23. Pearl Oat Dust.....	10.16	10.21	4.15	5.05	1.54	68.89
Average.....	11.93	9.75	4.76	12.92	4.15	56.58
Oat Siftings.						
1. Oat Siftings—P. Stuart	17.13	10.21	3.30	18.21	2.68	48.47
2. Oat Siftings, 1902	14.36	9.37	3.21	9.15	3.10	50.81
3. Oat Siftings, 1902	11.21	13.65	2.61	18.44	2.17	51.89
4. Oat Siftings, 1902	16.24	8.39	4.52	17.66	1.59	51.60
5. Oat Siftings, 1902	12.70	10.25	3.13	18.35	1.39	54.18
Average.....	14.33	10.37	3.36	16.76	2.19	51.39
Oat Feed and Oat Meal.						
1. Oat Feed — W. Thompson.	10.41	4		2	2.53	74.06
2. Feed Oatmeal—R. Martin	17.07	10.31	3.97	8.25	4.73	55.67
3. Oats coarsely ground	12.38	8.43	3.17	10.40	3.00	61.62
4. Oats kiln dried.....	11.60	9.92	4	56	4.01	60.76
5. Oatmeal	16.95	13.25	7	83	1.85	59.81
6. Oatmeal	12.80	11.17	8.24	6	1.29	67.84
7. Hulled Oats	16.00	9.20	6.25	59	2.36	64.30
Mill Feed.						
1. Mill Feed — P. McIntosh,	7.94	13.25	3.20	17.87	5.49	52.16
2. 3. Residue from patent Cereal Foods.....	9.23	7.42	1.01	27.51	10.97	43.86
	8.50	9.31	.98	27.78	9.34	44.09
4. Mill stuff—W. Bacon.....	4.75	6.58	1.56	34.35	5.34	47.42
5. Mill feed, 1902.....	8.76	12.36	3.10	19.52	4.76	51.50
6. Mill feed, 1902.....	9.27	10.52	2.75	16.24	5.32	55.90
7. Mill feed.	12.98	10.21	4.43	9.80	2.15	60.43
8. Mill feed.	11.63	8.37	4.26	7.21	3.09	65.44
9. Mill stuff.....	6.54	9.67	2.15	25.42	6.53	49.69
10. Mill stuff.....	3.22	10.72	1.69	20.61	7.42	56.34
11. Mill stuff.....	3.49	10.90	1.26	24.44	7.15	52.77
12. Mill stuff.....	4.84	9.62	1.11	21.27	6.21	56.95
Average.....	7.60	9.91	2.30	21.00	6.15	53.04

carbohydrates of higher quality than are furnished by many of the feed substitutes are often wasted on the farm. There is a class of feeders, however, to whom feeding-stuffs low in protein and which contain relatively large amounts of carbohydrates are valuable, namely, those who raise nothing themselves—city feeders of horses and stall-fed cattle. To these feeders, therefore, the quality of the carbohydrates is of greater importance. In the case of the horse, the animal is not provided with the extensive digestive apparatus of the cow. Nevertheless, he requires bulky material in connection with his grain, and he also requires that this bulky material be of good quality.

Referring to the table of composition we notice that the amount of total carbohydrates in oat dust is high, amounting to 69.40 per cent. Of this 12.82 per cent. appears in the form of crude fibre, the remaining 58.58 per cent. being soluble carbohydrates (starch, sugar, gums, etc.). If, therefore, the procuring of carbohydates were the object of the purchase, oat dust should command a high price, inasmuch as this food contains only a moderate amount of these in the form of crude fibre.

Oat Siftings.

Five samples of oat siftings indicate an average of 14.33 per cent. of protein. The fat content is also well in advance of many of the by-products on our markets. The percentage of crude fibre is rather higher than we would have expected in such a food. The microscopic examination, however, revealed the presence of only particles of finely divided oat hulls which could hardly be considered as an adulterant.

Oat Feed and Oatmeal.

Sample No. 1 of this table must be considered a low grade food since it contains less than 11 per cent. of protein and less than two per cent of fat.

Samples Nos. 2 and 7 of this table contain sufficient quantities of protein and fat to warrant us in classifying them as high grade foods. Such a food as No. 7 when mixed with milk or swill would make an excellent food for young pigs.

Two samples of oatmeal were analysed. As this food is not used to any extent as a cattle food, it is quite unnecessary to discuss the variation in composition.

Two samples of oats were analysed. In discussing the composition of oat dust, we observed that horses were usually fed on a ration consisting of bulky food and grain. In most cases the grain ration is made up largely of oats. It is interesting, therefore, to note that the amount of protein in the oat grains is low as compared with some of our concentrated by-products, and yet we seldom hear of oats being replaced in a ration for working horses by any of the highly nitrogenous materials

on our market. It may be that the quality of the proteids of the oat grain may have something to do with it; or the amount of fat may influence its nutritive value. Whatever be the cause we know that a component of a ration for work horses this special grain is of particular importance. Let us remember, however, that oats vary as greatly in composition as do some of the by-products we have examined, and that it is important that the amount of protein in oats be as large as possible. Remembering this the intelligent feeder will select the variety of this particular grain which gives the greatest yield with a corresponding decrease of crude fibre.

Mill Feed.

Comparing the average composition of the foods recorded in this table with those of oat dust, we find that the latter contains a much higher percentage of crude protein and a correspondingly lower percentage of crude fibre. The oat dust must, therefore, be considered the better of the two.

No experiments have yet been conducted at this station to show which of the two foods is the more digestible. We hope, however, to be able in the near future to furnish this very desirable information.

Barley Dust.

"This by-product in the manufacture of pot and pearl barley is obtained by continued scouring of the grain with a stone. During the process the dust is carried away by means of a suction fan. Should there be any oat grains in the barley, they would also be broken up in the process and would appear in the dust."

The ten samples show an average of 14 per cent. of protein, which is a fair amount in a feeding-stuff. It will be noticed, however, that there is a very considerable amount of crude fibre in this product. For this reason we do not consider it as valuable for feeding purposes as it would be if less fibre were present.

The microscopic examination of these samples revealed in most cases considerable quantities of finely pulverized barley hulls. Such by-products as barley hulls, because of their low digestibility, are very undesirable in a cattle food. Notwithstanding this fact the samples of barley dust examined show a fairly high protein content, and might be advantageously fed to certain classes of keep animals.

Malt Sprouts.

Dried grains and malt sprouts, by-products from distilleries and breweries, are frequently used as cattle foods. To obtain these products the grain is first caused to sprout, and as a result of this growth the starch of the grain is changed to sugar. The sprouts are then removed and sold by dealers, sometimes in the wet condition, but for shipment they are dried and put up in sacks or barrels.

Foods Analyzed.	Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Ash.	Soluble Carbohydrates.
Barley Dust.						
1. Barley Dust—Thompson ..	13.91	5.29	5.22	11.58	2.80	61.20
2. Barley Dust, Tillsonburg ..	14.78	9.01	2.37	7.61	5.40	60.83
3. Barley Dust — H. Wilson.	14.50	12.90	1.22	8.51	3.00	59.87
4. Barley Dust .. R. Martin	17.13	9.37	2.03	10.95	3.21	57.31
5. Barley Dust, 1902	12.40	13.65	1.12	15.43	2.95	54.45
6. Barley Dust, 1902	15.37	10.40	2.16	19.71	3.05	49.31
7. Barley Dust, 1903	13.21	9.80	1.95	13.25	3.40	58.39
8. Barley Dust. 1903	14.30	11.43	2.30	8.97	2.91	60.07
9. Barley Dust, 1903	11.21	12.70	1.07	10.40	3.87	60.75
10. Barley Dust	13.51	10.75	1.87	17.41	3.51	52.95
11. Barley Hulls.....	13.72	11.53	2.83	29.37	3.23	39.32
Average.....	14.00	10.62	2.20	13.93	3.39	55.86
Malt Sprouts.						
1. Malt Sprouts.....	29.24	8.70	1.85	15.27	7.80	37.14
2. Malt Sprouts.....	29.44	8.90	1.74	17.39	6.44	36.09
Average.....	29.34	8.80	1.79	16.33	7.12	36.62
Barley.						
1. Crushed Barley, Thorp.....	14.06	10.51	2.78	2.00	3.02	67.63
2. Barley Chop—T. E. Simpson	12.60	9.57	2.22	2.90	2.49	70.22
3. Barley—R. Harvey.....	12.90	9.63	2.21	3.58	1.52	70.16
4. Meal — Sent by M. Cohoe,	14.48	5.66	1.84	4.65	3.05	70.32
5. Barley Meal.....	11.69	10.12	2.96	2.92	2.96	69.35
6. Barley Meal.....	10.35	12.16	3.51	1.93	2.14	69.91
7. Barley Meal.....	8.73	13.62	2.27	2.58	2.29	70.51
8. Barley Meal.....	10.43	9.54	2.25	2.98	1.58	73.22
9. Barley Meal.....	11.69	11.25	2.83	2.79	1.79	69.65
Average.....	11.88	10.23	2.54	2.92	2.32	70.11
Dried Molasses Beet Pulp.						
No. 1 Dresden.....	8.81	2.71	1.46	14.14	6.34	66.54
No. 2 Dresden.....	9.03	2.56	1.53	12.29	5.93	68.66
No. 3 Dresden.....	8.50	2.95	1.21	14.43	7.07	65.84
No. 4.....	8.35	3.40	1.00	13.60	6.44	67.21
No. 5...	9.17	3.09	1.16	16.21	6.81	63.56
No. 6..	8.22	2.69	0.89	15.43	5.99	66.78
*No. 7 Dresden	7.69	3.17	0.73	20.07	6.03	62.31.
Average.....	8.54	2.94	1.14	15.17	6.37	65.84
Stock Food.						
1. Molassine, air-dried.....	9.63	3.46	0.13	11.28	10.26	65.24
2. Biddy's Calf Food.....	13.82	11.79	9.21	03.23	4.59	57.36
3. Calf Meal—Meyer's Mill Co.	12.57	4.53	4.54	13.62	3.75	60.99
4. Pratt's Animal Regulator ...	9.18	8.09	4.38	03.97	10.28	64.10
5. Molasses Cattle Food.....	8.81	2.71	1.46	14.14	6.34	66.54
6. Molasses Cattle Food	7.69	3.17	0.73	20.07	6.03	62.31

*Sample No. 7 contains no molasses

Only two samples of malt sprouts were analysed. These show an average of 29.34 per cent. of protein. As will be noticed these two samples are practically the same in composition. It must not be inferred however, that the composition of this feeding-stuff does not vary. As a matter of fact there is a very noticeable difference in the composition of sprouts from any two breweries. Moreover, the samples from one plant frequently differ among themselves as much as the averages from different plants.

Barley.

Three of the samples analsyed were obtained from a manufacturer, and six from dealers.

Barley fed alone is considered somewhat "heating," and if fed continuously is likely to cause skin troubles. When combined with other grains, however, such as oats, peas, and so forth, it gives good results. The table of analysis shows that the digestibile protein is lower in barley than in oats and considerably higher than in corn. The carbohydrates, on the other hand, exceed those of the oats and fall below those in corn. Barley has also less oil than either of the two grains mentioned. When mixed with oats and ground previous to feeding, it is considered an excellent constituent of a ration for dairy cows. Some authorities claim that it has an influence on the quantity of the milk and butter. The impression appears to be prevalent among certain farmers of the Province that barley fed alone is poisonous. This statement will be given little credence by the majority of those who have had any experience in feeding the grain. It is true, as before stated, that barley is considered somewhat heating and may produce skin trouble, but that it is a poison is certainly not the case. The experience of prominent feeders, both in England and the United States, and in Europe "(it is used extensively in the latter place for the producton of pork)" will allow us to regard barley meal as a very valuable component of a ration for farm animals.

Dried Molasses Beet Pulp.

This feeding-stuff consists of dried molasses and the pulp which remains as a residue from the manufacture of sugar from sugar beets. We have conducted a series of digestion experiments with this material and find it to be good feed for parties who do not have sufficient coarse feed for their stock; but beet pulp, like the coarse feeds of the farm should be supplemented by materials rich in protein. The writer is inclined to believe that the price asked for this material at the factory is altogether too high, and when the price is increased by the cost of transportation for long distance, the expense is certain to greatly over balance the gains. Whether, therefore, it will prove to be an economical feed depends upon the price asked for it and the cost of the coarser home grown feeding stuffs. Beet pulp must be regarded purely as a substitute for the coarse fodders of the farm, and should be fed with caution to young stock.

Stock Food.

Several samples of what are usually termed "stock food" have been examined. A glance at the above table will show that in some there is a very fair quantity of protein and fat, but it must be remembered that the cost of the nutritive components of foods when purchased in such form is much in advance of their real value. Moreover, the claims that by the use of condiments and spices the digestibility of other components of the ration can be increased and in this way a saving of food can be effected, have no basis in fact. As foods, pure and simple, therefore, the prices paid for stock foods are ridiculously high when compared with the price paid for some of our most expensive standard foods.

Another important point is the ash. As was pointed out the quantity of ash in a food for young and growing animals is very important. The ash of most of our home grown foods and the ash of many of the by-products of our mills furnish a very fair amount of bone forming material. A glance at the above figures shows that all of the stock foods examined contain very large quantities of ash. In most cases, however, the ash of condimental foods contains considerable quantities of potassium salts, which tax the excretory organs of the animal and are, therefore, a decided detriment.

Another claim made by dealers in stock food is that such foods are of a medicinal or stimulating nature, and are claimed to be particularly effective and valuable, not only for growing animals, but also for cows in milk and for horses. This claim, however, should carry very little weight with the intelligent feeder, since it is a well established fact that healthy animals need no medicine or stimulant.

The writer does not mean to insinuate that stock foods should not be used under any circumstances. On the contrary, we believe that they have their places. For example, feeders who are fitting their stock for the show have successfully used stock foods. Their place, therefore, appears to be in a ration for show animals, but probably it would be better to use such foods only in the last stages of the fitting process.

It is claimed by certain prominent feeders that a better bloom can be obtained by the use of small, and limited quantities of some stock food in the last stages of feeding. It must be remembered, however, that such feeders do not consider the cost of a feeding-stuff, and in such cases as these in which the cost of the food can be overlooked, stock foods may be used.

The following shows the composition of two substances from which it was proposed to manufacture a stock food. Readers will be struck at once with the comparatively small quantity of nutritive material which such a mixture would contain. As stated before, the claims that such foods increase the digestibility of other fodders have no basis in fact. Furthermore, the purchaser of stock foods is frequently assured that the secretion of the digestive fluids is very greatly increased by the use of certain condiments. That such, in certain instances, may be the case we have no doubt, but the price paid for these foods is likely to be far in advance of the gain.

Foods Analyzed.	Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Ash.	Soluble Carbo-hydrates.
Stock Food Ingredients.						
Sphagnum Moss	3.33	12.92	1.21	49.23	1.45	31.86
Beet Sugar Molasses	10.87	22.31	.....	.....	10.63	56.19
Poultry Feeds						
Western Poultry Food Co.	40.34	4.18	6.59	1.90	17.42	29.57
Cypher's Chick Food	12.03	6.01	1.28	3.10	29.42	48.16
Morgan's Animal Meal	58.10	7.59	21.25	1.34	12.60	0.0
Sutherland's Seeds	9.73	3.84	3.67	15.39	4.79	62.58
Spratt's Chick Meal	24.41	3.92	5.73	1.81	5.80	58.33
Spratt's Feed for large fowl	19.32	4.76	5.07	1.09	16.23	53.52
Pratt's Chick Food	15.19	8.31	7.18	7.51	7.02	54.79

Poultry Feeds.

The above table gives the average composition of seven distinct brands of poultry foods. These feeds are composed of the usual materials known to be of value in the feeding of poultry. Some of our recognized authorities on poultry feeding tell us that they believe it would be greater economy to purchase the ingredients of these foods separately. Other poultrymen, however, think they would rather pay the difference for the convenience of having a ready mixed poultry ration whereby they avoid the storing and subsequent care of a number of materials which are of limited use in the small quantities they would have to buy.

SUMMARY.

Only a few cases of actual adulteration have been found among the samples examined. In every instance the adulterated sample was forwarded to us by a feeder of live stock.

A considerable number of by-products, such as corn bran, oat hulls, and oat feed, etc., are of such inferior quality that they cannot, as a rule, be used to any profit.

An examination of the analyses of the feeds given in the foregoing tables, when considered in connection with the prices paid for these food materials will assist the purchaser in deciding which of the by-products is the most economical for his purpose.

At the present time the prices asked for cattle foods bear very little relation to their feeding value. That is, feed is retailed at so much per ton whether it is rich in protein and well suited to supplement our ordinary farm foods, or whether it is a starchy food, and, therefore, of much less value in compounding suitable rations for cattle. Such being

the case, special care in the purchase of feeds and some knowledge of their chemical composition will be found of paramount importance in keeping the cost of feeding down to a point which will admit of a profit.

TABLE SHOWING AVERAGE COMPOSITION OF FOODS ANALYZED.

FOODS.		Crude Protein.	Moisture.	Ether Extract.	Crude Fibre.	Ash.	Soluble Carbohydrates
Pea meal,	8 analyses	23.27	10.34	1.90	7.04	2.83	54.62
Pea hulls,	13 "	10.04	7.51	1.44	42.07	2.92	36.01
Mixed grain or chop,	21 "	12.81	11.27	4.61	11.00	3.96	56.35
Wheat middlings,	21 "	15.54	10.10	3.92	4.26	3.72	62.46
Wheat bran,	10 "	14.99	10.40	3.74	8.74	5.14	56.99
Low grade flour.	3 "	11.94	11.02	3.58	0.44	1.88	71.13
Shorts,	4 "	16.01	9.38	4.46	4.52	4.37	61.26
Beeswing,	3 "	9.60	6.93	0.41	18.19	2.29	62.58
Cotton seed meal,	5 "	44.18	5.94	13.65	4.78	6.91	24.54
Cotton seed hulls,	4 "	4.45	9.73	1.31	46.60	2.16	35.75
Oil cake,	13 "	30.41	9.06	7.07	10.64	5.89	36.93
Gluten meal,	22 "	24.96	7.12	8.54	3.70	0.23	54.85
Gluten feed,	17 "	25.65	8.61	7.52	5.92	0.82	51.47
Corn chop,	10 "	9.36	9.80	4.47	1.93	1.40	73.04
Corn bran,	5 "	8.64	5.97	2.02	16.27	2.20	65.90
Corn ensilage,	7 "	10.52	9.26	2.25	32.64	6.16	39.17
Green corn and silage,	9 "	9.26	.....	2.34	30.85	6.44	51.02
Oat bran,	11 "	6.74	8.07	1.16	29.38	4.90	49.75
Oat dust,	23 "	11.93	9.75	4.76	12.82	4.15	56.58
Oat siftings,	5 "	14.33	10.37	3.36	18.36	2.19	51.39
Mill feed,	12 "	7.60	9.91	2.30	21.00	6.15	53.04
Barley dust,	11 "	14.00	10.62	2.20	13.93	3.39	55.86
Malt sprouts,	2 "	29.34	8.80	1.79	16.33	7.12	36.62
Crushed barley,	10 "	11.88	10.23	2.54	2.92	2.32	70.11
Dried beet pulp,	7 "	8.54	2.94	1.14	15.17	6.37	65.84

The above table shows the average composition of the samples of feeding-stuffs analysed in our laboratory. We have discussed each table separately, and, where possible, have emphasized points of difference, etc., which we consider of greatest practical value to the feeder of live stock. As mentioned in the introduction, the percentage of protein in a food is invariably considered of prime importance because our home grown crops are more likely to be deficient in this than in any other component. In selecting a food, therefore, we should aim at obtaining the greatest amount of protein for our money. There are certain serious objections, however, to some of our feeding-stuffs which contain a very large quantity of protein. Cotton seed meal, for example, contains, on an average 44.18 per cent. of protein, but many of our best feeders do

not consider it a safe food to place on the hands of hired men. Many cases of milk fever and other diseases in dairy herds have been attributed to indiscriminate use of cotton seed meal. This food may be fed to advantage if care is observed as to the amount fed per day, the age of the animal, etc. All things considered, it might be wiser to make up any deficiency in protein in a ration by feeding another of the by-products mentioned (linseed meal for example). The addition of cotton seed meal to a ration for calves or pigs results in serious derangement of the digestive organs of these animals.

Pea meal, linseed meal, maize gluten, gluten feed, middlings, and wheat bran are by-products which contain a large quantity of protein, and are, therefore, most valuable components for a ration intended for dairy cows. For fattening pigs, good results have been obtained from a mixture of skim milk and low grade flour. Shorts is an excellent food for young pigs. Oat dust and other feeds of like composition, if pure, furnish nutritive materials at economical prices. The purchaser must, however, be on his guard, as frequently feeds are presented for sale on our markets which are heavily adulterated with foreign material of little value. Only to-day a sample of what was supposed to be wheat bran was sent to our laboratory. Upon examination we found this sample to be adulterated with large quantities of finely ground barley bran. From the result of our investigation, however, we are convinced that goods obtained from the local manufacturers are usually of good quality. In some instances we have found the nutritive materials, especially protein, present in smaller quantities than we might have expected, but in most cases this deficiency was due, not to adulteration, but to the poor quality of the grain from which the by-product was obtained.

Regarding mill feed, oat hulls and such low grade materials little need be said. The tables of composition show them to be entirely unfit to feed as substitutes for pea meal, linseed cake, and such nitrogenous materials. There are cases, however, in which these feeding-stuffs might be used to advantage, but the feeder is likely to be misled in the purchase of these materials, because the price asked, judged from the cost of standard food materials would indicate value which they do not possess. Economical purchase, however, does not imply the purchase of the lowest priced foods. As previously observed many of the waste products of our mills are not altogether worthless, but it is important that purchasers should know what they are and what relation they bear to the standard feeds. In some cases finely ground materials are sold under fancy names and these in many instances are essentially inferior to ordinary farm roughage. Feeders of live stock should not be deceived in such a case by false claims or a fancy name, suggesting good quality or good origin. Purchasers are, therefore, advised to be on their guard in the selection of some of these so-called cheap by-products. It is safer, as a rule, to buy standard foods as their quality may be pretty accurately judged.

APPENDIX.

As stated in the introduction, the tables giving the percentage composition of the foods analysed furnish us with information regarding the total amounts of the different constituents present in foods, but as only that portion of the food which is digested is of direct use to the animal, it has been deemed advisable to append a table giving the approximate amounts of digestible nutrients contained in the various fodders. The data upon which some of these calculations are based are taken from the results reported in Bulletin No. 77 of the U. S. Department of Agriculture. The digestibility of a number of these feeding-stuffs under consideration has been determined at this Station, and in such cases we have used our own data in calculating the amounts of digestible nutrients.

As will be seen from the following table, the digestibility of the different foods varies markedly, and it must also be remembered that the digestibility of some foods varies under different conditions. Furthermore, in those foods which are marked thus * the digestibile components have been calculated from the digestibility of American feeding stuffs of the same name, and the digestion co-efficients of these may vary quite widely from our own. Therefore, when using the figures which are given in the following table, the feeder must bear in mind that he is dealing with approximate quantities only.

The importance of the supply of protein in a ration has been sufficiently emphasized to require no further mention. It may be stated, however, that if an excess of the amount required to build up and repair the waste of the body be fed the protein may be converted into fat and deposited as such or used to produce heat and energy. For these purposes it is about as efficient as the carbohydrates, but it is far more expensive than the latter, and, therefore, only as much should be supplied to the mature animal as will be used in repairing the necessary breaking down of the nitrogenous tissues in the animal body. In the case of growing animals and such animals as are kept for the production of milk, wool, and so forth, an increased amount of protein in the food is necessary.

The matter of computing rations for the various kinds of animals raised on the farm is, therefore, an important one to the feeder, for since the protein, on the one hand, and the carbohydrates on the other, serve in the main different purposes in the animal economy, it is evident that relative amounts of these nutrients in the food should be considered. This relation is called the nutritive ratio, which means simply the relation of the digestible protein to the digestible carbohydrates and fat, the fat having been multiplied by 2.25 before adding it to the carbohydrates. The nutritive ratio is then found by dividing the carbohydrates plus 2.25 times the fat by the protein. In the following table the sum of the carbohydrates and fat thus obtained is given in the third column, which divided by the protein, as given in the second column, gives us the nutritive ratio of the food.

DIGESTIBLE NUTRIENTS IN STATED AMOUNTS OF FOOD STUFFS.

Kind and Amount of Food.		Total dry Matter.	Pounds of Digestible Nutrients.			Nutritive Ratio.
			Protein	Carbohydrates + (Fat X 2.25)	Total	
*Pea Meal	1 pound	.896	.193	.543	.736	1: 2.8
	2 "	1.792	.386	1.086	1.472	
	3 "	2.688	.579	1.629	2.208	
	4 "	3.584	.772	2.172	2.944	
	5 "	4.480	.965	2.715	3.680	
†Pea Hulls	1 "	.924	.073	.440	.513	1: 6.03
	2 "	1.848	.146	.880	1.026	
	3 "	2.772	.219	1.320	1.539	
	4 "	3.696	.292	1.760	2.052	
	5 "	4.620	.355	2.200	2.565	
	6 "	5.544	.438	2.640	3.078	
	7 "	6.468	.511	3.080	3.591	
	8 "	7.392	.584	3.520	4.104	
	9 "	8.316	.657	3.960	4.617	
†Mixed Grain or Chop	1 "	.887	.102	.573	.675	1: 5.6
	2 "	1.774	.204	1.146	1.350	
	3 "	2.661	.306	1.719	2.025	
	4 "	3.548	.408	2.292	2.700	
	5 "	4.435	.510	2.865	3.375	
	6 "	5.322	.612	3.438	4.050	
	7 "	6.209	.714	4.011	4.725	
	8 "	7.096	.816	4.584	5.400	
	9 "	7.983	.918	5.157	6.075	
	10 "	8.870	1.020	5.730	6.750	
*Wheat Middlings	1 "	.899	.124	.590	.714	1: 4.76
	2 "	1.798	.248	1.180	1.428	
	3 "	2.697	.372	1.770	2.142	
	4 "	3.596	.596	2.360	2.856	
	5 "	4.495	.620	2.950	3.570	
†Wheat Bran	1 "	.896	.116	.463	.579	1: 3.99
	2 "	1.792	.232	.926	1.158	
	3 "	2.688	.348	1.389	1.737	
	4 "	3.584	.464	1.852	2.316	
	5 "	4.480	.580	2.315	2.895	
	6 "	5.376	.696	2.778	3.474	
	7 "	6.272	.812	3.241	4.053	
	8 "	7.168	.928	3.704	4.632	
†Low Grade Flour	1 "	.889	.090	.600	.690	1: 6.67
	2 "	1.778	.180	1.200	1.380	
	3 "	2.667	.270	1.800	2.070	
	4 "	3.556	3.60	2.400	2.760	
	5 "	4.445	4.50	3.000	3.450	

Kind and Amount of Food.		Total Dry Matter	Pounds of Digestible Nutrients.			Nutritive Ratio
			Protein	Carbohydrates + (Fat X 2.25)	Total	
*Shorts	1 "	.906	.117	.614	.731	1: 5.25
	2 "	1.812	.234	1.228	1.462	
	3 "	2.718	.351	1.842	2.193	
	4 "	3.624	.468	2.456	2.924	
	5 "	4.530	.585	3.070	3.655	
	6 "	5.436	.702	3.684	4.386	
	7 "	6.342	.819	4.298	5.117	
	8 "	7.248	.936	4.912	5.848	
†Beeswing	1 "	.93	.072	.503	.520	1: 6.9
	2 "	1.86	.144	1.006	1.040	
	3 "	2.79	.216	1.509	1.560	
	4 "	3.72	.288	2.012	2.080	
	5 "	4.65	.360	2.515	2.600	
	6 "	5.58	.432	3.018	3.120	
	7 "	6.51	.504	3.521	3.640	
	8 "	7.44	.576	4.024	4.160	
	9 "	8.37	.648	4.527	4.680	
	10 "	9.30	.720	5.030	5.200	
*Cotton Seed Meal	1 "	.94	.390	.448	.838	1: 1.15
	2 "	1.88	.780	.896	1.676	
	3 "	2.82	1.170	1.344	2.514	
	4 "	3.76	1.560	1.792	3.352	
	5 "	4.70	1.950	2.240	4.190	
	6 "	5.64	2.340	2.688	5.028	
*Cotton Seed Hulls	1 "	.902	.006	.265	.271	1: 44.16
	2 "	1.804	.012	.530	.542	
	3 "	2.706	.018	.795	.813	
	4 "	3.608	.024	1.060	1.084	
*Oil Cake	1 "	.909	.259	.497	.756	1: 1.9
	2 "	1.818	.518	.994	1.512	
	3 "	2.727	.777	1.491	2 278	
	4 "	3.636	1.036	1.988	3.024	
	5 "	4.545	1.295	2.485	3.780	
	6 "	5.454	1.554	2.962	4.536	
*Gluten Meal	1 "	.929	.220	.513	.733	1: 2.3
	2 "	1.858	.440	1.026	1.466	
	3 "	2.787	.660	1.539	2.199	
	4 "	3.716	.880	2.052	2.932	
	5 "	4.645	1.100	2.565	3.665	
	6 "	5.574	1.320	3.078	4.398	
	7 "	6.503	1.540	3.591	5.131	
	8 "	7.432	1.760	4.104	5.864	

Kind and Amount of Food.		Total Dry Matter	Pounds of Digestible Nutrients.			Nutritive Ratio
			Protein	Carbohydrates + (Fat X 2. 25)	Total	
*Gluten Feed.....	1 "	.913	.219	.625	.844	1: 2.8
	2 "	1.826	.438	1.250	1.688	
	3 "	2.739	.657	1.875	2.532	
	4 "	3.652	.876	2.500	3.376	
	5 "	4.565	1.095	3.125	4.220	
	6 "	5.478	1.314	3.750	5.064	
	7 "	6.397	1.533	4.375	5.908	
	8 "	7.304	1.752	5.000	6.752	
*Corn Chop.....	1 "	.902	.063	.783	.846	1: 12.4
	2 "	1.804	.126	1.566	1.692	
	3 "	2.706	.189	2.349	2.538	
	4 "	3.608	.252	3.132	3.384	
	5 "	4.510	.315	3.915	4.230	
	6 "	5.412	.378	4.398	5.076	
	7 "	6.314	.441	5.481	5.922	
	8 "	7.216	.504	6.264	6.768	
†Corn Bran	1 "	.94	.053	.413	.466	1: 7.8
	2 "	1.88	.106	.826	.932	
	3 "	2.82	.159	1.239	1.398	
	4 "	3.76	.212	1.652	1.864	
	5 "	4.70	.265	2.065	2.330	
†Corn Ensilage	1 "	.21	.055	.451	.506	1: 8.2
	5 "	1.05	.275	2.255	2.530	
	12 "	2.52	.660	5.412	6.072	
	15 "	3.15	.825	6.765	7.590	
	18 "	3.78	.990	8.118	9.108	
	20 "	4.20	1.000	9.020	10.120	
†Oat Dust	1 "	.902	.081	.434	.515	1: 5.35
	2 "	1.084	.162	.868	1.030	
	3 "	2.706	.243	1.302	1.545	
	4 "	3.608	.324	1.736	2.060	
	5 "	4.510	.405	2.170	2.575	
	6 "	5.412	.486	2.604	3.090	
	7 "	6.314	.567	3.038	3.605	
	8 "	7.216	.648	3.472	4.120	
*Malt Sprouts	1 "	.912	.235	.316	.551	1: 1.3
	2 "	1.824	.470	.632	1.102	
	3 "	2.736	.705	.948	1.653	
	4 "	3.648	.940	1.264	2.204	
	5 "	4.560	1.175	1.580	2.755	
	6 "	5.472	1.310	1.896	2.306	
	7 "	6.384	1.645	2.212	3.857	
	8 "	7.296	1.880	2.528	4.408	
	9 "	8.208	2.115	2.844	4.959	
	10 "	9.120	2.350	3.160	5.510	

Kind and Amount of Food.		Total Dry Matter.	Pounds of Digestible Nutrients.			Nutritive Ratio
			Protein	Carbohydrates + (Fat X 2.25)	Total	
*Crushed Barley	1 "	.897	.096	.646	.742	1: 6.73
	2 "	1.794	.192	1.292	.484	
	3 "	2.691	.288	1.938	2.226	
	4 "	3.588	.384	2.584	2.968	
	5 "	4.485	.480	3.230	3.710	
	6 "	5.382	.576	3.876	4.452	
†Dried Beet Pulp.....	1 "	.970	.072	.655	.727	1: 9.09
	2 "	1.940	.144	1.310	1.454	
	3 "	2.910	.216	1.965	2.181	
	4 "	3.880	.288	2.620	2.908	
	5 "	4.850	.360	3.275	3.635	
	6 "	5.820	.432	3.930	4.362	
	7 "	6.790	.504	4.585	5.089	
	8 "	7.760	.576	5.240	5.816	
	9 "	8.730	.648	5.895	6.543	
	10 "	9.700	.720	6.550	7.270	

* Results calculated from American records.

† Digestibility of foods marked thus was determined at this Station. Work along this line is in progress, and we expect soon to have sufficient data for a bulletin dealing more particularly with the question of digestion co-efficients.