REPORT

OF THE

FEDERAL TRADE COMMISSION

ON

COMMERCIAL FEEDS

MARCH 29, 1921

WASHINGTON
GOVERNMENT PRINTING OFFICE
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HUSTON THOMPSON, *Chairman.*
NELSON B. GASKILL.
JOHN GARLAND POLLARD.
VICTOR MURDOCK.
JOHN F. NUGENT.
J. P. YODER, *Secretary.*

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The Commission also desires to acknowledge the valuable cooperation of the Department of Agriculture, and especially the assistance of Messrs. J. K. Haywood and George L. Bidwell, of the Bureau of Chemistry, with respect to questions of animal nutrition and State and Federal regulation of commercial feeds.

LETTER OF SUBMITTAL.

FEDERAL TRADE COMMISSION,
Washington, March 29, 1921.

To the President of the Senate of the United States.

SIR: There is transmitted herewith in response to Senate resolution 140, July 31, 1919, a report on the manufacture and sale of commercial feeds.

Commerce in animal feeds has grown enormously in recent years. This has been due in part to the greater knowledge of feed values and of the varied requirements of live stock. Many of the feedingstuffs now widely used are by-products which were formerly wasted.

Farmers and feeders may purchase their feed requirements in the form of ready-mixed feeds or they may buy the separate commodities and do their own mixing. The Federal and State Departments of Agriculture, the agricultural colleges, their staffs and other authorities render valuable assistance to farmers by advice on feeding problems, especially with reference to feed values and mixing their own rations.

An investigation of the animal-feeds industry to be complete involves a study of practically every industry which uses in its manufacturing processes vegetable material and some which use animal material. The by-products of all these industries supply a large number of different kinds of feedingstuffs. In addition to these feeds there are numerous others which are not the result of manufacturing processes. It follows, therefore, that to make a thoroughly comprehensive investigation of animal feeds would involve a study of the manufacturing processes and of results in a large number of industries which produce as by-products materials suitable for feeds. Some indication of the ramifications of the feedingstuffs industry may be appreciated from the following general classification of feedingstuffs:

1. The hays and straws. 2. The whole cereal grains. 3. Cereal mill by-products. 4. Starch and glucose by-products. 5. Brewery and distillery by-products and yeast and vinegar by-products. 6. Oil-mill by-products. 7. Sugar by-products. 8. Animal and fish by-products. 9. Miscellaneous feeds. 10. Commercial mixed feeds or proprietary feeds. 11. Condimental stock remedies or tonics.

The American Feed Manufacturers' Association has listed over 3,000 manufacturers of commercial mixed feeds, and the president of this association stated that this is very likely less than half of the total number. As a result of the foregoing facts it will be appreciated that anything like a complete survey of the feedingstuffs industry would involve an enormous expenditure of time and money. Under these circumstances the inquiry was confined to a study of representative feeds which enter into commerce and covers the period from 1913 to 1920, inclusive.

There is a great lack of authoritative data in regard to many phases of the industry and there are numerous questions confronting this business which are highly controversial. This is particularly the case with reference to the feed value of certain products commonly known as roughages or low-grade feeds. It is contended by some agricultural authorities and a few feed manufacturers that the use of certain of these low-grade feedingstuffs should be restricted, since, it is alleged, these feedingstuffs are roughages of which farmers produce, or should produce, an abundance. It is also frequently alleged that mixed feeds containing one or more of such low-grade ingredients are sold at prices out of line with their feed value. A number of plans have been suggested to check the use of these commodities, the most common one being the proposal to require the statement on tags and labels of the percentage of each ingredient used. However, important objections have been offered against the adoption of such a requirement.

The study of the prices of feeds is attended with considerable difficulty. In particular the comparison of the prices of commercial mixed feeds with one another or with the prices of the straight feeds from which they are made is difficult. This will readily appear when the great number of ingredients which enter into many brands of mixed feeds are considered, and also the very frequent changes in formulas of many, if not most, of these feeds. Hence no such precision is to be looked for in conclusions derived from a study of prices of these feeds as is possible in the study of prices of fairly homogeneous commodities.

Prices of all kinds of feeds, both the so-called straight feeds and the ready-mixed feeds, in common with the prices of practically all other commodities, increased greatly during the war period and for more than a year and a half following the armistice. Most feeds reached their highest prices in May or June, 1920. There were naturally considerable differences in the movement of prices of different feeds, due to their great variety and the different sources from which they are derived, there being at times a plentiful supply of some feeds, accompanied by scarcity of others. Demand, too, naturally fluctuates, but the price of every feed depends in some measure, greater or less, on the prices of other feeds, on account of the relative ease with which one feed can be substituted for another within fairly wide limits.

One of the most important influences affecting prices during the war and much of the time since the armistice has been the shortage of freight cars, which has not only delayed shipments of finished products but often held up receipts of raw materials. At times this shortage has been acute and has caused decreased production. This condition, of course, has not been peculiar to the feed business.

The wholesale prices of 10 important straight feeds and 12 commercial mixed feeds, which as a whole may be considered representative, respectively, of these two classes, were compared with the composite wholesale prices of a group of 32 farm products and of all commodities, as registered by index numbers compiled by the Bureau of Labor Statistics of the Department of Labor. These index numbers give the prices of these groups of commodities by months and years relative to the average price of the year 1913 taken as a base.

Composite index numbers were also computed for the group of 10 representative straight feeds and the group of 12 commercial mixed feeds.

A comparison of these different series of index numbers shows that the price of all commodities in 1919 was represented by 212 as compared with the base price of 100, or the average price of the year 1913. The other index numbers for the year 1919 were as follows: Farm products, 234; straight feeds, 236; ready-mixed feeds, 220. There was a very close correspondence in the relative increase in prices of mixed feeds and farm products, and also a rather close correspondence for straight feeds. The relative advance in prices from 1913 to 1919 in the two classes of feeds and also in farm products was considerably higher than in all commodities.

The prices of feeds as well as of all commodities continued to advance during the first half of 1920, but the second half of the year was marked by a very great decline in the prices of all feeds, both straight and ready mixed. The decline between June and December was as much as 57 per cent for some of the straight feeds. Different brands of mixed feeds declined in price from 20 per cent to more than 50 per cent.

So far as general conclusions can be drawn from the study of the statistics of feed prices the figures do not indicate a disproportionate rise in these prices as compared with farm products in general.

A study of the costs and profits of a representative group of nine mixed-feed manufacturers during 1915–1919 shows that during the period costs of materials about doubled, while with few exceptions all other items of manufacturing costs and expenses increased in about the same proportion. Since the average cost of raw materials for the period 1915–1919, inclusive, was about 83 per cent of the commercial cost of sales and about 80 per cent of the selling price, this would indicate that by far the largest factor causing the high prices of ready-mixed feeds in 1919 was the great increase in the cost of raw materials.

The net operating profit of these mixed-feed manufacturers was sufficient to net a fairly high rate of return on the investment in each year, while in 1917 and 1919 the rate of return was considerably larger, due probably in part to the fact that in these two years the net operating profit included some profit realized from an increase in value of raw materials during their period of conversion into mixed feeds. The average rate of return for the period 1915–1919 was 18.77 per cent. The percentages represent the profits on the total investment employed in the business, which includes borrowed capital. The rates of return would be greater on the capital stock and surplus, which is the net investment of these companies.

On the whole, competition in this industry is very active. It is true that there were indications that prices had been discussed by members of the American Feed Manufacturers' Association at or immediately following certain meetings of the executive committee. In 1919 also an attempt was made by certain members of this association to organize a bureau, which seems to have had price fixing as an object, but this organization was never completed. Although a careful examination was made of the correspondence files of various as-

sociations in the feedingstuffs industry and of a number of important feed manufacturers, no indications were found of any concerted action to advance prices. Although the discussions of prices above referred to may have tended to advance prices, no evidence was found to establish this. On the whole, as already indicated, the evidence obtained in the inquiry indicates a very sharp competition in the manufacture and sale of feedingstuffs.

The distribution of three important feed commodities, corn gluten feed, cane blackstrap molasses, and dried beet pulp, is in each case in the hands of a few concerns. This does not appear, however, to exclude competition in these commodities, nor does there appear to be any collusion or combination between the manufacturers in any one of the three groups.

A number of manufacturers grant overages, i. e., a commission to old dealers on feeds sold to new dealers in the former's territory. It is possible that this may be a price discrimination, and the Commission has taken steps to determine whether it is in violation of section 2 of the Clayton Act or section 5 of the Federal Trade Commission Act.

The use of alternate or different brand names for the same feed may be unfair unless the use of such alternate brands is fully understood by the dealer and the consumer. In any case it leads to an undue multiplication of brands, and it is questionable whether it is desirable from an economic standpoint.

While the Eastern Federation of Retail Feed Merchants is opposed to direct selling to consumers by manufacturers, such opposition, according to a careful examination of this association's records, is in the nature of the "educational argument" and not by boycott or threats of boycott.

Animal feeds are subject to regulation by practically all States and by the Federal Government. This regulation was found to be necessary because fraudulent practices such as adulteration and misbranding were at one time quite common. The enactment and enforcement of feed laws by the various States, however, has undoubtedly resulted in great improvement so far as these practices are concerned.

In most States feeds must be so labeled as to show the guaranteed chemical analysis and the names of each ingredient. The use of harmful or deleterious materials is generally prohibited.

The results of feed law enforcement, as reported by the different States, indicate that the great bulk of the feeds which enter into commerce have been found to be substantially equivalent to the guaranty under which they have been sold. A comparison made from published sources by the Commission of the extent to which the straight and ready mixed feeds varied from their guaranteed chemical analysis showed no consistent differences in the average percentage of deficiencies and overages as between the two classes.

Respectfully,

HUSTON THOMPSON, *Chairman.*
NELSON B. GASKILL.
JOHN GARLAND POLLARD.
VICTOR MURDOCK.
JOHN F. NUGENT.

SUMMARY.

The inquiry into the manufacture and sale of commercial feeds for animals was undertaken pursuant to Senate resolution 140, Sixty-sixth Congress, first session, which reads as follows:

Resolved, That the Federal Trade Commission be, and it is hereby, instructed to make an investigation of the manufacture and sale of commercial feeds for animals; such investigation to include the gathering of statistics as to the supply of the various commodities which are used for animal feeds, together with the fluctuation in the prices of these commodities, the extent to which these commodities are converted into concentrated food by manufacturers; what combinations or understandings, if any, exist between the feed manufacturers and wholesale feed dealers and retail feed dealers; and what fraud, if any, is practiced by dealers, in the way of misbranding or using inferior substitutes in mixed feeds.

Resolved further, That the Secretary of Agriculture be, and he is hereby, directed to cooperate with the Federal Trade Commission in this investigation.

DEVELOPMENT OF THE INDUSTRY.—Commerce in animal feeds has grown enormously in recent years. This has been due in part to the greater knowledge of feed values and of the varied requirements of live stock. Many of the feedingstuffs now widely used are by-products which were formerly wasted. Molasses, corn gluten feed, and flour-mill by-products, to name but a few, are some of the by-products which were at one time burned, run into streams, or buried for want of a better means of disposing of them.

The scientific feeding of animals began to receive serious consideration in the United States during the period 1870 to 1880, and since then has steadily grown in importance. State agricultural colleges have devoted more and more care to feeding questions. Many State and private experimental farms conduct tests and experiments with various feedingstuffs. Dairy farming and the raising of all kinds of live stock more and more demand scientific management in feeding, as well as in other matters, if the maximum return is to be realized. Although rapid progress has been made in recent years, nevertheless, most authorities agree that much is yet to be learned.

The Federal and State Departments of Agriculture, the agricultural colleges and other authorities render valuable assistance to farmers by advice on feeding problems, especially with reference to feed values and mixing their own rations. The extent to which farmers use ready-mixed feeds can not be stated, since this is dependent upon many factors. However, the use of mixed feeds has grown tremendously in recent years and appears likely to continue. That ready-mixed feeds have a place is now undisputed. They serve a beneficial purpose and to many owners of animals are almost a necessity. Their increased use has been due largely to the demand for balanced rations; the increased use of by-products; the shortage of farm labor and desire of farmers for labor-saving devices; the growth of the dairy industry on small farms near centers of popula-

tion and the increase in raising of poultry by dwellers in cities; and finally to the extensive advertising campaigns of the manufacturers of mixed feeds.

CLASSIFICATION OF FEEDINGSTUFFS.—An investigation of the animal feeds industry, to be complete, involves a study of practically every industry which uses in its manufacturing processes vegetable material and some which use animal material. The by-products of all these industries supply a large number of different kinds of feedingstuffs. In addition to these feeds there are numerous others which are not the result of manufacturing processes. It follows, therefore, that a thoroughly comprehensive investigation of animal feeds would involve a study of the manufacturing processes and of results in a large number of industries which produce as by-products materials suitable for feed. Some indication of the ramifications of the feedingstuffs industry may be appreciated from the following general classification of feedingstuffs:

1. The hays and straws.
2. The whole cereal grains.
3. Cereal mill by-products.
4. Starch and glucose by-products.
5. Brewery and distillery by-products and yeast and vinegar by-products.
6. Oil-mill by-products.
7. Sugar by-products.
8. Animal and fish by-products.
9. Miscellaneous feeds.
10. Commercial mixed feeds or proprietary feeds.
11. Condimental stock remedies or tonics.

The American Feed Manufacturers' Association has listed over 3,000 manufacturers of commercial mixed feeds and the president of this association has stated that this is very likely less than half of the total number. As a result of the foregoing facts it will be appreciated that anything like a complete survey of the feedingstuffs industry would involve an enormous expenditure of time and money. Under these circumstances the inquiry was confined to a study of the representative feedingstuffs which enter into commerce and covers the period from 1913 to 1920, inclusive.

PRODUCTION OF FEEDINGSTUFFS.—In discussing the production and supply of animal feeds the numerous feedingstuffs which do not enter into commerce must, of course, be considered. Pasturage and grazing lands are very important factors in feeding animals and the condition of such lands affects commerce in feeds very markedly. It was noted that in the fall of 1920 pasturage throughout the country was far better than usual and several important representatives of the feed trade stated that it had enabled farmers to carry their stock into the winter without purchasing as much feed as usual. An additional factor was the low price of corn, causing many farmers to feed their corn rather than sell it.

Next to pasturage in importance are the home-grown feeds, such as the cereal grains, the hays, straws, and other fodders, as well as ensilage. By far the greater part of the production of wheat, rye, and rice is handled commercially. In the case of the hays and straws,

while there is considerable commerce in them they are largely consumed where grown. This is also true of corn, oats, and barley.

The above factors affect the extent to which farmers purchase feeds. While the total value of pasturage and the home-grown feeds consumed exceeds that of the feeds sold, the latter form an important factor in the commerce of the country and their total value is enormous, exceeding a billion dollars annually.

Of the commercial feedingstuffs—that is, the feeds which enter into commerce—the hays, straws, and whole grains, exceed, both in quantity and in value, the total of all the other kinds of commercial feedingstuffs, including mixed feeds. It is not feasible to determine the exact production of these various groups.

Commerce in feedingstuffs varies greatly between the different sections of the country not only in quantity but in the kinds of feeds purchased. The prairie States buy large quantities of the high protein feeds and relatively smaller quantities of the roughages, while in the Eastern States it is necessary for many farmers to buy not only the high protein feeds but much of their roughage. This situation is responsible for the fact that the best market for mixed feeds is in the Eastern States. It should be borne in mind, however, that farmers and feeders of to-day do not as a rule depend entirely upon home-grown feeds. It is realized that variety in a ration is important, and for this reason many farmers buy concentrates to supplement their home-grown feedingstuffs, while, as previously stated, others buy practically all their feed requirements, either ready-mixed or unmixed.

The number of feedingstuffs is so large, and they are produced by so many widely scattered concerns that it was not to be expected that entirely satisfactory production statistics could be secured. However, the production of the more important feeds was determined and the figures are presented in the report. Since many of these feedingstuffs are by-products, their production is not dependent, except to a very small degree, upon the demand for them, but rather upon the demand for the main or primary product. Similarly the price of most of these by-product feeds depends to a considerable extent upon the demand and price for the primary products.

During a part of the period covered by the report the regulations of the United States Food Administration affected the production of many feedingstuffs as well as the prices at which numerous feeds were sold. The regulation requiring flour millers to obtain a higher percentage of flour than normally, reduced considerably the production of wheat mill feeds. An increase in the production of oat hulls resulted from the regulations requiring the use of wheat substitutes.

The work of agricultural scientists and others in experimenting with various products has tended to increase the supply of animal feeds. Thus, in the manufacture of tin plate considerable quantities of wheat middlings are used to absorb the palm oil through which the sheets of metal are passed during the manufacturing process. After these middlings have served this purpose they are passed over a magnetic field to remove all particles of metal, and the middlings are then sold for feed, and it is alleged that the palm oil which has been absorbed increases the feeding value of the middlings.

Numerous other factors influence the production of certain feedingstuffs. The Volstead Act affected the production of brewery and distillery by-products. In 1917 the estimated production of brewers' dried grains was 456,000 tons. In 1918 the estimated quantity produced was 377,000 tons, and in 1919 the estimated production was but 208,000 tons. A more marked decline occurred in 1920 when the estimated production was only 69,000 tons. A similar decline occurred in the production of malt sprouts.

The use of beet molasses instead of cereals in the manufacture of yeast has resulted in a decrease in the production of dried yeast grains. In 1918 the production of the largest yeast manufacturer in the United States was over 25,000 tons, and in 1920 was estimated to be about 12,000 tons. It is probable that in the future the production of this by-product will be practically negligible.

The imports of cane blackstrap molasses have increased steadily from year to year. In 1908 about 16,700,000 gallons of molasses (not above 40°) were imported from Cuba, the chief source of supply. In each succeeding year an increased amount was imported except in 1919, and it is estimated that the quantity imported from Cuba during the first eleven months of 1920 was 150,000,000 gallons.

Practically the entire quantity of cane blackstrap molasses imported into and produced in the United States is used in the manufacture of alcohol or as a feed for animals. The division of the supply between these two uses differs greatly at times, depending on various factors such as the relative price of molasses and other raw materials for alcohol manufacture, particularly corn.

Several other important feedingstuffs may also be used for purposes other than feeds. Cottonseed meal, tankage, and fish scrap are frequently used for fertilizer, although in recent years such use has decreased. It is therefore difficult to determine exactly the extent to which these commodities are used as animal feeds. However, it is possible to give estimates of the quantities so used which are satisfactory for all practical purposes.

A number of feedingstuffs are rarely used by farmers as ingredients in home-mixed rations. Practically the entire quantity of such commodities used as feeds therefore enters into mixed feeds. Among this group are flax plant by-product and clipped oat by-product. Other commodities are used in large quantities both as part of home-mixed rations and as ingredients in mixed feeds. The oil-mill by-products, corn gluten feed and dried beet pulp, are examples of this class. Other feedingstuffs, such as wheat bran, while widely used as ingredients in ready-mixed feeds, are more extensively used by farmers in mixing their own rations.

The quantities of the various feedingstuffs which are used by mixed-feed manufacturers could not be determined, even with a fair degree of accuracy, without the expenditure of time and money entirely out of proportion to the value of any results which might have been secured.

Prices of feedingstuffs.—The study of the prices of feeds is attended with considerable difficulty. In particular the comparison of the prices of commercial mixed feeds with one another, or with the prices of the straight feeds from which they are made, is difficult. This will readily appear when the great number of ingredients which

enter into many brands of mixed feeds are considered, and also the very frequent changes in formulas of many, if not most, of these feeds. Hence no such precision is to be looked for in conclusions derived from a study of prices of these feeds as is possible in the study of prices of fairly homogeneous commodities.

Prices of all kinds of feeds, both straight and ready-mixed, in common with the prices of practically all other commodities, increased greatly during the war period and for more than a year and a half following the armistice. Most feeds reached their highest prices in May or June, 1920. There were naturally considerable differences in the movement of prices of different feeds, due to their great variety and the different sources from which they are derived, there being at times a plentiful supply of some feeds and a scarcity of others. Demand, too, naturally fluctuates, but the price of every feed depends in some measure on the prices of other feeds, on account of the relative ease with which one feed can generally be substituted for another.

One of the most important influences affecting prices during the war, and much of the time since the armistice, has been the shortage of freight cars, which has not only delayed shipments of finished products, but often held up receipts of raw materials. At times this shortage has been acute, and has caused decreased production. This condition, of course, has not been peculiar to the feed business.

The wholesale prices of 10 important straight feeds and 12 commercial mixed feeds, which may be considered representative of these two classes, were compared with the composite wholesale prices of a group of 32 farm products and with a group of "all commodities," as registered by index numbers compiled by the Bureau of Labor Statistics of the Department of Labor. These index numbers give the prices of these groups of commodities by months and years relative to the average price of the year 1913 taken as a base. Composite index numbers were also computed for the group of 10 representative straight feeds and the group of 12 commercial mixed feeds.

A comparison of these different series of index numbers shows that the price of all commodities in 1919 was represented by 212 as compared with the base price of 100, or the average price of the year 1913. The other index numbers for the year 1919 were as follows: Farm products, 234; straight feeds, 236; ready-mixed feeds, 220. There was a very close correspondence in the relative prices of the mixed-feeds group, the farm-products group, and also a close correspondence in most of the years between the latter and the straight-feeds group. The relative advance in prices from 1913 to 1919 in the two classes of feeds and also in farm products was considerably higher than the advance in all commodities.

The prices of feeds as well as of all commodities continued to advance during the first half of 1920, but the second half of the year was marked by a very great decline in the prices of all feeds, both straight and ready mixed. The decline between June and December was as much as 57 per cent for some of the straight feeds. Different brands of mixed feeds declined in price from 20 per cent to more than 50 per cent.

So far as general conclusions can be drawn from the study of the statistics of feed prices the figures do not indicate a disproportionate rise in these prices as compared with farm products in general.

COSTS, PROFITS, AND RETURN ON INVESTMENT OF REPRESENTATIVE MIXED-FEED MANUFACTURERS.—A study of the costs and profits of a representative group of nine mixed-feed manufacturers during 1915–1919 shows that during the period costs of materials about doubled, while with few exceptions all other items of manufacturing costs and expenses increased in about the same proportion. Since the average cost of raw materials for the period 1915–1919, inclusive, was about 83 per cent of the commercial cost of sales, and about 80 per cent of the selling price, this would indicate that by far the largest factor causing the high prices of ready-mixed feeds in 1919 was the great increase in the cost of raw materials.

The net operating profit of these mixed-feed manufacturers was sufficient to yield a fairly high rate of return on the investment in each year, while in 1917 and 1919 the rate of return was considerably larger, due probably in part to the fact that in these two years the net operating profit included some profit realized from an increase in value of raw materials during their period of conversion into mixed feeds. The average rate of return for the period 1915–1919 was 18.77 per cent. The percentages represent the profits on the total investment employed in the business, which includes borrowed capital. The rates of return would be greater on the capital stock and surplus, which is the net investment of the companies.

COMPETITIVE CONDITIONS.—On the whole, competition in this industry is very active. This is natural in an industry which includes so many different products and such a large number of widely scattered manufacturers. The various straight feeds not only compete with one another to a greater or less extent but also with the ready-mixed feeds, and both these feeds must compete with the home-grown feedingstuffs. This competition tends to keep the prices of ready-mixed feeds and straight feeds in line with one another on the basis of their feed utility. The possibility of home mixing and the wide variety of commodities which may be substituted for one another in any mixed feed tends in no small degree to prevent unreasonable prices and probably also to prevent attempts on the part of producers of feedingstuffs to organize and combine to obtain price control.

It is true that prices were discussed by members of the American Feed Manufacturers' Association at or immediately following certain meetings of the executive committee. In 1919 an attempt was made by certain members of this association to organize a bureau which seems to have had price fixing as an object, but this organization was never completed. Although a careful examination was made of the correspondence files of various associations in the feedingstuffs industry, and of a number of important feed manufacturers, no indication was found of any concerted action to advance prices. While the discussions of prices above referred to may have tended to advance prices, no evidence was found to establish this. On the whole, as already stated, the evidence obtained in the inquiry indicates a very sharp competition in the manufacture and sale of feedingstuffs.

The distribution of three important feed commodities, corn gluten feed, cane blackstrap molasses, and dried beet pulp, is in each case in the hands of a few concerns. This does not appear, however, to exclude competition in these commodities, nor does there appear to be

any collusion or combination between the manufacturers in any one of the three groups.

TRADE PRACTICES.—A number of manufacturers grant overages, i. e., a commission to old dealers on feeds sold to new dealers in the former's territory. It is possible that this may be a price discrimination, and the Commission has taken steps to determine whether it is in violation of section 2 of the Clayton Act or section 5 of the Federal Trade Commission Act.

The use of alternate or different brand names for the same feed may be unfair unless the use of such alternate brands is fully understood by the dealer and the consumer. In any case it leads to an undue multiplication of brands and it is questionable whether it is desirable from an economic standpoint.

Many feed manufacturers sell their goods guaranteed against price decline, although a majority of them believe the practice should be stopped. Another trade practice which most manufacturers condemn and yet many indulge in, is that of long-time contracts. Both of these practices are due to competition. In an effort to do away with them members of the American Feed Manufacturers Association passed resolutions to the effect that the practices should be discontinued. However, these resolutions did not have the desired result.

DISTRIBUTION OF FEEDS.—Animal feeds reach the consumer through a system of distribution similar to that of other food products. Practically every manufacturer makes use of the retail feed dealer and in some sections of the country farmers' cooperative organizations engage in this business. Most manufacturers also are willing to make direct sales provided the purchaser is financially responsible. In such cases the manufacturers frequently allow a commission to the local retail dealer, although he may have performed no service. While the Eastern Federation of Retail Feed Merchants is opposed to direct sales to consumers by manufacturers, a careful examination of this association's records did not indicate that it resorted, either directly or indirectly, to boycott or threats of boycott as a means of preventing direct selling.

LOW-GRADE FEED PROBLEM.—There is a great lack of authoritative data in regard to many phases of the industry and there are numerous questions which are highly controversial. This is particularly the case with reference to the feed value of certain products commonly known as roughages or low-grade feeds. It is contended by some agricultural authorities and a few feed manufacturers that the use of certain of these low-grade feedingstuffs should be restricted, since, it is alleged, these feedingstuffs are roughages of which farmers produce, or should produce, an abundance. It should be pointed out, however, that in some sections of the country farmers do not produce sufficient roughages to meet their requirements. It is also frequently alleged that mixed feeds containing one or more of such low-grade ingredients are sold at prices out of line with their feed value. A number of plans have been suggested to restrict the use of these commodities, the most common one being the proposal to require the statement on tags and labels of the percentage of each ingredient used. However, important objections have been offered against the adoption of such a requirement, nor is it certain that it would achieve the result desired. It should be pointed out in con-

nection with the foregoing that much of the agitation over the use of some of these low-grade feedingstuffs is based on selfish grounds and is due largely to competition between manufacturers of mixed feeds.

Before this controversy over the low-grade feeds can be definitely and satisfactorily settled a series of exhaustive tests should be undertaken with these low-grade feeds and probably combinations of these low-grade feeds with certain high-grade feeds. Such tests should be made by a disinterested body, preferably the United States Department of Agriculture.

Guaranteed chemical analysis.—At the present time most States require that feedingstuffs be sold under a guaranteed chemical analysis, showing the minimum amount of crude protein, the minimum amount of crude fat, the maximum amount of crude fiber, and in some States the total carbohydrates contained in the feed. In addition to the chemical analysis most States require that feeds offered for sale shall have attached thereto tags or labels showing the name of each ingredient in the feed.

The chemical analysis has come to be widely recognized as an index or measure of the value of a feedingstuff. However, such use of the guaranteed chemical analysis is held to be unwise by most scientists and manufacturers. For example, it has been determined that there are several kinds of protein and that these proteins differ both in digestibility and in other qualities. Consequently merely to state that a feed contains given percentages of protein, fat, and fiber does not, it is maintained, tell the complete story. However, in spite of the insufficiency of the chemical analysis as a standard, it is the one most frequently used, and apparently must suffice until scientists have developed a better one.

Regulation.—With the growth of commerce in feedingstuffs various forms of fraud and deceit began to be practiced by manufacturers of and dealers in these commodities. These practices were responsible for the enactment of laws regulating commerce in feeds. The first feed law was enacted by Connecticut in 1895, and shortly thereafter other States also enacted statutes on this subject, until at the present time practically all States have regulated commerce in feedingstuffs. The few States which do not have specific feed laws are those in which commerce in feeds is small. The statutes of most States are quite uniform in their essential provisions, although there is such a difference in some requirements, particularly registration of brands, as to cause manufacturers considerable difficulty in meeting the requirements. A few State laws differ markedly from the majority in that they require, under certain conditions, the statement of the percentage of each ingredient in a feed. In addition to the various State regulations the Federal Food and Drugs Act of 1906 is applicable to feeds for animals.

The State and Federal authorities in charge of enforcing feed laws have formed an association known as the Association of Feed Control Officials of the United States, which has served to bring about more uniformity in matters pertaining to feed regulations. These officials adopted the policy of publicity in respect to fraudulent practices. For example, as early as 1898 Massachusetts issued a bulletin regarding the inspection of feedingstuffs in that State. This

bulletin contained advice to farmers regarding feeding matters, and cautioned them against the use of certain feeds.

The results of feed-law enforcement, as reported by the different States, indicate that the great bulk of the feeds which enter into commerce have been found to be substantially equivalent to the guaranties under which they have been sold. A comparison made by the Commission from published sources of the extent to which the straight and ready-mixed feeds varied from their guaranteed chemical analyses showed no consistent differences in the average percentage of deficiencies and overages as between the two classes.

It is undoubtedly a fact that the enactment and enforcement of feed laws has resulted in great improvement so far as fraudulent practices are concerned. There are being found to-day comparatively few cases where feedingstuffs have been adulterated with substances considered deleterious or as having practically no nutritive value.

COMMERCIAL FEEDS.[1]

CHAPTER I

ORIGIN AND SCOPE OF REPORT.

Section 1. Origin of inquiry.

This investigation was undertaken pursuant to a resolution of the United States Senate which reads as follows:

SENATE RESOLUTION 140

Resolved, That the Federal Trade Commission be, and it is hereby, instructed to make an investigation of the manufacture and sale of commercial feeds for animals; such investigation to include the gathering of statistics as to the supply of the various commodities which are used for animal feeds, together with the fluctuation in the prices of these commodities, the extent to which these commodities are converted into concentrated food by manufacturers; what combinations or understandings, if any, exist between the feed manufacturers and wholesale feed dealers and retail feed dealers; and what fraud, if any, is practiced by dealers in the way of misbranding or using inferior substitutes in mixed feeds.

Resolved further, That the Secretary of Agriculture be, and he is hereby, directed to cooperate with the Federal Trade Commission in this investigation.

FEEDINGSTUFFS COVERED.—The inquiry dealt chiefly with those commodities which enter into commerce either as ingredients in commercial or proprietary mixed feeds or those which are purchased for use in home-mixed rations. Inasmuch as the use of commercial mixed feeds is increasing yearly and there is considerable discussion regarding the feeding value of some of the ingredients used in such mixtures, especial attention was given to these feeds. The investigation did not include the whole grains and the hays and straws, except as they are used as ingredients in mixed feeds.

PERIOD COVERED.—On account of the disturbed conditions created by the war it was deemed advisable to study and compare conditions during recent years with those prevailing in 1913 and 1914. This inquiry, therefore, as a whole reviews conditions existing in the animal feeds industry during the period 1913 to 1920, inclusive.

SOURCES OF INFORMATION.—The Commission through its field agents covered the principal producing and consuming centers of animal feeds in the United States with the exception of the Pacific coast, which was not included because of the expense and time it would have involved. Representatives of all factors interested in feedingstuffs were interviewed and data as to the manufacture and sale of commercial feeds for animals were collected. In order to ascertain the profits realized by mixed feed manufacturers the Commission secured data on the subject from a representative group of manufacturers of such feeds.

[1] Subsequent to the presentation of this report to the Senate in manuscript, a few minor changes in text and figures were made in the copy submitted to the printer.

Production figures for most of the feedingstuffs and their ingredients which were covered by the investigation did not exist and the Commission was in many instances forced to rely upon estimates and computations based upon average conversion percentages. In other cases questionnaires were used to secure production data. In several instances the quantities produced could not be ascertained with sufficient accuracy to justify presentation.

Statistics of wholesale prices were secured from manufacturers and jobbers, and monthly averages of the figures from these sources are presented in this report. Price figures from the trade press and other public sources were also compiled and were used for purposes of comparison. Average prices for a few feeds computed from these published figures have been used in the tables in this report where no satisfactory figures were secured from manufacturers or jobbers.

An investigation of competitive conditions in the industry was made to determine whether or not combinations or understandings existed. The files of many feed manufacturers, dealers, and associations were examined, and the information developed therefrom was supplemented by interviews.

Many State and Federal officials charged with the enforcement of laws regulating the manufacture and sale of feeds were also interviewed. From these interviews and from published reports of these officials certain facts in regard to adulteration and misbranding have been ascertained and are here presented.

Lack of authoritative information.—The animal feeds business is of considerable size and importance. Aside from hays, straws, and the whole grains, however, feeds are largely by-products of a wide variety of industries, such as cereal milling, cornstarch and glucose factories, cottonseed, linseed, and other oil mills, sugar factories, etc. (Chap. III, secs. 2–8.) Each one of the thousands of little country flour and grist mills is a producer of feedstuffs, as are also each of the hundreds of cottonseed-oil mills, as well as a large number of small plants in various other industries scattered over the length and breadth of the United States. It is estimated that the value of feedingstuffs which enter into commerce greatly exceeds a billion dollars annually, which is probably conservative. R. W. Chapin, president of the American Feed Manufacturers' Association, has stated that the association has listed the names of over 3,000 manufacturers of mixed feeds alone, and that this very likely is less than half the total number. While, therefore, it is impossible to measure the feedingstuffs industry in any exact terms, such as total volume of production, value of feedingstuffs produced, or the number of producers, it engages the activities of a very large number of manufacturers and is geographically probably one of the most widely distributed of all manufacturing industries.

As has already been indicated, there exist only very meager statistical data concerning the feed industry. The extent of the by-product character of the feed industry, its size, and its widespread geographical distribution, explain in a considerable degree why statistics of some commodities could not be secured without the expenditure of time and money far in excess of the value of the results which might have been secured.

Furthermore, it is desired to point out that accurate information respecting several important phases of the business could not be se-

cured because representatives of the trade did not have the records from which such information could be obtained. Thus it was not possible to obtain the costs and profits of retail feed dealers, chiefly because such dealers rarely kept their records of account covering a sufficient period; and, secondly, because such few accounts as were available could not be put upon a comparable basis.

In the feedstuffs industry there are several very much disputed questions. While great progress has been made in the science of animal nutrition, authorities on the subject are not entirely in accord, and the numerous theories held by these scientists render it difficult to determine the truth. Furthermore, there is a deficiency of authoritative data supporting a number of these theories, which increased the difficulty of arriving at accurate conclusions. For example, while a number of scientists hold that certain feedingstuffs should not be used because of their low feed value, they appear to be without sufficient authoritative data, such as feeding tests, to support their contentions.

Chapter II.

THE DEVELOPMENT OF ANIMAL FEEDS INDUSTRY.

Section 1. Historical.

Introductory.—The scientific feeding of animals is of fairly recent origin. Prior to 1870 domestic animals in this country were fed in a rather haphazard manner. The feedingstuffs used were those produced by the owner of the stock, the only commerce in feeds being the comparatively small amount required by dwellers in cities and towns.

The feedingstuffs of 50 or 60 years ago were the forage crops and cereal grains. By-product feeds, i. e., the by-products of various milling and converting processes were not used for feeding in the early days, for the reason that little or nothing was known as to the utility of these products for this purpose. For the want of a better means of disposal they were frequently burned, run into streams, or buried. This is the early history of most of the by-products now commonly recognized as valuable for feeds. Flour mill by-products, molasses, corn gluten feed, to name but a few, were thus wasted. The ready-mixed feed of the present day, i. e., a feed produced by a manufacturer and containing two or more ingredients, did not of course exist at this early date. Such mixing of rations as there may have been was done by the individual farmer, who realized that stock produced to better advantage on some feeds than on others without knowing why this was true. There was nobody to explain the beneficial results that could be expected from discrimination in the use of the farmer's various home-grown products. Intensive feeding for high production of milk, fat, or work was practically unknown.

The first step from the feeding of home-grown feeds, as hays, some roots, and whole grains, toward the use of converted products, was the grinding of the whole grains before feeding them. This, however, was not a commercial proposition, strictly speaking, since the farmer carried his grains to the country gristmill to be ground.

Early commerce in feeds.—It is not the purpose of this report to give the history of each feedingstuff. Indeed it would be difficult to ascertain when many of the commodities now used as feeds were first utilized for this purpose. It may be stated with assurance, however, that it was not until after the early eighties that most of the present important by-product feeds began to be seriously considered as feed for animals. Even at that time many were still allowed to go to waste. The first commercial, or ready-mixed, feeds came into the market about this time. They were simple mixtures, such as corn and oat chops, and one oatmeal miller claimed to have been using oat hulls in a mixture.

It was in the period from 1870 to 1880 that scientific feeding of animals in the United States may be said to have begun. It was

not until about 1880, however, that the teaching of scientific feeding of animals was undertaken. About this time Dr. W. O. Atwater began teaching this subject at the Connecticut Experiment Station at Middletown, Conn. In 1883 Dr. H. P. Armsby and Prof. W. A. Henry also began teaching and demonstrating the science of feeding at the University of Wisconsin.[1] This study of animal nutrition has undoubtedly accounted for much of the success in the introduction of many of the by-product feeds.

Wheat bran was one of the by-products to be first considered as a feed. About 1883 [2] a Minneapolis miller became convinced that bran, which at that time was being run into the river, should be utilized commercially as a feed. Experiments were made with cattle fed on bran and the results were so satisfactory that this miller published a report of the tests. Shortly thereafter a demand for this product developed which has steadily increased. Other by-products were gradually discovered to be of value as feeds for animals, but European nations have been quicker than this country to realize the feed value of some of the by-products. Linseed cake for use as animal feed has been exported for 30 years, and until the advent of the European war much of this product produced in the United States was exported.

A number of by-products of various industries were first used by farmers in the vicinity of the source of supply as a supplement to the home-grown ration. The farmers hauled away these by-products and were rarely if ever charged for them. A number of by-products, however, required considerable missionary work on the part of the producers before they became widely accepted by the farmers and other feeders.

Necessity for regulation.—There being at first little or no commerce in feedingstuffs there was, of course, no necessity for regulation. As commerce in feeds increased, however, various forms of fraud and deceit began to be practiced. Feeds were quite often adulterated and misbranded, and these fraudulent practices were the direct cause of the enactment of laws regulating commerce in feeds. In 1895 Connecticut enacted the first feed law in this country. Shortly thereafter other States began to pass feed laws.

The officials enforcing the State laws, and also the agricultural colleges teaching the scientific feeding of animals, early adopted the policy of publicity in respect to fraudulent practices. In 1898 Massachusetts issued a bulletin regarding the inspection of feedingstuffs in that State. This and other early pamphlets and bulletins contained advice to farmers and cautioned them against the use of certain feeds, both straight (single ingredient) and mixed (two or more ingredients). Feeds were classified as concentrates and roughages, much as they are to-day.

The study of the science of animal nutrition steadily became of more importance. This was particularly true in sections thickly populated, where farms were small and intensively cultivated, because of the necessity of utilizing the farm products to the best advantage. State agricultural colleges devoted more and more care to feeding questions and more State legislatures enacted laws designed to

[1] The Feed Industry in the United States, G. A. Chapman.
[2] Bran had been used in some localities prior to this as a feed but so far as the Commission was able to ascertain it was not then widely regarded as a feed of value.

protect purchasers of feeds and also honest manufacturers. Dairy farming and the raising of all kinds of live stock demanded scientific management in feeding, as well as in other matters if the maximum return was to be realized.

In 1906 the Federal Food and Drugs Act was passed and a number of States without legislation affecting feeds adopted the Federal act for the regulation of commerce in foods and also feeds. Nearly all States now have some legislation regulating commerce in feeding-stuffs, but there are some of these that have not undertaken extensive activities along these lines. As a whole, however, animal feeds are subject to constant and careful policing, with the result that fraudulent practices have been greatly lessened. The officials enforcing the State and Federal laws have formed an association for the purpose of cooperation in working out their common problems. The science of animal nutrition absorbs the attention of many scientific men. Theories of feeding are developed frequently and rapid progress has been made along these lines in recent years. Numerous feeding theories have been discarded. Great as has been the advance in the scientific feeding of animals, most scientists of to-day agree that much is yet to be learned. The activities of agricultural scientists and feed-control officials have been of great service to the animal-feeds trade. Farmers receive valuable aid and advice from them and manufacturers are also assisted by the efforts of these scientists.

Farmers and feeders of today do not as a rule depend entirely upon home-grown feeds. The importance of variety in a ration is realized. Many farmers buy the concentrates to supplement their home-grown feeds. Others buy practically all their feed requirements, either ready mixed or unmixed. This latter is particularly true of the Eastern and Northeastern States and of the territory in close proximity to the larger cities where farms are small.

The use of mixed feeds has grown steadily and appears likely to continue. That these rations have a place is now undisputed. They serve a beneficial purpose by utilizing many commodities valuable as feeds which would otherwise be wasted or poorly utilized. To many owners of animals the ready-mixed feeds are almost a necessity. It is also true that mixed-feed manufacturers have done much to educate feeders and farmers in the proper care as well as the feeding of stock.

As a part of the work of the agricultural scientists many of the State agricultural institutions maintain experimental farms where feeding tests and experiments are conducted. The results of these experiments are frequently made public. Some manufacturers also conduct private experimental farms.

The growth of the mixed-feed industry has been due to several factors: The increased use of by-products; the demand for balanced rations; the shortage of farm labor and desire of farmers for labor-saving methods; the extensive advertising and educational campaigns of the manufacturers of mixed feeds; the growth of the dairy industry on small farms near the large cities; and the increase in the raising of poultry by dwellers in the cities and towns. All of these factors have played a part in this increase.

The actual growth of the mixed-feed industry is difficult to measure. The Purdue Agricultural Experiment Station (Indiana) com-

pares the sales of this class of feed with those of by-product feeds in the State of Indiana. These figures are probably typical of the important middle western territory. There are States where the percentage of mixed feeds is much higher, and some of the prairie States use a much smaller percentage.

TABLE 1.—*Comparison of sales of mixed feeds with by-product feeds, in the State of Indiana, by years, 1914–1919, inclusive.*

Year.	Compounded manufactured feeds.[1]		Straight by-product feeds.[2]	
	Tons.	Per cent.	Tons.	Per cent.
1914	69,821	26	201,930	74
1915	78,646	29	191,693	71
1916	85,826	27	231,838	73
1917	108,154	29	263,062	71
1918	145,545	34	288,654	66
1919	201,486	40	299,608	60

[1] Includes calf meals, poultry scratch feeds with and without grit, poultry mashes, chop feeds, and proprietary mixed feeds, including molasses, horse, dairy, and hog feeds.
[2] Includes such feeds as cottonseed meal, tankage, linseed oil meal, corn germ meal, hominy feed, mill by-products, bran, middlings, shorts, red dog, etc.

It is undoubtedly true that the animal feeds industry is yet in its infancy. Nevertheless it has already reached such proportions that it must be regarded as one of the important industries of the country. Many changes in the present feeding theories and practices may be expected. The movement of the population of the country to the cities is bound to have its effect upon the feeding situation. It is highly probable that the primary result will be the further increase in the use of ready-mixed rations. The situation is one which calls for much additional information as to feed values.

Section 2. Distribution of animal feeds.

INTRODUCTORY.—Feedingstuffs for animals reach the ultimate purchasers through a system of distribution common to other commodities, particularly foodstuffs. Brokers, jobbers, commission men, wholesale and retail dealers, and other distributors, are frequently used as the connecting links between manufacturers or producers of feeds and the purchasers. Then, too, as is common with many other commodities used by farmers, there are cooperative purchasing organizations through which farmers buy their feeds without the intermediary services of any of the above-mentioned distributors or middlemen. The consumer may also, under certain circumstances, purchase his feeds direct from the manufacturer or producer, as will appear later.

The number of manufacturers is so great that it is only natural to find considerable diversity in general sales policies and distributive methods. Certain trade practices are substantially uniform. Others differ widely, due to various reasons—some geographical, some dependent on inherent characteristics of the material handled, and some growing out of differences of opinion as to the best way of developing a profitable business.

The functions performed by the distributors of animal feeds are too well known to require discussion in this report. There are, how-

ever, a few points in connection with the distribution of animal feeds to which attention should be called.

USE OF BROKERS.—The producers or manufacturers of the by-product feeds usually sell their by-products through brokers. Thus, the flour mills of Minneapolis sell a large part of their wheat feeds through brokers. Cottonseed-oil crushers dispose of much of their cake, meal, and hulls, in a similar manner. It is largely because of the fact that the commodities are by-products that they are thus handled, the producers usually devoting most of their efforts to the sale of their primary products—in the foregoing cases flour and cottonseed oil. Then, too, the brokers are a never-failing outlet and furnish a channel of distribution which the producers of the by-products can apparently utilize more cheaply than to maintain their own distributing organizations.

Mixed-feed manufacturers do not distribute their feeds through brokers to as great an extent as do the producers of the by-product feeds. Most mixed-feed manufacturers maintain rather extensive sales forces and many of the larger companies have branch offices in different sections of the country.

USE OF JOBBERS.—Feed manufacturers do not distribute their products through jobbers to any great extent except in the Southern States. In that section the feed jobbers, who are usually wholesale grocers, are used because of credit conditions. These jobbers pay cash for the feeds and in turn sell on credit to the local dealers.

RETAIL FEED DEALERS.—The bulk of the feeds bought by farmers and others are purchased from retail feed dealers. Attempts apparently have been made by some retail dealers and some associations of such dealers to place their business upon a cash basis, but without much success. It was stated by the secretary of the largest association of retail dealers that the establishment of a strictly cash feed business would be almost impossible.

VALUE OF THE VARIOUS DISTRIBUTORS.—Manufacturers and producers of feeds were practically unanimous in asserting that all the various types of distributors were necessary to the efficient conduct of trade in feedingstuffs. Brokers and jobbers, so it is asserted, afford outlets for feeds at practically all times, and serve to broaden the market without adding unduly to the expense of distribution.

During the car shortage and other transportation difficulties of the past few years brokers and jobbers, it is alleged, rendered an important service in that they were able to maintain the feed supply of the retail dealer, and hence the farmer. This was due to the shipments which these distributors were able to make either from goods in transit or in their warehouses at nearby points.

The retail dealer is also alleged to be a necessity. Unless a supply of feedingstuffs is constantly and immediately available to feeders their feeding program is bound to suffer.

Section 3. The guaranteed chemical analysis.

It is not the intention to give in this report a history of the development of the science of animal nutrition, nor to discuss the various theories and practices of animal feeding. The Commission is not equipped to give this information except in so far as it may be obtained by study of published material. Much of this is available to the public in numerous works on the subject. The information nec-

essary to enable the reader to understand the chemical and scientific terms used in this report will be found in Appendix 1.

At the present time mixed feeds are sold on a guaranteed chemical analysis.[3] This guaranty consists of a statement of the minimum amount of crude protein, the minimum amount of crude fat, the maximum amount of crude fiber, and in some States, the total carbohydrates, contained in the mixture.[4] Some of the straight unmixed feedingstuffs, for example, cottonseed meal and linseed meal, corn gluten feed, etc., are also sold on a guaranteed chemical analysis, although there are a few of these feedingstuffs, such as screenings and the straight grains, which are not required to be guaranteed in this manner.

Chemists usually determine the amounts of moisture and ash contained in samples of feeds analyzed, in addition to the content of protein, fat, fiber, and carbohydrates.

The guaranteed chemical analysis as an index or measure of the value of a feed is disputed. Scientists have determined, for example, that there are several kinds of protein. The proteins differ both in digestibility and in other qualities. The same is true of fat and fiber. Consequently merely to state that a feed contains a given percentage of protein, fat, and fiber does not, it is maintained, tell the complete story. However, in spite of the fact that the chemical analysis as a standard does not give all the information that is desirable, still it is of much value, serves a very useful purpose, and apparently must suffice until scientists have developed a better one.

[3] Except in a few States not having laws requiring such guaranty.
[4] See Appendix 1.

Chapter III.

PRODUCTION OF PRINCIPAL FEEDS.

Section 1. The important commercial feeds.

Introductory.—Scores, if not hundreds, of different kinds of feeds for live stock are used in the United States.[1] Many of these are fed almost entirely on the farms where they are produced or in the neighborhood, and enter little if at all into commerce. A large number of these feeds are of importance to the farmer, dairyman, and feeder. This report, however, does not deal with this class of feeds as such, but only with those which are commonly bought and sold—in other words, the commercial feeds.

It is the purpose of this chapter to give a brief description of the principal commercial feeds, together with the statistics of their production so far as these have been secured. As already explained, however, no accurate statistics or even satisfactory estimates are available for several of the important feeds. Even less information is available concerning the extent to which the so-called straight feeds are used as ingredients in commercial mixed feeds.

Classification.—All the commercial feeds, both roughages[2] and concentrates,[3] may be divided for convenience of discussion into 11 main groups, as follows:

1. The hays and straws.
2. The whole cereal grains.
3. Cereal mill by-products.
4. Starch and glucose by-products.
5. Brewery and distillery by-products and yeast and vinegar by-products.
6. Oil-mill by-products.
7. Sugar by-products.
8. Animal and fish by-products.
9. Miscellaneous straight feeds.
10. Commercial mixed feeds or proprietary feeds.
11. Condimental stock remedies or tonics.

Hays and straws.—Hays and straws may be classed as roughages, much the greater part of the production of which is consumed on the farms. While the commerce in these commodities is large, it is not, however, of primary importance in the consideration of commercial feeds, and the Commission did not include them in this inquiry.[4]

Whole cereal grains.—Great quantities of the whole cereal grains, particularly corn and oats, are sold for feeds. Much of this whole grain is used as feed for animals. Large quantities are also purchased by the manufacturers of mixed feeds. Part of this is

[1] Woll, F. W., Productive Feeding of Farm Animals, 2d ed., p. 163.

[2] Roughages are the coarser feedingstuffs, which are higher in fiber and supply a lower percentage of digestible matter. (Henry and Morrison, 17th ed., p. 10.)

[3] Concentrates are feedingstuffs of condensed nature, which are low in fiber, and hence furnish a large amount of digestible matter. (Henry and Morrison, 17th ed., p. 10.)

[4] Alfalfa meal, which is manufactured from alfalfa hay, is an important feed which is given consideration later.

chopped or ground for use in mixed feeds, while part finds its way as whole grain into the mixtures known as scratch feeds, which are sold for poultry feeding. No complete statistics are available to show the quantities of the whole grains which are sold directly to feeders or to manufacturers of mixed feeds.

By-product feeds.—It will be noted that groups three to eight, inclusive, in the above classification include only by-products of industries which furnish food and drink for human consumption. Many of these by-products are sold directly to feeders for use in home mixing, but large quantities of all the by-product feeds are used as ingredients in commercial mixed feeds. Certain of these by-products are high in fiber and are usually classed as roughages or low-grade feeds. These feeds are considered in Chapter IV, and will therefore be only briefly mentioned in this chapter. Other by-product feeds are generally recognized as having high feeding value, and most of them are widely used both in home-mixed and in commercial-mixed feeds. These feeds are described in this chapter. Brief descriptions of the processes of manufacture by which they are derived are given in order to furnish a clearer idea of their source and character. The general opinion of the feeding value of each of the most important feeds is stated, as is the chief purpose which each serves in the nutrition of live stock. The average content of crude protein, crude fat, and crude fiber is stated for each of the more important feeds, in order to give the reader a more definite idea of their qualities.

In the description of the various by-product feeds, and of processes of manufacture, in addition to information secured by the Commission's representatives from manufacturers and others, published sources have been freely used.[5]

Section 2. Cereal mill by-products.

By-products of wheat milling.[6]—This group is a large one and may be conveniently divided on the basis of the different kinds of grain. The by-products from the manufacture of wheat flour, gen-

[5] The Association of Feed Control Officials of the United States has adopted definitions of a large number of the by-product feeds. This association is composed of feed-control officials of the several States and representatives of the Bureau of Chemistry of the United States Department of Agriculture. The adoption of definitions by the association, therefore, gives them an official character and they are generally recognized by feed-control officials and by the trade. In addition to these official definitions, the association has tentatively adopted definitions of other by-product feeds. The tentative definitions are considered by the association at its annual meetings and if found satisfactory are adopted as official definitions. Both the official and tentative definitions will be found in full in Appendix 2.

[6] Following is a brief description of the modern process of manufacturing wheat flour. The process of milling flour from rye, barley, and buckwheat is sufficiently similar not to require description in connection with the description of the by-products derived from the milling of those grains.

By the use of a series of sieves, separators, scourers, and washers the foreign material is separated from the grain and the latter thoroughly cleaned.

When wheat has been thoroughly dry cleaned by these processes, it is not generally considered necessary to wash it, but some millers prefer to wash all the wheat, afterwards subjecting it to a drying process. The grain is then tempered to make it easier to separate the outer part of the wheat kernel. This is accomplished by any one of several methods which consist in softening the grain by heat and moisture.

The grain is then subjected to a gradual process of reduction by passing between successive sets of rollers placed at decreasing distances apart, and the flour is separated from the offal by sifting. Each stage in the rolling process is called a "break." When the partly crushed grain passes from the first roll or "break" it goes to the "scalper," where it is sifted by means of a series of screens covered with wire or bolting cloth. The resulting material then passes through successive processes of rolling and sifting, the number differing in different mills.

The middlings obtained from the various rolls and sifters are mixed and constitute the part that is to be made into flour. Three important machines are used in this operation—the purifier, the smooth rolls or pulverizer, and the bolter. In the "purifier" the small particles of remaining bran are removed by the use of sieves and a current of air. The "smooth rolls" pulverize the purified middlings, and in the "bolter" the resulting material is sifted through many sieves of silk bolting cloth. The fine flour is then separated from the middlings and any remaining bran. The coarser parts are passed repeatedly through the purifier and smooth rolls and are finally separated by the bolter. The germ is ordinarily removed by bolting and purifying in the early stages of the refining process. Cf. Food Industries, by Vulté and Vanderbilt, 2d ed. (1916), Chap. V.

erally referred to as "offal," constitute from 25 per cent to 33 per cent of the weight of the entire grain and are among the most important and widely used feeds for live stock.[7]

The composition and qualities of these by-products will be better understood from the following brief description of the wheat grain.

> The wheat berry is covered by three different coatings of tough, thick-walled cells, which contain a considerable proportion of fiber * * *. Directly beneath the innermost seed-coat is a layer of cells, very rich in protein, called the aleurone layer; inside of this is the soft white portion (endosperm) of the berry, made up of cells largely filled with starch grains. These also contain protein substances, known under the name of gluten (gliadin and glutenin). Within the inner starchy portion of the berry is found the germ containing the embryo of the wheat plant. * * *
>
> The aim of the miller is to obtain all the starch cells and gluten possible from the wheat, and to avoid the germ and the bran, including the aleurone layer, which would give an undesirable yellow tinge to the flour and lower its keeping quality.[8]

Somewhat different terms are used in different parts of the country to designate these feeds, but those most commonly used are wheat bran, standard middlings or shorts, white or flour middlings, red dog, and wheat mixed feed.

Bran consists of the coarse outer coatings of the wheat kernel. It is light and chaffy and carries a considerable amount of fiber. It is probably more widely used in feeding live stock than any other single by-product. Its chief use is as a feed for dairy cattle.[9]

Middlings consist of the finer bran particles and some low-grade flour and some of the germs. Standard middlings or shorts contain little flour, while white or flour middlings contain more flour and less bran and sweepings. Middlings are very largely used as a feed for hogs.[10]

Red dog is a low-grade dark flour which generally contains some of the wheat germs and is therefore rich in crude protein and fat.[10]

Wheat-mixed feed is the entire mill-run of the residues of the wheat kernel left after separating the commercial flour.[10]

Screenings.—In addition to these by-products of flour milling the cleaning of the wheat yields more or less screenings. This product consists of broken and imperfect wheat kernels, weed seeds, and other foreign materials.[10] A comparatively small part of the screenings which enter into commerce is obtained from the cleaning preparatory to milling. Much more is obtained from the cleaning and grading of the wheat at the elevators. The characteristics and feed value of screenings are discussed in some detail in Chapter IV, section 3.

CHEMICAL COMPOSITION OF WHEAT-FLOUR BY-PRODUCTS.—The average protein, fat, and fiber content of the chief wheat-flour by-products, as determined by Henry and Morrison (17th ed., p. 634) from a very large number of analyses, is shown in the following statement:

By-product.	Crude protein.	Fat.	Crude fiber.	Number of analyses.
	Per cent.	*Per cent.*	*Per cent.*	
Bran	16.0	4.4	9.5	7,742
Standard middlings (shorts)	17.4	4.9	6.0	4,641
Flour middlings	17.8	5.0	4.7	470
Red-dog flour	16.8	4.1	2.2	259
Wheat feed	16.8	4.6	7.6	1,601

[7] Feeds and Feeding, by Henry and Morrison, 17th ed., p. 157; Principles of Feeding Farm Animals, by Slecter Bull, p. 194.

[8] Woll, Productive Feeding of Farm Animals, pp. 179-180. See also Jordan, W. H., The Feeding of Animals, pp. 243-244.

[9] Henry and Morrison, 17th ed., pp. 156-157; Bull. p. 194.

[10] Henry and Morrison, 17th ed., pp. 157-159; Bull., pp. 194-199.

Production.—The United States Grain Corporation has published statistics of the total output of wheat-flour offal for the crop years 1917–18, 1918–19, and 1919–20. Similar figures for earlier years are not available, but estimates have been made for the crop years 1913–14 to 1916–17 on the basis of the total weight of wheat used in milling [11] by assuming that 30 per cent of the wheat is recovered as mill feed. The following table shows the total estimated production in tons of wheat-flour by-products for the crop years 1913–14 to 1919–20:

TABLE 2.—*Estimated production of wheat feeds, by crop years, 1913–14 to 1919–20, inclusive.*[1]

Year.	Tons.	Year.	Tons.
1913–14	4,924,000	1917–18	4,383,000
1914–15	4,785,000	1918–19	4,300,000
1915–16	5,133,000	1919–20	5,338,000
1916–17	4,672,000		

[1] Figures for 1913–14 to 1916–17 are estimates on basis of wheat used as shown by the report of the Federal Trade Commission on Commercial Wheat Flour Milling, p. 95, by using 58 pounds per bushel to obtain total weight and assuming mill feed equals 30 per cent of the total weight. Figures for 1917–18, 1918–19, and 1919–20 are from the United States Grain Corporation figures published in supplement to Grain and Flour Statistics During the War, Table 22, p. 22.

Imports of bran and middlings entered for domestic consumption and exports of bran and middlings were, according to Foreign Commerce and Navigation of the United States, as follows:

Year.	Imports.	Exports.	Year.	Imports.	Exports.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1913–14	60,751	2,570	1917–18	61,608	6,833
1914–15	36,077	11,426	1918–19	20,796	6,213
1915–16	41,625	14,613	1919–20	44,597	2,907
1916–17	32,717	7,428			

The estimated output of mill feeds for the first four years ranged from 4,672,000 tons for 1916–17 to 5,133,000 tons in the year preceding. For 1917–18 the estimated production fell to 4,383,000 tons and for 1918–19 to 4,300,000 tons. The 1919–20 production was 5,338,000 tons or more than 1,000,000 tons greater than for 1918–19.

The Food Administration secured reports during a part of the war period from most of the wheat-flour mills, showing the quantities of bran, shorts, and middlings produced. The figures for the crop year 1917–18 are as follows: Bran, 1,797,000 tons, or 41 per cent; shorts, 1,183,410 tons, or 27 per cent; middlings, 569,790 tons, or 13 per cent, out of the total of 4,383,000 tons, as given above; the remaining 19 per cent being mixed feeds.[12]

Similiar figures are not available for the other years, and it is doubtful whether these percentages applied to the totals for other years would give correct results, on account of the differences in milling practices during the war.

BY-PRODUCTS OF RYE MILLING.—Bran, shorts, and middlings are mentioned by the writers on animal feeds as the by-products of the manufacture of rye flour, The bran and middlings are usually combined as rye feed. The Association of Feed Control Officials recognizes only rye middlings or rye feed and rye red dog flour, the

[11] Federal Trade Commission Report on Commercial Wheat Flour Milling, p. 95.
[12] War Industries Board Price Bulletin No. 8, p. 5, and No. 9, p. 15.

latter consisting of low-grade flour with some particles of bran and other offal, while the former consists of the products other than flour.

The rye flour by-products are said to resemble closely the corresponding wheat flour by-products, but authorities differ with regard to their feeding value as compared with the latter.[13] The average of 186 analyses of rye feed shows the content of protein, fat, and fiber, respectively, as 15.3 per cent, 3.2 per cent, and 4.7 per cent. These figures show a somewhat lower content of crude protein and fat and considerably lower fiber content than the corresponding figures for wheat flour by-products.

Statistics of the total production of rye flour offal are not available, but the quantity is very small as compared with that of wheat flour offal. The census figures for 1914 show the total quantity of rye ground in that year as 12,814,000 bushels as compared with 545,728,000 bushels of wheat ground.[14] While figures for this particular year may not be typical, they will answer for the purpose of a rough comparison. The corresponding figures for the census of 1919 are not yet available.

By-products of barley milling.—Barley mills produce barley flour and pearl barley for human consumption. The latter is made by removing the outer and inner husk of the grain, after which it is ground to a round form and put through a polishing process.[15] Writers on the subject of animal feeds refer to the by-product from both these processes as "barley feed" or "barley meal." The Association of Feed Control Officials, however, distinguishes in its official definitions between "barley feed" and "barley mixed feed," the former being the by-product from the manufacture of pearl barley, and the latter that from the milling of barley flour.

The barley by-products closely resemble wheat bran in composition and are said to have about the same feeding value.[16]

The averages of 13 samples of barley feed (Henry and Morrison, 17th ed.) give protein, 12.7 per cent; fat, 3.4 per cent; fiber, 7.8 per cent.

Statistics of the quantity of barley by-products produced have not been secured. They are, however, quantitatively unimportant as compared with wheat feeds.[17]

By-products of buckwheat [18] milling.—In the manufacture of buckwheat flour the by-products are hulls, and shorts or middlings. The black, woody hulls have little feeding value, but the middlings are recognized as a valuable feed, which is used almost entirely for dairy cows. Sometimes the hulls are mixed with the middlings and the product is sold as buckwheat feed, which is said to contain ordinarily from one-half to two-thirds of hulls.[19] The average content of protein, fat, and fiber, respectively, in buckwheat middlings (54 analyses) is 28.3 per cent, 7.4 per cent, and 4.8 per cent. Similar

[13] Henry and Morrison, 17th ed., p. 164; Bull. p. 203.
[14] Census of Manufacturers, 1914, Vol. II, Table 13, p. 401.
[15] Vulté and Vanderbilt, Food Industries, p. 49.
[16] Henry and Morrison, 17th ed., p. 164; Woll, p. 183, Official Definitions, Appendix 2.
[17] The census statistics for 1914 give the quantity of barley milled as 20,288,000 bushels, while, as stated above, the quantity of wheat milled in 1914 was 545,728,000 bushels. The quantity of barley milled in that year was, however, considerably larger than that of rye (12,814,000 bushels), and the rye crop in recent years has averaged only about one-third that of barley. (Department of Agriculture Year Book, 1919, pp. 542 and 549.) Presumably, therefore, the quantity of by-products from barley milling is normally considerably larger than the by-products from rye milling.
[18] Buckwheat is not a cereal botanically, but is usually classed as such for commercial purposes. (Bull. p. 205.)
[19] Henry and Morrison, 17th ed., p. 171; Woll, p. 184; Dairymen's League News, Feb. 25, 1919, p. 4.

figures for good grade buckwheat feed (18 analyses) are 19.3 per cent, 5.2 per cent, and 17.9 per cent.

Buckwheat by-products are not of very great importance on account of the small production. The milling season lasts only about four months. The number of mills is not large and the largest mill in the country produced in 1919 less than 500 tons of buckwheat feed. The census of 1914 gives the quantity of buckwheat grain milled in that year as only 5,478,000 bushels, though the total crop of that year was nearly 17,000,000 bushels. In more recent years the buckwheat crop of the United States has averaged about 16,000,000 bushels.[20]

BY-PRODUCTS OF CORN MILLING.—The principal products of the modern roller processes of corn milling are corn meal, cracked corn, hominy, hominy grits, and brewers' grits. Corn oil is also produced from the germ. Corn flour, the finely divided material separated by bolting, may be regarded as a by-product of the gradual reduction process.[21] The by-products resulting from corn milling, which are used as stock feeds, are corn bran, corn feed meal, hominy feed, and corn oil cake. Corn bran corresponds approximately to the bran obtained in the milling of wheat in the modern flour mill, and corn feed meal is a cattle feed consisting usually of a mixture of bran and fine offal, mostly of a starchy nature, obtained as a by-product in the nondegerminating process of milling corn. The ground germ is often in part an ingredient of corn feed meal.

The nature of the by-products of corn milling will be better understood from a brief description [22] of the structure of the corn kernel, which is in some respects similar to that of wheat.

There is first the outside husk, or skin, made up of two distinct layers. This is high in fiber, scarcely any being found in the other portions of the kernel. Next is a layer of cells rich in gluten. The body of the kernel surrounding the germ or embryo consists of closely compacted starch cells, though some of this interior tissue on the sides of the kernel next to the walls is flinty.[23]

Hominy feed.—Hominy feed, which is also called hominy meal, hominy chops, and corn hearts, consists of the kiln-dried mixture of the bran, germ (with or without a partial extraction of the oil), and part of the starchy portion of the corn kernel obtained in the deger-

[20] Census of Manufactures, 1914, Vol. II, p. 401; Department of Agriculture Year Book, 1919, p. 554.
[21] Department of Agriculture Bulletin No. 215, p. 5.
[22] Jordan, The Feeding of Farm Animals, pp. 252–253.
[23] There are two processes of roller milling known as the degerminating and the nondegerminating processes. The following description of the degerminating process is taken from Bulletin No. 215 of the United States Department of Agriculture entitled "Composition of Corn (Maize) Meal Manufactured by Different Processes and the Influence of Composition on the Keeping Qualities," by A. L. Winton, W. C. Burnet, and J. H. Bornmann:

"Corn is carried from the elevator or bin through a magnetic separator to remove nails, etc., then through a screen to remove large pieces of cobs or other foreign matter and over a fine screen to remove sand and grit. It is then aspirated with a strong air current to remove impurities of a light, fluffy nature.

"The cleaned corn now goes through the tempering device and to the degerminator. In the latter machine the kernels are broken open, the germs are partly broken loose from the starchy portion of the grain, and the bran is partially removed. This broken corn is dried and allowed to flow through the hominy separator. In this machine the stock is led through a revolving sheet-iron cylinder, through the metal of which are numerous narrow slots. Within this cylinder are beaters revolving in the opposite direction from the cylinder. This removes some bran and most of the rotten grains, which latter are shattered into very fine particles as they pass through the degerminators.

"From this cylinder the stock passes through a sizing reel which removes all the material fine enough to pass a number seven screen (seven meshes to the linear inch). At the same time it is aspirated to remove dust and bran. The coarse portion from this machine, which is now quite well cleaned, is passed through the first, second, and third break rolls, being screened after each break, separating flour, meal, fine grits, coarse grits, and hominy.

"As the products attain the desired degree of fineness they are aspirated thoroughly before bagging."

The degerminating process yields the important by-products known as hominy feed and corn oil cake or meal. The by-products from the nondegerminating process are corn bran and corn feed meal.

minating process. It is a palatable feed, like corn in composition, but somewhat bulkier. It contains more fat than corn and is somewhat lower in nitrogen-free extract and higher in fiber. It is highly valued as a dairy feed and for fattening steers and is also used as a substitute for corn in the rations for the other farm animals.[24]

Corn bran and corn feed meal.—The difference between corn bran and corn feed meal can not be sharply defined. Pure corn bran is the outer coating or hull of the corn kernel and does not possess high feeding value. When any considerable quantity of the germ and starchy part of the kernel is ground into the bran the product merges into what is termed corn feed meal. The feeding value of corn feed meal depends almost entirely on the grade of table meal produced.

If 20 per cent of the corn ground goes into by-product it will show about 9 per cent protein, 5 per cent fat and 9 per cent crude fiber. The percentage of protein remains almost stationary, but the percentage of fat increases and that of fiber decreases as the volume of feed advances above 20 per cent. The commercial value of corn feed meal is, therefore, entirely dependent upon the character of the milling process followed.[25]

Corn oil cake.—This is a by-product not only of the corn mills but also of the starch and glucose factories and is taken up in the next section of this chapter.

The average protein, fat, and fiber content of hominy feed, corn bran, and corn feed meal are given in the following statement from Henry and Morrison (17th ed.):

By-product.	Crude protein.	Fat.	Fiber.	Number of analyses.
	Per cent.	*Per cent.*	*Per cent.*	
Hominy feed (high grade)	10.6	8.0	4.4	778
Hominy feed (low grade)	9.5	6.2	8.5	68
Corn bran	9.7	5.7	9.8	77
Corn feed meal (corn meal or chop)	9.3	3.8	2.3	5,335

Other corn-mill feeds.—In some parts of the country the entire corn kernel is ground in small mills into a fine meal and is used as a feed for cattle, horses, hogs, and poultry. However, much of the feed product is made from that part of the kernel left after the manufacture of cracked corn or table meal, and is correctly called corn feed meal.[26]

Corn and cob meal and ground corn cobs are discussed in Chapter IV, section 2.

Production.—The Commission did not find it feasible to secure complete statistics of the production of by-products from corn milling, largely on account of the very large number of mills producing these by-products. Reliable estimates are also lacking.

The hominy feed produced prior to November, 1916, was to a large extent the by-product of hominy grits manufactured for brewing purposes. About that time there developed an abnorml export demand for corn flour and corn grits for use as substitutes for wheat flour. Exports of these products were unusually large in 1917, 1918, and 1919. During part of this time there was also a heavy domestic demand for

[24] Woll, p. 185; Henry and Morrison, 17th ed., p. 155.
[25] Statement of E. S. Miller, quoted in Price Current-Grain Reporter, Aug. 20, 1919, p. 40.
[26] Henry and Morrison, 17th ed., p. 153.

corn products as a substitute for wheat foods. This led to a greatly increased production of hominy feed. In the fall of 1920 the production of hominy feed was reported to be comparatively small on account of the withdrawal of the domestic demand for brewers' grits and the great falling off in the demand for corn flour and corn meal as a substitute for wheat flour.

Comparatively little corn bran comes on the market as such, since it is usually mixed with the other by-products.[27]

BY-PRODUCTS OF OATMEAL MILLS.—The oat by-products are obtained chiefly from the manufacture of oatmeal and other breakfast foods. Besides the primary products of the oatmeal mills, viz, oat groats, or the kernels of the oat berry, which are ordinarily used as human food, four oat by-products are recognized by the Association of Feed Control Officials. These are oat hulls, oat middlings, oat shorts, and clipped oat by-product. The first three are derived from the oatmeal mills, and the clipped oat by-product comes partly from the mills and partly from grain elevators. These by-products are described and their qualities discussed in Chapter IV, sections 5, 9, and 10.

Production.—The production of oat feed,[28] by years, 1913 to 1919, inclusive, as furnished by 11 of the principal oatmeal millers of the country, is shown in the following table:

TABLE 3.—*Production of oat feed by 11 principal oatmeal millers, by years, 1913–1919, inclusive.*[1]

Year.	Tons.	Year.	Tons.
1913	89,731	1917	202,210
1914	95,783	1918	262,294
1915	118,545	1919	169,414
1916	117,047		

[1] In addition to the domestic production of oat feed, according to Foreign Commerce and Navigation of the United States, there were imported for domestic consumption the following quantities of oat hulls (presumably oat feed):

Year.	Tons.	Year.	Tons.
1913–14	28,763	1917–18	15,433
1914–15	13,036	1918–19	17,669
1915–16	25,545	1919–20	11,229
1916–17	14,634		

The abnormally large production of the war years 1917 and 1918 is to be noted. This doubtless is accounted for by the very large production of oatmeal resulting from the demand for substitutes for wheat foods, brought about by the Food Administration's conservation program.

Similar statistics for clipped oat by-product were not secured, because this commodity comes largely from the grain elevators, and these are so numerous that it was not practicable to secure statistics from them. If the statements of the trade may be relied on, however, the tonnage of clipped oat by-product exceeds that of oat feed

[27] Henry and Morrison, 17th ed., p. 155.
[28] Oat hulls, oat shorts, and oat middlings.

given above. Practically the entire production of clipped oat by-product is used by mixed-feed manufacturers.

BY-PRODUCTS OF RICE MILLING.—The rice grain as it comes from the threshing machine, which separates the grain from the straw, is called rough rice. When damaged or sufficiently low in price the whole rough rice is sometimes used for feeding stock. But the whole grain is probably not fed extensively anywhere, and its use as a stock feed seems to be limited to the poorer grades near the place of growth.

The main product resulting from the processes of rice milling [29] is the polished rice of commerce; the by-products are bran, polish, and hulls, and in a few mills the additional by-product called pearling cone meal.

Rice hulls, as the name indicates, form the outer coating of the grain. The qualities and uses of this by-product are discussed in Chapter IV, section 6.

Rice bran is the brown covering of the rice grain or the bran layer or pericarp beneath the hull, which is removed by friction in the process of milling. Its particles are smaller and of a more delicate texture than those of wheat bran. Commercial rice bran is a mixture of the by-products from different machines. It contains small broken particles of the rice grain, some small particles of hulls, and practically the entire germ. Careful modern milling should remove most of the hull particles from the bran. Rice bran contains a high percentage of fat and moisture, and therefore is likely to heat and become rancid and cake. It loses weight and does not keep well or bear shipment over long distances. The bran will keep better if mixed with an ingredient which absorbs the fat. Two methods are used successfully to prevent heating and caking. (See also Chap. IV, sec. 6.) One is to dry the bran so as to reduce its moisture to 8 or 9 per cent. The other is to remove a part of the oil by the expeller or naphtha process. Some millers assert that drying is not needed unless the harvesting season has been wet, and that bran will keep indefinitely if properly treated and kept free from weevils.

Authorities agree that rice bran is an excellent feed, either straight or mixed, for cattle, horses, or hogs. Pure rice bran is suitable for human food.

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[29] In the milling of this rough grain for the production of the commercial polished rice for human food certain by-products result which are used as feed for live stock. The first process in milling consists in cleaning the grain, removing foreign matter, the long beard, and stems, and light or blighted grains. The cleaned grain is then run between hulling stones in order to crack or split the hulls, as the outer chaffy coverings are called. The whole product then goes to the stone reel, which is a revolving octagonal framework covered with wire screens. The fine material which passes through this reel consists of broken hulls, germs, and true bran. It is called stone-reel bran. The loose hulls are removed by suction.

In the next process the "paddy" machine separates the remaining rough rice from the hulled grains. The unhulled grains are again passed between hulling stones set closer together than the first set, and the operations are repeated till all the hulls are removed.

From the paddy machines the brown rice grains go to the "first break hullers," consisting of a grooved cylinder revolving within a concentric hollow cylinder. In this machine friction loosens the bran or outer brownish coating of the hulled grain, and the stream of rice then passes to the "first break reel," which removes the loosed bran. A second set of hullers, with parts more closely adjusted, then loosens more of the bran and the rice stream then passes to another reel, which removes the "second break bran."

In a very few mills the last two operations are increased by the addition of "pearling cones" which follow the hullers. The object of the pearling cones is to permit such adjustments of the hullers as to lessen the violence of the friction, to make the removal of the bran a more gradual process, and to diminish the proportion of broken rice grains, which must be sold at a lower price than the whole grains. The product removed by the pearling cones is called "pearling cone meal." It consists mainly of the layers which belong in the "rice polish" in mills where no pearling cones are installed.

After going through the processes described, the rice, which has become very warm from friction, is passed to large bins, where it cools for several hours. It is then passed on to the "brush." This consists of a vertical cylindrical frame covered with a thick padding of soft leather strips, the forward edge of which is fast, while the other edge is free, so as to throw it outward by centrifugal force. This causes the leather strips to rub vigorously against the stream of rice which is falling from the top of the cylinder, while the leather frame revolves rapidly within a cylinder of wire screen. This process of polishing removes by friction the last of the inner bran coats, and the fine powder resulting is called rice polish. (Department of Agriculture Bulletin No. 570, Aug. 11, 1917.)

Rice polish consists of the last bran layers and some part of the starch from the rice grain inside the bran layers. It is a fine powder with a small proportion of minute particles of broken grain and a very small part of the germ.

Rice polish is an excellent horse and cattle feed, but when fed to these animals is mixed with less concentrated feed. It may be fed straight to hogs, and when made into a slop is considered by some feeders the best hog feed known. The polish contains more starch and less protein and fat than are contained in the bran.

Pearling cone meal is the by-product resulting from the use of pearling cones, and consists of about 70 per cent bran and 30 per cent polish. It is sometimes sold under the name of pearling cone meal and sometimes mixed with and sold as either bran or polish. This by-product is not important because so few of the mills produce it.

Production.—The estimated annual production of rice bran and polish for the years 1913 to 1919 is given in the following table:

TABLE 4.—*Estimated production of rice bran and rice polish, by years, 1913–1919, inclusive.*[1]

Year.	Rice bran.	Rice polish.	Year.	Rice bran.	Rice polish.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1913	49,207	11,640	1917	66,223	16,666
1914	45,042	10,655	1918	73,743	17,445
1915	55,243	13,068	1919	78,248	18,510
1916	78,219	18,503			

[1] Compiled by statistical department Louisiana State Rice Milling Co. (Inc.). The estimate was made on the basis of an average production of 13.95 pounds of rice bran and 3.30 pounds of rice polish from a barrel (162 pounds) of rough rice.

Rice bran is used entirely as a stock feed and is consumed largely in the South. Rice polish is used to some extent in the arts, but the proportion so consumed has not been determined. Unlike rice bran it is suitable for shipping long distances. Hence it is more widely distributed than that commodity.

Section 3. Starch and glucose by-products.

The main primary products of the starch and glucose factories are the dry starches, corn sirups and sugars, the dextrines, and corn oil. In the manufacture of these commodities by-products are turned out which are important feeds for live stock. These are corn gluten meal, corn gluten feed, and corn oil cake, and corn oil cake meal. Corn oil cake meal is the ground form of corn oil cake and is also known as corn germ meal and germ oil meal.

PROCESS OF MANUFACTURE.—In the manufacture of starch and glucose products the shelled corn, which is the raw material, is first passed through a cleaning machine, which removes pieces of cob, dirt, dust, etc. It is then immersed in large steeping tanks, where it remains about two days. This causes the corn to soften and swell and the component parts are loosened. The water takes up the corn solubles and is drawn off and evaporated and the resultant material forms part of the corn gluten feed.[30] The steeped corn is then ground coarsely so that the germ is not broken, but the interior starch cells

[30] Formerly this seep water was allowed to run to waste. (Henry and Morrison, 17th ed., p. 154.)

are set free. The resultant soft mass is run into separators filled with a mixture of starch and water. The germs, which contain the oil, are lighter, rise to the surface, and flow off to screens by which they are separated from the raw starch (starch and gluten). The hulls being heavier sink to the bottom, and are also screened from the raw starch and form a part of the corn gluten feed.

The raw starch, which consists of the endosperm and is composed of starch and gluten, now passes over a series of tables. The gluten runs off at the end and afterwards forms part of the corn gluten feed. The starch settles to the bottom and is later removed. After the starch has been separated from the bran and gluten, these two latter are united and are sold as corn gluten feed. Sometimes the gluten is not mixed with the bran, but is dried and sold as corn gluten meal.

The germ of the corn, which contains considerable oil, is ground and cooked and most of the oil squeezed out in powerful presses. The residue is called corn oil cake, and, as stated above, when ground is known variously as corn oil cake meal, corn germ meal, and germ oil meal.[30a]

CORN GLUTEN MEAL.—This by-product is sometimes also called corn by-product without corn bran to distinguish it from corn gluten feed, which contains the bran or hulls in addition to the gluten. It is one of the richest concentrates in protein. One of the leading brands is guaranteed to contain not less than 40 per cent protein. The results of 307 analyses compiled by Henry and Morrison, of high-grade corn gluten meal show an average protein content of 35.5 per cent, with 4.7 per cent fat, and 2.1 per cent fiber.

Corn gluten meal, though a very valuable feed, is not of great importance commercially on account of the small production, most of it being mixed with the bran and sold as corn gluten feed.[31]

CORN GLUTEN FEED.—Corn gluten feed, or, as it is generally called, gluten feed, is also rich in crude protein, though it contains much less protein, somewhat less fat, and considerably more fiber than corn gluten meal. The leading brands on the market are guaranteed to contain 23 per cent protein. The averages determined from 800 analyses show 25.4 per cent crude protein, 3.8 per cent fat, and 7.1 per cent fiber.

Corn gluten feed is used principally as a feed for dairy cows, though it is also fed to other animals.

CORN OIL CAKE OR CORN GERM CAKE AND CORN OIL MEAL OR CORN GERM MEAL.—This by-product has already been described. Exports are made in the form of cake, while the meal is generally used in this country.[32] The protein content of this feed is somewhat lower than that of corn gluten feed, but the fat content is much higher than in either corn gluten feed or corn gluten meal. The average of 36 analyses of high-grade germ oil meal shows crude protein, 22.6 per cent; fat, 10.8 per cent; fiber, 9 per cent. Similar figures for low-grade germ oil meal, based on 22 analyses, are 13.7 per cent, 10.4 per cent, and 8.7 per cent, respectively. One well-known brand on the market, however, has a guaranteed fat content of only 5 per cent, though samples analyzed by State officials showed 7 or 8 per cent of fat.

[30a] Corn and Its Uses, published by the American Manufacturers' Association of Products from Corn.
[31] Bull., p. 190; Henry and Morrison, 17th ed., p. 154.
[32] Henry and Morrison, 17th ed., p. 155.

PRODUCTION.—Practically the entire output of cornstarch and glucose products and by-products is produced by 10 companies. The Commission secured the statistics of the corn gluten feed and corn oil cake and meal produced by these companies during the years 1913–1919, inclusive. The aggregate output of these 10 companies, which may be taken as substantially the total for the United States, is shown in the following table:

TABLE 5.—*Production of corn gluten feed and corn oil cake and meal, by ten principal manufacturers, by years, 1913–1919, inclusive.*

Year.	Corn gluten feed.[1]	Corn oil cake and meal.	Year.	Corn gluten feed.[1]	Corn oil cake and meal.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1913	327,323	39,363	1917	417,111	36,494
1914	303,288	35,573	1918	497,354	40,480
1915	358,718	38,305	1919	444,826	30,812
1916	422,059	38,031			

[1] Including comparatively small quantities of corn gluten meal.

The annual production of corn gluten feed during the seven-year period covered has ranged from 303,000 tons to 497,000 tons. The average for the five-year period ending with 1919 was 428,000 tons. The output of corn oil cake and meal [33] is much smaller, being less in recent years than 10 per cent of the production of corn gluten feed.

Section 4. Brewery and distillery by-products and yeast and vinegar by-products.

The by-products of brewing and distilling which are used as feeds for live stock are called brewers' grains and malt sprouts and distillers' grains. Yeast and vinegar dried grains are obtained as by-products from the manufacture of yeast or vinegar.

PROCESSES OF MANUFACTURE.—The following brief description of the manufacture of brewers' grains and malt sprouts is taken from the Productive Feeding of Farm Animals, by F. W. Woll: [34]

Brewers' grains are the by-product obtained in the manufacture of beer. The barley is steeped in warm water and held at a warm temperature until it begins to sprout; by this process the starch content in the grain is converted into sugar (maltose), through the action of the ferment diastase found in barley. When the malted barley contains a maximum amount of sugar it is quickly dried. The tiny dry sprouts are then separated and form the feed called malt sprouts, while the remaining dried grains make what is known as malt. This is treated with large quantities of water to extract the sugar, ash, and other soluble components; the extracted malt makes wet brewers' grains, and these, on drying in vacuum, are changed into dried brewers' grains.

Distillers' grains are the residue obtained in the manufacture of alcohol and distilled liquors from cereals. The rye or corn from which the liquor is made is ground and heated in large steel drums, in order thoroughly to cook the starch grains. The ground grains are then cooled and treated with a solution of malt and part of the starch is changed to maltose or malt sugar. The sugar is changed into alcohol by the addition of yeast. The alcohol is distilled off, leaving a watery residue known as distillers' slops. These slops are often fed to steers at or near the distillery, and such cattle are known

[33] The figures do not include the output of corn mills.
[34] Page 188; see also Bull, pp. 200-201.

on the live-stock market as "distillers." Distillers' slops are also fed to hogs. The grains from the slop are also dried in driers especially constructed for the purpose and put on the market as distillers' dried grains. They consist of the hulls, germ, protein, and carbohydrates of nutritive value. Corn makes the best and rye the poorest distillers' grains.[35]

Yeast and vinegar dried grains are described as follows:

> Yeast or vinegar dried grains are the dried residue from the mixture of cereals, malt and malt sprouts (sometimes cottonseed meal), obtained in the manufacture of yeast or vinegar. They consist of corn or corn and rye, from which most of the starch has been extracted, together with malt added during the manufacturing process to change the starch to sugars, and malt sprouts (sometimes cottonseed meal), added during the manufacturing process to aid in filtering the residue from the wort and serve as a source of food supply for the yeast.[36]

CHARACTERISTICS OF BREWERY AND DISTILLERY FEEDS.—The wet brewers' and distillers' grains are hardly to be considered commercial feeds in the ordinary sense. Though they are often sold, from their very nature it is necessary to use them shortly after they are made and near the place of production. They can not be shipped long distances. On the other hand, dried brewers' and distillers' grains can be kept indefinitely and shipped like other commercial feeds.[37]

Brewers' dried grains are said to be an excellent feed for cattle and horses but not fitted for hogs on account of their high content of crude fiber.

According to Henry and Morrison, the average of 431 analyses of brewers' dried grains shows crude protein, 26.5 per cent; fat, 6.9 per cent; and fiber, 14.6 per cent. The corresponding results for 139 analyses of samples containing less than 25 per cent protein were 23.1 per cent, 6.4 per cent, and 15 per cent, respectively.

Malt sprouts are a light, bulky, and somewhat dusty feed. They contain a considerable amount of protein but are said to be not very palatable. On account of its dustiness this feed is either mixed with other concentrates or with silage, or is moistened or soaked before it is used. It is an especially valuable dairy feed and may be used in limited quantities for other animals. The average of 253 analyses of malt sprouts showed 26.4 per cent protein, 1.5 per cent fat, and 12.6 per cent fiber.

Distillers' dried grains make a rich and valuable feed for farm animals. In the rye grains the protein content is 30 per cent or less, while in the better grades the protein may run as high as 34 to 36 per cent, with 10 to 12 per cent of fat or more. The distillers' dried grains, according to one of the textbooks on animal nutrition, "have a high digestibility and must be classed among our most satisfactory and economical protein feeds, of a value nearly similar to oil meal when fed in rations for dairy cows."[38] They are said to be unsuitable for hogs, except in small amounts, on account of their high fiber content.

It is said that yeast and vinegar dried grains probably have a feeding value similar to distillers' dried grains.

PRODUCTION.—The estimated annual production of brewers' dried grains and malt sprouts for the fiscal years ending June 30, 1913 to 1920, inclusive, is shown in the following table:

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[35] Woll, pp. 189–190, and Bull, p. 192.
[36] Bull, p. 231.
[37] Woll, pp. 188–189.
[38] Woll, p. 190; see also Bull, pp. 192–193.

TABLE 6.—*Estimated production of brewers' dried grains and malt sprouts, by fiscal years ended June 30, 1913–1920, inclusive.*[1]

Fiscal year.	Brewers' dried grains.	Malt sprouts.	Fiscal year.	Brewers' dried grains.	Malt sprouts.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1913	490,000	54,000	1917	456,000	51,000
1914	496,000	55,000	1918	377,000	42,000
1915	449,000	50,000	1919	208,000	23,000
1916	440,000	49,000	1920	69,000	7,700

[1] This estimate of the output of brewers' dried grains and malt sprouts is based on the statement by the United States Brewers' Association that the by-product from the production of 60,000,000 barrels of beer will amount to 450,000 tons of dried grains and 50,000 tons of malt sprouts. The output of fermented liquors by fiscal years was as follows: 1913, 65,324,876; 1914, 66,189,473; 1915, 59,808,210; 1916, 58,633,624; 1917, 60,817,379; 1918, 50,266,216; 1919, 27,712,648; and 1920, 9,231,280 barrels. (Report of Commissioner of Internal Revenue, 1918, p. 169, and 1920, p. 171.)

No satisfactory statistics or estimates of the production of distillers' dried grains were secured. This product is naturally of comparatively small importance since the advent of nation-wide prohibition.

Statistics of yeast-dried grains were secured from the leading producer. The annual output for this concern from 1913 to 1919, inclusive (with an estimate for 1920), was as follows:

TABLE 7.—*Production of yeast-dried grains by the principal manufacturer, by years, 1913–1920, inclusive.*

Year.	Tons.	Year.	Tons.
1913	11,576	1917	22,381
1914	13,515	1918	25,698
1915	15,903	1919	14,852
1916	22,555	1920	[1] 12,000

[1] Estimated by producer.

It is stated on competent authority that probably not more than 1,000 tons of yeast-dried grains are produced yearly by other manufacturers. It is also stated that most of this commodity goes directly to feeders and probably very little into commercial mixed feeds.

Most of the yeast manufacturers have recently substituted beet molasses for cereals as the raw material in the manufacture of yeast. In the future, therefore, it is probable that the supply of yeast grains will be negligible. It will be noted that the estimated production for 1920, as shown in the above table, was less than half the production for 1918.

The total production of vinegar grains for the United States is comparatively small.

Section 5. Oil-mill by-products.

The oil-mill by-products are the residues left after the extraction of the oil from various seeds and nuts. By far the most important among these are cottonseed by-products and flaxseed by-products. Peanut cake and meal, coconut-oil meal, and soy-bean cake and meal may also be mentioned as important feeds in this group. The minor oil-mill by-products are those derived from sunflower seed, rapeseed

sesame seed, hempseed, palm nuts, and a few others. Most of these are little used in this country but are better known in Europe.

COTTONSEED BY-PRODUCTS.—Cotton seed was long used in mixtures with bran, meal, etc., as an animal feed; but the modern uses of cottonseed oil have made the whole seed too valuable to be used to any extent directly as feed. The chief by-products from the manufacture of cottonseed oil are cottonseed cake and meal, cold pressed cottonseed cake, cottonseed feed, cottonseed hulls, and the so-called cottonseed hull bran, all of which are used as feed.

Process of manufacture and description of by-products.—When cotton seed comes from the gin there is a furry coat of very short fibers adhering tenaciously to the seed. This fibrous material is called linters or hull fiber. Some varieties of cotton seed have very little of this hull fiber and others as high as 200 pounds or more per ton of seed.

When the linters have been removed the seeds appear black and of an irregular oval shape. The average size is that of a small pea and the outer covering or hull is of a smooth, hard texture. Within this thick, hard hull is the folded embryo of the cotton plant, the kernel or meat of the cotton seed. It contains the oil and most of the other materials which give the seed value as a feed and fertilizer. Wide differences are found in the chemical composition of cotton seed according to the part of the cotton belt in which they are grown, and these differences show markedly in all the cottonseed products.

The process of extracting the oil from the cotton seed involves the following steps: Removing all dirt and foreign matter from the seeds; stripping the seeds of the linters or hull fibers; opening the seeds; separating the kernels or meats from the hulls; crushing and steaming the meats; wrapping and molding the meats for the presses; extracting the oil in hydraulic presses.

These processes yield the main product—cottonseed oil—and the by-products, linters, hulls, and, cake, as the residue is called after the greater part of the oil has been expressed. When this cake is ground it is called cottonseed meal. Various uses are made of the linters, but only the cake, meal, and hulls are used as animal feeds. Cottonseed feed is the product resulting from the mixture of greater or less quantities of hulls with the meal. (See Chap. IV, sec. 8.)

Cottonseed hulls.—Cottonseed hulls have already been described as the thick, hard outer covering of the seeds. Their composition and qualities are considered in Chapter IV, section 8. It is sufficient to mention the fact that they are generally regarded as having comparatively low feeding value, and that, other things being equal, the greater the amount of hulls included with the meal the lower will be the protein content of the product.

The hulls are sometimes finely ground and freed from the particles of lint which were left in the delinting process, the resulting product being commonly but erroneously called cottonseed hull bran.

Cottonseed cake.—It has already been stated that the hard residue of the meats after the oil is expressed is called cottonseed cake. It is in slabs 13½ by 32 inches and about 1 inch thick. This by-product differs considerably in its content of ammonia and protein, owing to natural causes, arising from differences in seed, climate, and seasons. Moreover, the cake as it comes from the press always contains more or less hull particles. It is impossible to separate the hulls from the

meats perfectly with the present machinery. The cake may contain as high as 20 per cent (by weight) of hulls or as low as 6 to 8 per cent. The average is about 12 to 15 per cent. Authorities differ on the proportion of hulls which should be left with the meats in order to secure the best results in extracting the oil, some crushers asserting that the best oil extraction is secured when the meats are freest from hulls. Those who argue for the presence of hulls with the meats say that the drainage of oil is better, and that unless a mill is fully equipped with the best modern machinery it can not operate most efficiently by pressing the pure meats. While present milling methods do not enable the oil miller to determine beforehand exactly the percentage of hulls which will go with the meats, the machinery and methods are such that he can approximate the minimum of 6 per cent, if he will equip his mill with available machines. On the other hand, he can approximate some high proportion of hulls up to 20 per cent, if he believes it profitable to do so.

There is no opportunity to mix into cottonseed cake more hulls than were left in the process of separating the hulls from the kernels. For this reason some purchasers prefer to buy cake rather than the meal, for they thus secure a more uniform product and one which could not have been adulterated by the addition of extra hulls. Some mills cut the cake into small lumps and sell these sacked. By far the greater part of the cottonseed cake manufactured, however, is ground into meal. Exports are generally in the form of cake.

Cottonseed meal.—When the cake is ground a quantity of ground hulls may be poured into the hopper, giving the meal a higher percentage of hulls than was in the cake. After the operation of grinding the cake has been completed it is also possible to mix any proportion of ground hulls with the meal. Another practice is the blending of two meals having different percentages of protein to produce a meal of intermediate protein content. By these means meals can be made which differ considerably in protein content and hence in feeding and market values.

About 20 per cent of the oil mills are equipped to grind cottonseed hulls and not more than 2 per cent are equipped to remove from the hulls the fine particles of lint or hull fiber which are left after the delinting process. At least one mill of the latter class produces ground cottonseed hulls and sells them to the trade and to other mills. It is probable that other mills similarly equipped manufacture ground hulls solely for use in their own plants, and some of the mills which grind the unrefined hulls may supply these to other mills not equipped for grinding the hulls. Some dealers in cottonseed meal maintain a plant for grinding hulls and mixing the ground product with meal, in order to reduce its protein content.

The assertion is made by some oil millers and chemists who serve the trade that it is scientific and proper to restore to the product of the cottonseed meats all the hulls taken from them, so that the meal shall contain all the hulls that originally went with the kernels from which it is made. This would necessitate adding ground hulls to the meal either during or after the grinding process. Some who defend this position hold that it is unfair to call this adulteration, since it is merely putting together materials which grew together in

nature. Others defend the practice of adding ground hulls to the meal on the ground that this method enables them to supply a meal having the protein content demanded by the purchaser.

In opposition to this practice others assert that it is adulteration, that the product should bear another name, and that products made in this way are not uniform.

Decline in protein content of cottonseed meal.—Much has been said in recent years about the decline in the percentage of protein in cottonseed meal. There seems to be ample evidence that there has been such a decline, and there can be little doubt that this has been due mainly to an increase in the proportion of ground hulls present in the meal. The fact that the percentage of protein in cottonseed meals has been decreasing in the past 20 years is rather forcibly illustrated by the following table. This shows average results of analyses of cottonseed meal made at the Massachusetts Experiment Station since 1897. The number of samples analyzed seems to be sufficiently large to furnish accurate data for generalization.

TABLE 8.—*Average results of analyses of cottonseed meal made at the Massachusetts Experiment Station, 1897–1919.*[1]

Year.	Number of samples.	Protein.	Fat.	Fiber.
		Per cent.	*Per cent.*	*Per cent.*
1897–1902	93	46.2	11.2	5.8
1902–1906	190	45.4	9.6	6.4
1906–1911	85	42.0	9.2	7.3
1911	30	41.0	8.2	7.7
1912	64	41.0	7.7	8.4
1913	87	40.2	7.7	9.2
1914	50	40.2	7.6	9.4
1915[2]	70	41.2	7.7	9.6
1916[2]	72	39.7	7.1	10.5
1917[2]	79	38.3	7.0	11.7
1918[2]	92	37.0	6.6	12.4
1919[2]	55	36.6	6.7	12.4

[1] Mass. Agricultural Experiment Station Bulletin No. 158 (December, 1914), p. 62; Control Series, Bulletin No. 10 (October, 1918), p. 21; Control Series Bulletin No. 11 (November, 1919), p. 30.

[2] The figures cover the period beginning Sept. 1 of the preceeding year and ending Apr. 30 of the given year.

It will be noted that there has been an almost steady decline in the percentage of protein in cottonseed meals analyzed at the Massachusetts Experiment Station, a considerable decrease in fat content, and a constantly increasing percentage of fiber. The average protein content of these samples has fallen from 46.2 per cent for the years 1897–1902 to 36.6 per cent in 1919. As the protein content decreased the per cent of fiber increased from 5.8 per cent in the period 1897–1902 to 12.4 per cent in 1919. This points to the substitution of hulls for part of the protein-bearing kernels. The per cent of fat as well as that of protein has decreased in rather marked degree, but this is partly explained by improvements in oil extraction. The best extraction leaves about 6 per cent of oil in the cake.

The decline in protein content was hastened by conditions during the World War. The great demand for linters for munitions purposes led to a more thorough delinting of the seed than had previously been the practice. This more complete delinting of the seeds caused a larger proportion of the hulls to pass through with the meats in the

process of separating hulls from meats. It is asserted that this practice made a 36 per cent protein meal a sort of temporary standard, but apparently there is a rapid movement back to the higher grade of meal used before the war. An additional factor is increased freight rates, which make the purchase of the higher protein meals relatively more profitable.

The opinion is held by some that the reduction of the protein percentage in cottonseed meal is uneconomic, because the hulls in such meal are not of sufficient value to warrant shipping them long distances. It is argued that the most economical method of feeding cottonseed meal is to buy a meal of the highest protein content and to mix it with the best roughages available at the place where the meal is fed.

It is also argued that the dissatisfaction resulting from the use of inferior meal will injure the market for all cottonseed meal, and that the temporary advantage of increased profits will be more than offset by the permanent bad effect on the trade.

State officials and others opposed to the practice of reducing the proportion of protein by the addition of hulls take the position that cottonseed meal gained a trade position and definition when it was manufactured by methods of milling which separated from the meats as much of the hulls as possible, or as much as good milling practice requires. It is therefore unfair, they say, and uneconomic and harmful to the trade to permit the sale of a product under the name of cottonseed meal which contains a higher percentage of hulls than occurs in the best methods of extraction. They hold that this product should bear a distinguishing name, in order that the buyer may be on his guard and may know exactly what he is buying.

On the other side, it is argued that the higher protein meals do not bring a price in proportion to their feed value as compared with the lower protein feeds, and that oil millers would be perfectly willing to make the higher protein meals if they could secure prices commensurate with their feed value.

Feeding value of cottonseed meal.—Cottonseed meal is a rich and economical source of protein and also an important fattening feed. However, it contains a toxic substance, and experiments and tests by experiment stations have shown that cottonseed cake or cottonseed meal is not always a safe feed. It is often fatal to swine, and calves are easily affected by its poisonous properties.

In spite of this undesirable quality, Henry and Morrison conclude that cottonseed meal is one of the most valuable feeds when used rationally, "often being the cheapest available source of protein, and through it, of nitrogen for maintaining soil fertility." These writers also say:

> This most nutritious feed, the richest in fertilizing constituents of all our common feedingstuffs of plant origin, is often spread directly on the land as a fertilizer. Obviously, its full value can be realized only when the meal is first fed to animals and the resulting manure applied to the soil.[39]

Cottonseed cake and meal are too highly concentrated to be fed alone. They must be fed with roughage, and are usually mixed with roughage and other concentrates to make a balanced ration.

[39] Henry and Morrison, 17th ed., pp. 174–175.

The following statement shows the average protein, fat, and fiber content of different grades of cottonseed meal, as determined by Henry and Morrison:

Grade.	Crude protein.	Fat.	Fiber.	Number of analyses.
	Per cent.	*Per cent.*	*Per cent.*	
Choice	44.1	9.1	8.1	2,556
Prime	39.8	8.3	10.1	1,322
Good	37.6	8.2	11.5	482

Cold pressed cottonseed cake.—In the ordinary process of oil extraction, as has been stated above, the seeds are hulled and the meats are subjected to heat before pressing. Sometimes, however, seeds which are comparatively free from lint are put into the press whole (i. e., without being hulled) and subjected to great pressure without being heated or steamed. The residue after this process has been employed is the entire seed less the oil and lint removed. The cake is sold broken into pieces of nut or pea size, or it may be ground into meal. In the latter case it is called ground cold pressed cottonseed.

This product contains the entire hulls and is therefore less highly concentrated and has a lower feeding value than cottonseed meal. Its average protein content is only about 26 or 27 per cent, whereas the minimum of protein permitted in cottonseed meal under the definitions of the Association of Feed Control Officials is 36 per cent.

The average of 64 analyses of cold-pressed cottonseed cake by Henry and Morrison showed 26.1 per cent crude protein, 7.7 per cent fat, and 24 per cent fiber.

Production.—The annual production of cottonseed cake and meal and cottonseed hulls, as reported by the Bureau of the Census, is shown in the following table for the years 1913–1919, inclusive.

TABLE 9.—*Estimated production of cottonseed cake and meal, together with exports and estimated domestic consumption; also estimated production of cottonseed hulls, by years, 1913–1919, inclusive.*[1]

Year.	Cotton seed.		Cake and meal.					Hulls produced.
	Produced.	Crushed.	Produced.	Exported.	Domestic consumption.			
					Total.	Feed.	Fertilizer.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1913	6,305,000	4,847,628	2,220,000	399,987	1,820,013	1,080,013	740,000	1,400,000
1914	7,186,000	5,779,665	2,648,000	739,533	1,908,467	1,025,467	883,000	1,677,000
1915	4,992,000	4,202,313	1,923,000	528,611	1,394,389	753,389	641,000	1,220,000
1916	5,113,000	4,479,176	2,225,000	575,080	1,649,920	907,920	742,000	969,000
1917	5,040,000	4,251,680	2,068,000	22,340	2,045,660	1,356,660	689,000	996,000
1918	5,360,000	4,478,508	2,170,000	155,813	2,014,187	1,291,187	723,000	1,137,000
1919	5,074,000	4,012,704	1,817,000	224,786	1,592,214	986,214	606,000	1,143,000

[1] All figures except those showing distribution of domestic consumption between feed and fertilizer were obtained from Bulletin 145, published by the Bureau of the Census on Cotton Production and Distribution, 1919–20, p. 96.

The quantity of cottonseed meal used as fertilizer was taken as one-third of total production according to estimate of Department of Agriculture. (See Bulletin 798, 1919, p. 11.)

The domestic consumption for feeding purposes was computed by deducting the estimated quantity used as fertilizer from the total production of cake and meal less exports.

The figures for quantity of seed produced relate to the growth year, and quantity crushed and cake and meal produced to the year beginning Aug. 1, while export figures are for the year ending June 30 following.

Imports of cottonseed cake have been comparatively small. During the four fiscal years ended June 30, 1916, the largest imports were 5,787 tons in the fiscal year 1915. For the subsequent years imports were as follows: 1917, 17,141 tons; 1918, 14,939 tons; 1919, 25,689 tons; and 1920, 17,547 tons.

FLAXSEED BY-PRODUCTS.—The manufacture of linseed oil from flaxseed yields the by-product linseed oil cake or meal, which is a very valuable stock feed. Other flax by-products are flax feed or screenings, which are referred to in Chapter IV, section 2, and unscreened flax oil feed, the by-product resulting from the extraction of the oil from unscreened flaxseed. There is also a by-product from the manufacture of rugs from the flax plant, known as flax plant by-product,[41] which is also described in Chapter IV, section 2.

Process of manufacture.—Flaxseed is very rich in oil. On the average about 19 pounds of oil are extracted from a bushel of seed (56 pounds). There are two methods of extracting the oil, called respectively, the old process and the new process. By the old process the oil is extracted from the cleaned seeds by crushing and pressure, while by the new process it is dissolved out of the crushed seed with naphtha or some other volatile solvent. The oldest method was to subject the cold crushed seeds to heavy pressure, which expressed from 70 to 80 per cent of the oil, the residue being a cake containing 10 to 15 per cent of oil. Later the warm-pressure process was introduced. By this method the crushed seeds are moistened, heated to 160° to 180° F., and subjected, to a pressure of 2,000 to 3,000 pounds to the square inch. This increased the oil extraction to about 90 per cent, leaving a cake containing about 6 or 7 per cent of oil.

After the removal of the oil by the old process the residue is a hard, boardlike cake about 1 inch thick, 1 foot wide, and 3 feet long. It may be sold in this form as old process linseed cake, or broken into small pieces, but usually the cake is ground into a fine meal. This is variously known as old process linseed oil meal, linseed meal, or simply oil meal. In the United States nearly all the linseed oil meal is made by the old process.[42]

The new process is described as follows:

> In the new process of manufacture the flaxseed is ground and heated to about 160° F., and is then placed in large percolators holding about 1,000 bushels or more. The seed is treated repeatedly with naphtha till practically all the oil is dissolved. Live steam is then introduced into the percolators and the naphtha gradually driven out of the mass. The meal is transferred to steam-heated driers, and, when dried, elevated to the meal bins and sacked. The naphtha is evaporated from the oil solution, and commercial linseed oil remains.[43]

Properties of linseed meal.—The average protein content of old process linseed meal is about 34 or 35 per cent, and it contains about 7.5 per cent of fat. New process meal runs higher in protein—about 37 per cent—but it contains only a small amount of fat—about 3 per cent. The following figures show the average protein, fat, and fiber content, respectively, of the meal from the two processes: Old process (714 analyses), 33.9 per cent, 7.5 per cent, 8.4 per cent; new process (182 analyses), 36.9 per cent, 2.9 per cent, 8.7 per cent.[44]

[41] This is not an oil-mill by-product, but is mentioned in this connection because it is derived from the flax plant.
[42] Woll, p. 195; Henry and Morrison, 17th ed., p. 175.
[43] Woll, p. 195.
[44] Henry and Morrison, 17th ed., p. 636.

Though the new process meal carries a higher percentage of protein, there is but little more of it digestible than in the old process meal. This lower digestibility is attributed to the use of steam for driving off the naphtha in the new process, since cooking lowers the digestibility of many foods rich in crude protein.[45]

The relative values of the old and new process meals are much discussed; it is said that many farmers are prejudiced in favor of the former, possibly because anything considered as a food is regarded with suspicion if it has been treated chemically. Prof. Jordan expresses the opinion that "no good evidence exists, however, that new process meal is less palatable or less healthful than the old process product, nor has practice demonstrated that in a general way it is less nutritious."[46]

The authorities generally regard linseed meal as a very valuable feed.[47]

Production.—While no definite figures are available showing the total production and consumption of linseed cake and meal in the United States, the following table shows the estimated production, exports, and net amount available for domestic consumption of linseed cake and meal for the seven years, 1913–14 to 1919–20:

TABLE 10.—*Estimated production of linseed cake and meal, by crop years, 1913–14 to 1919–20, inclusive.*

Crop year.	Flaxseed.			Linseed cake and meal.		
	Domestic production.	Imports for domestic consumption.	Exports.	Production.[1]	Exports.	Domestic consumption.
	Bushels.	*Bushels.*	*Bushels.*	*Tons.*	*Tons.*	*Tons.*
1913–14	17,853,000	8,652,022	305,546	440,991	331,434	109,557
1914–15	13,749,000	10,373,902	4,145	404,578	262,397	142,181
1915–16	14,030,000	14,637,543	2,614	484,136	320,458	163,678
1916–17	14,296,000	12,484,859	1,017	451,147	268,492	182,655
1917–18	9,164,000	12,785,034	21,481	366,232	75,700	290,532
1918–19	13,369,000	8,433,426	15,574	363,770	101,394	262,376
1919–20	7,661,000	23,367,328	24,044	525,075	168,168	356,907

[1] Domestic production of flaxseed plus imports for domestic consumption less exports and less 1,000,000 bushels annually for seed; 1 bushel of flaxseed estimated to produce 35 pounds of cake.

FLAX PLANT BY-PRODUCT.—Accurate figures of the production of flax plant by-product could not be secured. It appears to be produced by less than six concerns. From production figures submitted by three leading manufacturers it is believed that the average annual production of flax plant by-product for the past three years is approximately 8,000 tons.

PEANUT OIL BY-PRODUCTS.—The principal commercial peanut feeds are the by-products of the peanut oil industry, though in the South, where the peanut crop is produced, whole peanuts and peanut hay are also fed to stock. The chief by-products of the manufac-

[45] Jordan, pp. 260–263; Woll, p. 196; Bull, p. 207; Henry and Morrison, 17th ed., p. 176.
[46] Jordan, p. 262.
[47] The following statement from Henry and Morrison, 17th ed., p. 176, is typical of their views: "There is no more healthful feed for limited use with all farm animals than linseed oil cake or oil meal, with its rich store of crude protein, slightly laxative oil, and its mucilaginous, soothing properties. Its judicious use is soon apparent in the pliable skin, the sleek, oily coat, and the good handling quality of the flesh of animals receiving it. It is therefore most useful as a conditioner for run-down animals. A small amount of linseed meal is helpful in the rations for horses and dairy cows."

ture of peanut oil are peanut cake and meal and unhulled peanut oil feed.

Process of manufacture.—The machines used for crushing peanuts are the same as those used for crushing cottonseed hulls, with the exception that the delinting machines, which remove the hull fiber from the cotton seeds, are not needed in crushing peanuts. The steps in the process of manufacturing peanut oil are roughly as follows: Removing the hulls or shells from the kernels, cooking the kernels, passing the cooked kernels between rollers and pulverizing the mass of meats, molding and wrapping the meats in haircloth, submitting the molds to hydraulic pressure of 4,000 pounds to 8,000 pounds per square inch in the oil presses. This forces out most of the oil. An effort is made not to leave more than 6 per cent of oil in the residue of the meats as it comes from the presses.

Peanut cake and meal.—The hard residue remaining after the oil has been expressed is called peanut cake. The cakes are about 12½ by 32 inches by 1 inch thick. The peanut cake is more brittle than cottonseed cake and contains some hulls, since the process of separating hulls from kernels is never complete. The separation is partly under the control of the miller, who can regulate to some extent the amount of hulls left with the meats.

Peanut cake is generally ground into a meal called peanut meal. The Interstate Cottonseed Crushers' Association recognizes two grades of cake and meal, viz, choice and prime. The choice grade must contain not less than 44 per cent of protein, or 50 per cent combined protein and fat, and the prime grade not less than 34 per cent of protein or 40 per cent of combined protein and fat.[48] The average content of protein, fat, and fiber in peanut cake as determined from 2,480 analyses was, respectively, 47.6 per cent, 8 per cent, and 5.1 per cent. Peanut meal is more palatable to stock than cottonseed meal and seems to contain no toxic substance. It is too highly concentrated to feed without mixing with other feeds. Peanut meal of high grade, containing little or no hulls, has a high digestibility and feeding value. When the proportion of hulls is larger, the digestibility and feeding values are correspondingly less.

Peanut meal is in strong demand and is largely sold near the mills where it is produced. It goes mainly to feeders and feed manufacturers, but a small part, probably not to exceed 20 per cent of the product, is used as fertilizer.

The Commission was unable to secure satisfactory statistics of the annual production of peanut cake and meal.

Peanut hulls or shells.—Peanut hulls are one of the so-called low-grade feeds, and their qualities are discussed in Chapter IV, section 2.

Some States, e. g., Alabama and Georgia, forbid the use of peanut hulls as an ingredient of commercial feeds. However, some oil millers who shell peanuts report that there is a strong demand for bulk peanut hulls by mixed-feed manufacturers, the price in bulk running from $3 to $5 a ton. Other millers report that they sell hulls in bulk both to feed manufacturers and to farmers. The latter use them for bedding for animals, and also for feed and fertilizer. In some places the hulls are used mainly for fuel. They are also mixed with palm oil

[48] Rules Interstate Cottonseed Crushers' Association, 1920-21, pp. 26-27.

and used to polish tin plate. Some large oil millers grind the hulls and bolt them and make a product incorrectly called peanut-hull bran, which is used to mix with peanut meal or other concentrated feeds. Ground peanut hulls are mixed with peanut meal, usually at the time of grinding, to lower the protein content or adulterate it.

Whole pressed peanuts.—In some cases peanuts are first cleaned and then passed through expellers or hydraulic presses which force out the oil without separating the hulls and kernels. The residue when ground is called ground whole pressed peanuts, or unhulled peanut-oil feed. Under the official definition of the product the ingredients must be stated as peanut meal and hulls. (See Appendix 2.) This is a feed of excellent value, though it contains a high percentage of hulls. It is permitted under the laws of Alabama and Georgia, in both of which States peanut hulls are forbidden as an ingredient of mixed feeds.

COCONUT CAKE OR MEAL.—Coconut cake or meal is the residue left after extraction of the oil from the dried meat of the coconut, which is known as copra. The meal is variously known as coconut-oil meal, coconut meal, and copra meal. It contains about 20 per cent of protein, or considerably less than linseed meal, cottonseed meal, peanut meal, or soy-bean meal. It is especially recommended for dairy cows, since it produces a butter of good quality and firmness. It is well adapted for summer feeding, but can not be kept long in hot weather on account of its tendency to become rancid. When fresh, coconut meal has a pleasant flavor and is greatly relished by cattle and other stock.[49]

Production.—Copra, the raw material from which coconut-oil meal is produced, is entirely an imported product. The following table shows the estimated quantity of coconut-oil meal available for domestic consumption for the year 1915–1920, inclusive:

TABLE 11.—*Estimated production and domestic consumption of coconut cake and meal, by years, 1915–1920, inclusive.*

Year.	Domestic production.[1]	Imports.	Domestic consumption.	Year.	Domestic production.[1]	Imports.	Domestic consumption.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
1915	18,952		18,952	1918	75,280	17	75,297
1916	27,770	27	27,797	1919	41,674	12,705	54,379
1917	63,480	15	63,495	1920	37,481	66,794	[2] 104,011

[1] Computed from net imports of copra on the basis of 35 per cent recovery of coconut cake.
[2] Domestic exports of 264 tons of coconut meal have been deducted in arriving at this figure.

It will be seen that the quantity of this by-product manufactured in the United States increased very rapidly from 1915 to 1918, increasing from 18,952 tons in 1915 to 75,280 tons in 1918, an increase of nearly 300 per cent. In 1919, however, the imports of copra fell off so greatly that the estimated production of coconut-oil meal was not much over half that of the preceding year, while the production for 1920 was even less; but in that year so much coconut cake was imported that the total quantity available was much larger than in earlier years.

[49] Henry and Morrison, 17th ed., p. 179; Woll, p. 202; Bull, p. 214.

This decrease in the imports of copra and the resulting decrease in domestic output of coconut-oil meal is explained by the fact that in the past two years the prices of coconut oil, the main product from copra, have been relatively so low that it has been more profitable to import the oil than to import copra and manufacture the oil in this country.

SOY-BEAN CAKE AND MEAL.—This is the residue after the extraction of the oil from soy beans. The beans are crushed by the same machinery as is used in crushing cotton seed. There have been only small quantities of domestic beans available for crushing up to the present time. On the Pacific coast, oil mills have been crushing soy beans imported from the Orient for several years. There has been a ready sale for the cake and meal. Some feed manufacturers are also experimenting with soy-bean cake imported from the Orient.[50]

Soy-bean meal has a high protein content, some analyses showing as high as 48 per cent. The average of 6 analyses (Henry and Morrison) gave crude protein 41.4 per cent, fat 7.4 per cent, and fiber 5.3 per cent. Its chemical analysis and palatability give it a rank with cotton-seed meal and peanut meal as an excellent concentrate or feed ingredient. The protein has a digestibility of 97.7 per cent, and is therefore a highly digestible feed. It is too rich a concentrate to feed unmixed. It is undoubtedly of high feeding value, but so far the supply is very limited.

MISCELLANEOUS OIL-MILL BY-PRODUCTS.—Among the minor oil-mill by-products may be mentioned sunflower seed cake, rapeseed cake, sesame seed cake and meal, and palm kernel oil meal. These feeds, as already stated, are better known in Europe than in the United States, and have been used only to a very limited extent in this country.

Palm kernel oil meal.—This has been defined by the Association of Feed Control Officials as "the ground residue from the extraction of part of the oil by pressure or solvents from the kernel of the fruit of *Elaeis guineensis* or *Elaeis malanococca.*

Sesame cake.—This is the residue from the extraction of oil from sesame seed, containing about 55 per cent combined protein and fat and about 12 per cent crude fiber.

The nature of the other miscellaneous feeds mentioned above is fairly well indicated by their names. They are not of sufficient importance to need further mention or description.

The Association of Feed Control Officials gives definitions of "oil cake" and "ground oil cake." When these terms are used alone they are to be understood, according to these definitions, to designate the "product obtained from partially extracted, screened and cleaned flaxseed." When used to cover any other product the name of the seed from which it is obtained should be prefixed to the term "oil cake" or "ground oil cake." [51]

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[50] Imports of soy-bean cake for the fiscal years ending June 30, 1913 to 1920, inclusive, were as follows: 3,502 tons, 1,582 tons, 2,988 tons, 5,234 tons, 5,880 tons, 293 tons, 1,382 tons, and 8,137 tons. In addition to the above imports of soy-bean cake, the following quantities of soy beans have been imported for the fiscal years ending June 30, 1914 to 1920, inclusive; 965 tons, 1,919 tons, 1,502 tons, 2,672 tons, 15,906 tons, 1,602 tons, and 2,011 tons.

[51] For definitions, see Appendix 2.

Section 6. Sugar by-products.

DRIED BEET PULP.—The beet-sugar factories yield two by-products which are used as stock feeds, namely, beet pulp and molasses. In the sugar factory the beets are thoroughly washed and then shredded and placed in large vats. Pure water is then admitted and the sugar is soaked out by the diffusion process. The liquor is drawn off and the pulp, containing about 95 per cent of moisture, is conveyed to the driers, where after being run through presses and the moisture content reduced to about 85 per cent, it is put into the driers, where it is dried so that it contains less than 10 per cent of moisture. The drying process lasts about one hour. The pulp as it leaves the drier is immediately sacked and is ready for shipment. About 5 to 6 per cent of the original weight of the beets is recovered in the pulp.[52]

Qualities of dried beet pulp.—Dried beet pulp is a valuable feed for dairy cows, steers, and sheep, and to a limited extent for other farm animals. The protein content is low and the carbohydrate content high. It contains about 60 per cent nitrogen-free extract (N. F. E.) and about 8 or 9 per cent protein and practically no fat.[53]

Dried pulp is usually moistened for several hours before feeding.[54] It will absorb about five times its weight of water and will swell up to three times its original bulk.[55]

Production.—No complete statistics of the annual production of dried pulp are available. There were 90 beet-sugar factories in operation in the United States during the crop year 1919–20, which were owned by 42 operating companies.[56] Of these 90 factories but 47 are equipped with beet-pulp driers, and these are owned by 30 different operating companies. The quantity of beets worked in factories from 1913 to 1919 has ranged between 5,288,500 tons and 6,150,293 tons.[57] Assuming that the factories equipped with driers worked 3,000,000 tons of beets and that the recovery of dried pulp was 5 per cent, the average annual production would be 150,000 tons. On the same basis the production from the 1920 crop of 8,545,000 tons of beets worked will be in excess of 200,000 tons of dried beet pulp.[58]

BEET MOLASSES.—Beet molasses is the residue of the beet juice after that part of its contents has been removed which can be recovered by crystallization in the form of granulated sugar. It contains 60 per cent or more of nitrogen-free extract, nearly all of which is sugar. It also contains about 10 per cent of ash, mostly potash and

[52] The Sugar-Beet in America, by Franklin S. Harris, p. 169.
[53] Henry and Morrison, p. 637; Woll, p. 194.
[54] Henry and Morrison, 17th ed., p. 185; Woll, p. 195.
[55] Bulletin No. 1, published by the Agricultural Department of the Great Western Sugar Co. on The Feeding of Dried Pulp in the North Platte Valley during the feeding season of 1916–17, p. 4.
[56] Report of Federal Trade Commission, Sugar Supply and Prices, p. 22.
[57] Agriculture Department Year Book, 1919, p. 633; Monthly Crop Reporter, December, 1920, p. 148.
[58] Monthly Crop Reporter, December, 1920.

In addition to the domestic production, according to Foreign Commerce and Navigation of the United States, there were imported during the fiscal years specified the following quantities of dried beet pulp:

Year.	Tons.	Year.	Tons.
1913–14	13,649	1917–18	2,679
1914–15	5,283	1918–19	7,272
1915–16	5,683	1919–20	13,266
1916–17	915		

soda. In the beet sugar districts it is usually a cheap source of carbohydrates. In feeding beet molasses it is generally thinned with water and sprinkled over hay, cut straw, and other roughage. It is very laxative on account of its content of alkali salts and other purgative substances, and hence must be fed sparingly.[59]

Beet molasses was formerly used to a considerable extent by manufacturers of mixed feeds in the so-called sweet feeds or molasses feeds. It seems probable, however, that in the future it will be of very small importance as a commercial feed. Beet molasses has now largely displaced malted grains as the raw material for the manufacture of yeast. (Sec. 4.) This new demand seems likely largely to cut off the supply of this product for use as a feed.

CANE BLACKSTRAP MOLASSES.—"Blackstrap, or low-grade cane molasses, is the term given to the uncrystallizable residue, or syrup, obtained in the manufacture of sugar, or the sugar-refining process."[60]

It is an almost pure carbohydrate feed, differing from beet molasses chiefly in the composition of the non-nitrogenous constituents and a smaller protein and ash content. Unlike beet molasses it has a sweet taste and is very palatable. It does not have the purgative effect of beet molasses, but on the contrary tends to be costive in its action.[61] Dr. Dalrymple, of the Louisiana College of Agriculture, mentions four qualities contributing to its value as a feed—its palatability, its high carbohydrate content (about 53 per cent), the almost complete digestibility of the carbohydrates, and its cheapness under normal conditions as a source of carbohydrates.[62]

Henry and Morrison (17th ed.) point out that while the nitrogen-free extract of both cane and beet molasses is really all digestible, when molasses is fed with other feeding stuffs a depression of the digestibility of the basal ration occurs, due to the large amount of soluble carbohydrates it contains. Hence the digestibility of the nitrogen-free extract of cane molasses is reckoned at 90 per cent.[63]

Blackstrap has been used for a number of years as an appetizer and tonic for stock, but in recent years it has been used extensively as a regular ingredient of mixed rations on farms and plantations, particularly in the South, where it has been fed largely to horses, mules, and fattening steers. It is reported to have a beneficial effect on the health of animals and their working capacity.[64]

In recent years blackstrap has also taken a place as an important commercial feed, being used very extensively by manufacturers of mixed feeds in the so-called molasses or sweet feeds.

Production.—The following table shows approximately the supply of blackstrap molasses from cane sugar for recent years. The table shows first the production of blackstrap in Louisiana for the calendar years 1912 to 1919, inclusive. Figures showing the production of Louisiana blackstrap separately from other kinds of molasses are not available for the earlier years.

The import figures given in the other columns are for fiscal years from 1908 to 1918 and for the calendar years 1919 and 1920. The imports from Porto Rico and Hawaii include some higher-grade

[59] Henry and Morrison, 17th ed., p. 186; Woll, p. 192.
[60] Blackstrap Cane Molasses, by W. H. Dalrymple.
[61] Henry and Morrison, 17th ed., pp. 186–187; Woll, p. 193.
[62] Louisiana State University Extension Circular No. 38.
[63] Henry and Morrison, 17th ed., p. 187.
[64] Woll, p. 193; Louisiana Extension Circular No. 38.

molasses, and while it is not known how much this amounts to in any year, it can be stated that the quantities are very small. The import figures for Cuba and "all other" sources are for molasses not above 40° (polariscope test).

TABLE 12.—*Supply of cane blackstrap molasses, in gallons, by years, 1908–1920, inclusive.*

Year.	Production in Louisiana.[a]	Imports.			
		Porto Rico.[b]	Hawaii.[b]	Cuba.[c]	All other.[c]
Fiscal:	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
1908	.....	4,799,213	23	16,743,349	109,273
1909	.....	8,359,363	624	20,994,836	193,164
1910	.....	9,604,926	100	30,489,714	506,990
1911	.....	8,868,860	1,801,796	20,000,337	2,222,693
1912	7,756,054	10,937,670	1,734,318	25,451,085	1,521,185
1913	15,723,403	11,150,572	3,736,877	29,468,901	1,768,674
1914	11,190,908	15,577,832	4,110,404	50,171,978	626,151
1915	7,016,338	18,004,811	5,202,913	64,748,504	3,594,221
1916	14,272,535	16,279,073	8,393,014	82,501,070	3,724,062
1917	12,544,435	18,751,212	10,979,383	106,788,759	2,205,714
1918	16,101,650	14,495,752	14,671,477	126,055,181	4,624,907
Calendar:					
1919	6,649,242	15,554,493	9,882,567	110,244,781	7,554,290
1920	.....	20,770,640	12,126,132	148,062,698	11,571,746

[a] Calendar years, American Cane Growers' Association figures.
[b] Molasses and sirup.
[c] Imports for consumption of not above 40° molasses.

Total supplies of molasses from all sources are not shown in the table on account of the lack of strict comparability of the figures for the different sources, as just pointed out. It shows approximately the blackstrap available in recent years for all uses. It is not practicable to give a satisfactory estimate of the proportion used as feed. It may be stated that the two main uses of this commodity are for the production of alcohol and for feeding purposes. The division of the supply between these two uses differs greatly at different times, depending on various factors, such as the relative price of molasses and other raw materials for alcohol manufacture (particularly corn), the demand for alcohol, and the demand for sweet feeds. The control of the supply of blackstrap is practically in the hands of the producers of alcohol. (See Ch. VII, sec. 7.)

The striking feature of the table is the very great increase in the imports from various sources in a comparatively few years. Imports from Porto Rico increased from less than 5,000,000 gallons in 1908 to from 14,000,000 to 18,000,000 gallons in recent years. The imports from Hawaii, which were negligible in 1908, now run as high as 9,000,000 to 14,000,000 gallons. Cuban imports, which were less than 20,000,000 gallons in 1908, now amount to over 100,000,000 gallons annually, being nearly at 150,000,000 gallons in 1920.

As nearly as can be ascertained the total supply of blackstrap available for manufacturers in the United States has increased approximately fivefold within 10 years.

Section 7. Animal and fish by-products.

PACKING-HOUSE BY-PRODUCTS.—The packing houses make a valuable contribution to the feed industry by furnishing important by-products. These are tankage (also sold as meat scrap or meat meal), dried blood or blood meal, and ground bone or bone meal.

Tankage.—Tankage is produced from meat scraps, intestines, bones, carcasses of dead and condemned animals, etc., by cooking in specially constructed tanks, under steam pressure of about 40 pounds, for from 4 to 12 hours, the average time being from 6 to 8 hours. After most of the grease and tallow have been removed from the cooked mass, the solid material is separated from the tank water and dried and ground.[65]

Tankage is used both as a fertilizer and for feeding purposes. That which is to be used for feeding "must necessarily be more carefully prepared, and be free from stomach matter, hair, paunch manure, and excess bone; and further, must be of particularly fine grinding and of the proper color." [66]

There is considerable variation in the composition of the animal by-products according to the amount of bone included. The Association of Feed Control Officials stipulates in its definitions that digester tankage containing more than 10 per cent phosphoric acid must be designated as "digester meat and bone tankage." Similarly, meat scrap and meat meal containing more than 10 per cent of phosphoric acid must be designated "meat and bone scrap and meat and bone meal." [67]

The feeds which are by-products of the packing houses are chiefly valuable for their high protein content. The best grades of tankage are sold under a guaranty of 60 per cent protein and 6 per cent fat, while meat meal or beef scraps contain 40 to 50 per cent protein, 8 per cent or more of fat, and about 25 per cent ash, largely phosphate of lime.[68]

The average protein, fat, and fiber content of different grades of tankage, as determined by Henry and Morrison (17th ed.), are shown in the following statement:

Grade.	Crude protein.	Fat.	Fiber.	Grade.	Crude protein.	Fat.	Fiber.
Over 60 per cent	63.1	12.9	3.6	45–55 per cent	51.7	14.0	3.0
55–60 per cent	58.1	13.0	4.9	Below 45 per cent	40.4	17.0	3.7

Tankage and meat meal are used chiefly as a hog and poultry feed, but mixed with other feeds may be fed to cattle, horses, or sheep.[69]

Dried blood.—Dried blood is prepared by coagulating, drying, and grinding. The blood flowing from the slaughtered animals is conveyed as soon as possible into vats, where it is heated by means of steam until coagulated. It is then placed in press cloths and as much moisture as possible is extracted in high-power presses, after which it is passed through hot-air driers until the moisture remaining constitutes but 5 to 10 per cent of the weight. The grinding process consists in passing the material through a cage mill, which breaks up the small lumps, so that the whole mass is in suitable condition for commercial purposes. Many abattoirs do not have facilities for

[65] Federal Trade Commission, Report on the Fertilizer Industry, p. 67.
[66] The American Fertilizer Hand Book, 1919, sec. J–2.
[67] Appendix 2.
[68] Woll, pp. 204–205.
[69] Woll, p. 204; Henry and Morrison, 17th ed., p. 183.

preparing dried blood, and at such plants the blood is run in with the tankage.[70]

Ground dried blood, which is also known as blood meal or blood flour, is the richest in protein of all the packing-house by-products and probably has a higher protein content than any other live-stock feed. It carries over 80 per cent crude protein, sometimes as high as 86 per cent. It is low in mineral matter as compared with tankage. The average of 45 analyses showed crude protein, 82.3 per cent; fat, 0.9 per cent; and no fiber.

Blood meal is considered particularly valuable as an ingredient in feeds for young pigs and calves.

Raw bone meal.—This product, as the name indicates, consists of ground bone. It may be used, according to Henry and Morrison, to supply mineral matter particularly needed by young and growing animals when their rations are deficient in lime and phosphoric acid. These writers consider, however, that ground rock phosphate, which is usually cheaper, is probably just as effective as a mineral supplement.[71]

Production.—The annual production of the packing-house by-products used as feeds for live stock can be only approximately estimated, no actual figures being available. The estimates below of the production of tankage and blood are based on the figures furnished in a previous investigation,[72] by F. S. Lodge, of the Armour Fertilizer Works, as showing the average quantity of tankage and blood recovered, by good practice, per head of live stock slaughtered.

Material.	Cattle.	Calves.	Sheep.	Goats.	Swine.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tankage (10 per cent moisture basis)	12	2.4	1.2	1.2	4.8
Blood (10 per cent moisture basis)	7	.75	.5	.5	1.2
Concentrated tankage (5 per cent moisture, 10 per cent copperas, 14.5 per cent ammonia)	6	1.2	.6	.6	2.4

These per head figures applied to the total number of animals slaughtered under Federal inspection plus one-third of the estimated commercial slaughter not under Federal inspection show the following estimated production in tons of abattoir tankage and dried blood for the calendar years 1913–1919:

TABLE 13.—*Estimated production of tankage and dried blood, by years, 1913–1919, inclusive.*

Year.	Tankage.	Dried blood.	Year.	Tankage.	Dried blood.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1913	247,000	41,000	1917	274,000	48,000
1914	237,000	40,000	1918	323,000	56,000
1915	261,000	45,000	1919	311,000	52,000
1916	294,000	48,000			

While the above figures show the approximate production of animal tankage and blood, it is not definitely known what proportion of

[70] Federal Trade Commission, Report on the Fertilizer Industry, pp. 66–67.
[71] Henry and Morrison, 17th ed., p. 184.
[72] Federal Trade Commission, Report on the Fertilizer Industry, pp. 70–72.

these amounts were used as animal feed. However, a survey of the fertilizer industry made by the Department of Agriculture showed, according to returns received from 386 firms reporting and which market the bulk of the tankage and blood produced, that of 182,320 tons of high-grade tankage sold by these firms in 1918 for feed and fertilizer 43 per cent was sold for feed and 57 per cent as fertilizer. About 17.5 per cent of the 32,578 tons of dried blood handled went for feeding purposes.[73]

The demand for tankage for feeding purposes centers largely on that guaranteed to contain a minimum of 60 per cent protein, and a late estimate [74] gives about 70 per cent of the production of high-grade tankage by the large packing houses as used for hog feed.

FISH SCRAP AND FISH MEAL.—Fish scrap has long been used as a fertilizer. Fish meal, which is used for feed, is made by the same general methods as are now used in preparing dried fish s crap for fertilizer, namely, steam cooking of the raw materials, pressing, drying, and grinding. Fish meal compares favorably with high-grade digester tankage in protein content, being usually sold on a minimum guaranty of 55 per cent as against 60 per cent for high-grade tankage.

The amount of fish meal used in this country for feeding purposes is small as compared with packing-house by-products. In recent years the Department of Agriculture has made efforts to develop the production of this commodity and to secure its increased use as a feed. As a result of experiments made by the department the conclusion was reached that "the universally favorable results obtained in the feeding of fish meal appear to warrant its extended use as a supplementary feedingstuff."

The following conclusion is also stated by the department:

> Where fish meal can be obtained conveniently at a reasonable price and in suitable quantity, it has a very considerable value in pig feeding. When given a fair trial and used in proper proportions it should become one of the most popular as well as most remunerative protein supplements for pig feeding.[75]

Fish meal is also a valuable poultry feed, being used to a considerable extent in poultry mashes. It may also be fed to horses and cattle to a limited extent.[76]

Production.—The following tabulation gives the production of dried fish scrap by the menhaden industry on the Atlantic and Gulf coast and the production of fish scrap for fertilizer purposes and fish meal by the canners on the Pacific coast, by years, 1913 to 1919:

TABLE 14.—*Production of fish scrap and fish meal, by years, 1913–1919, inclusive.*

Year.	Menhaden industry fish scrap.	Pacific coast.		Year.	Menhaden industry fish scrap.	Pacific coast.	
		Fertilizer fish scrap.	Fish meal.			Fertilizer fish scrap.	Fish meal.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
1913	36,580	3,000	.....	1917	20,825	1,390	5,297
1914	24,205	2,099	1,284	1918	16,047	802	7,773
1915	21,414	1,032	2,863	1919	15,103	.....	[a] 11,795
1916	22,458	776	2,640				

[a] Fertilizer and fish meal.

[73] U. S. Department of Agriculture Bulletin No. 798 (1919), p. 8.
[74] National Provisioner, Apr. 17, 1920.
[75] U. S. Department of Agriculture Bulletin No. 378, pp. 16–20; and Bulletin No. 610, p. 9.
[76] Woll, p. 205.

The menhaden industry affords one of, if not, the greatest prospective source of supply of fish meal. It is only recently that grinding machinery has been installed by some of the fish factories centering on Chesapeake Bay. Five concerns, including two of the largest, are now equipped for making fish meal. About 3,500 tons of fish meal were sold from the 1919 production by one concern handling the greater part of the output of the menhaden fish factories. A number of mixed-feed manufacturers have for several years purchased considerable quantities of dried fish scrap and converted it into fish meal in their own factories. The production of fish meal on the Pacific coast has increased from 1,284 tons in 1914 to 7,773 tons in 1918, and to about 11,000 tons in 1919, while the fish scrap for fertilizer has steadily decreased. Two concerns in British Columbia in 1919 produced more than 1,000 tons of fish meal in addition to the 11,000 tons domestic production.

Other potential sources of fish meal are the shrimp fisheries of the South Atlantic and Gulf States and the fish canneries of the North Atlantic States.

Section 8. Miscellaneous straight feeds.

In addition to the feeds which have been described in the preceding sections there are a great many commodities which are used as feeds for live stock and which to some extent are articles of commerce. It may be repeated here that no attempt is made in these pages even to mention by name the very large number of products which are used on the farms for feeding animals but which do not enter the channels of commerce except perhaps occasionally or only locally.

Probably the only really important product so far as present use is concerned which has not already been included in the groups discussed above is alfalfa meal. Other miscellaneous feeds which have come into limited use in recent years and which rank as valuable feeds, though not so far sold in large quantities, are dried buttermilk and velvet bean meal. Another feed which is interesting, particularly on account of its source, is a product recovered after the polishing process in the manufacture of tin plate, which is known as palmo midds or palmo meal, according to the ingredients used.

Among the numerous miscellaneous commodities which are used as feeds or ingredients in feed mixtures the following may be mentioned as illustrating sources of supply. Some of these are perhaps hardly to be considered seriously as commercial products but rather as possibilities in the line of feeds. At any rate the mere fact that some of these articles are suggested as useful for stock feeding is significant of the extent to which the conservation movement has been carried in this line. The following is a partial list of minor feedingstuffs: Clover meal, cocoa shells, cull beans, ivory nut turnings, shea nut meal and morah nut meal, tomato seed waste, vegetable meal (dried ground garbage from which the oil has been removed),[77] and watermelon pulp.

Alfalfa meal.—Ground alfalfa hay is called alfalfa meal. It varies in fineness from a product nearly as fine as corn meal to a coarsely chopped or shredded material, containing pieces half an inch in length. As a substitute for alfalfa hay it has the advantage

[77] Bull, p. 230.

of being easier to ship long distances and of somewhat less waste in feeding.[78]

Henry and Morrison (17th ed.), give the average of 176 analyses of alfalfa meal, as showing, 14.3 per cent crude protein, 2 per cent fat, and 35.8 per cent nitrogen-free extract, of which 30.1 per cent is crude fiber. The average ash content is 9 per cent.

The following statement of the qualities of alfalfa and alfalfa meal has been made by the Massachusetts Agricultural Experiment Station:

The fact should be borne in mind that alfalfa either in the form of meal or in the bale is simply an excellent kind of roughage (a hay rich in protein) and does not compare either in digestibility or net available energy with the cereal grains.[79]

Production.—No statistics are available showing the exact annual production of alfalfa meal nor the amount used by the manufacturers of ready mixed feeds. Several of the largest producers and distributers of the product, however, estimated that about 400,000 tons were produced in 1919, practically all of which was used by the manufacturers of ready-mixed feeds, particularly in molasses feeds.

VELVET BEAN MEAL.—Velvet beans are regarded by the Department of Agriculture as one of the most important crops of recent introduction and as a determining factor in developing the live-stock industry in the South.

The velvet bean first came into notice as a forage and fertilizing crop about 1890, at which time it was grown almost exclusively in Florida. Later its culture was extended northward into Virginia and Tennessee. The area covered by the crop in 1917 was estimated at 5,000,000 acres. This product is of interest in this connection only as it figures as a commercial feed in the form of velvet bean meal. The following statement with reference to this feed is made by the Department of Agriculture.[81]

Velvet-bean meal is rapidly becoming a standard feed for live stock, and especially as the concentrated part of the many mixed feeds offered for sale on the market. In the manufacture of this meal the hard beans and tough pods are ground or, rather, crushed together by machinery especially designed for handling such material. No standard of fineness for grinding meal has been established, but up to a very recent period most of it was ground so as to pass through sieves having meshes one-fifth to five-eighths of an inch in size. The trade is now demanding a finer ground meal, and many mills are grinding it as fine as corn meal. This meal is preferred for the manufacture of mixed feeds. It is questionable whether it is necessary to grind the beans and pods when they are to be fed to cattle at home, as practically equal feeding results will be obtained from the use of the unground pods. At most, cracking the beans is all that is required, as they absorb water very quickly when the seed coat is broken. It is impossible to grind velvet beans finely unless they are well matured and thoroughly dry. On this account some mills kiln-dry all beans before grinding. This adds considerably to the cost of manufacture, but it is necessary early in the season in order to prevent the meal from spoiling.

Velvet beans may be ground alone or with other feeds, but when ground alone the meal should be fed in combination with other feeds. A common mixture is to grind velvet beans and corn in the shuck together. In accordance with the use to be made of the feed, velvet-bean meal is used in varying proportions in the manufacture of mixed feed. In horse feed it seldom forms more than 25 per cent of the entire mixture, while in mixed feeds for dairy cows it may run as high as 70 per cent. A popular mixed feed for dairy purposes is composed of 15 per cent cottonseed meal, 45 per cent corn-and-cob meal, and 40 per cent velvet-bean meal, while a popular horse feed contains in addition to the velvet-bean meal, corn, oats, and ground hay or straw.

[78] Henry and Morrison, 17th ed., p. 229.
[79] Massachusetts Agricultural Experiment Station Bulletin No. 11, Control Series, November, 1919, p. 23.
[81] U. S. Department of Agriculture Farmers' Bulletin No. 962, pp. 3 and 28.

DRIED BUTTERMILK.—A comparatively new and not very widely used feed is dried buttermilk, which is manufactured by only a few concerns. Dried or evaporated buttermilk is used both as a human food and as a feed for animals. The product which is used as an animal feed is made by the hot-roll process, by which the buttermilk is dried by means of hot rolls and heated metallic plates, after which it is ground. The product for human use is ground finer and then bolted.

One manufacturer of dried buttermilk gives the average analysis as follows: Crude protein, 25 per cent; crude fat, 7 per cent; nitrogen-free extract, 25 per cent; fiber, none.

It is used largely in hog feeds and laying mashes for hens, but some is disposed of for crate fattening of chickens.

SEMISOLID BUTTERMILK.—Another form in which buttermilk is sold for feeding purposes is in a semisolid condition. It is shipped in barrels. This product has apparently only recently come on the market and the quantity sold is comparatively small.

PALMO MIDDS AND PALMO MEAL.—In the manufacture of tin plate the metal sheets pass through a palm-oil bath. The plate covered with this oil coating then passes between rollers covered with sheepskin, and as the tinned plate emerges it is showered with fine-ground wheat middlings or peanut hulls, in order to absorb the oil and polish the plate. After passing between rollers again it receives another shower of middlings or ground peanut hulls, until all the oil is absorbed. A process has been discovered by which this polishing material is freed from the particles of metal which it has taken up and is made fit for use as feed. This is done by passing it through an air blower, screening it, and passing it over a magnetic field, until all traces of the metal are removed. The company which handles this product states that it has been analyzed by many State chemists, who report that they have found no injurious matter after the reclaiming process.

The reclaimed middlings are sold under the name of palmo midds, the guaranteed analysis being crude protein, 16 per cent; crude fat, 7 per cent; crude fiber, 9 per cent. A recent analysis by the Indiana State chemist showed crude protein, 17.6 per cent; crude fat, 8.7 per cent; and crude fiber, 7.7 per cent. The ground peanut hulls are also reclaimed and put on the market as palmo meal, with a guaranteed analysis as follows: Protein, 7 to 10 per cent; fat, 6 to 10 per cent; fiber, 30 to 55 per cent.

It has been said that most of these reclaimed middlings and peanut shells are produced entirely by one concern. It was stated by an officer of this company that palmo meal is sold entirely to manufacturers of mixed feeds, while the reclaimed middlings are sold as straight feeds to brokers and others, and that not more than 2 per cent goes into manufactured mixed feeds. It was also stated by the representative of this company that a very high grade of middlings is used in polishing tin plate, and that the reclaimed product is better for feeding purposes than the original middlings on account of the oil taken up in the polishing process.

It will be noted that the palmo meal carries a high percentage of fiber, owing to the character of the basic material, peanut shells. It should also be noted that peanut shells are conceded to have a very low feeding value, and if used in mixed feeds are classed as an

adulterant in several States. While this product goes almost exclusively into mixed feeds, it is so far of comparatively small importance on account of the small quantity sold.

The remaining miscellaneous feeding stuffs are not of sufficient importance to require special definition or description.

Section 9. Proprietary or ready-mixed feeds.

INTRODUCTORY.—The commercial mixed feeds are generally divided into two groups, viz, the so-called sweet feeds, which contain molasses, and the dry feeds, which do not have molasses as an ingredient. The trade recognizes the following seven distinct classes of ready-mixed feeds:

1. Dairy feeds.
2. Stock feeds.
3. Horse and mule feeds.
4. Hog feeds.
5. Poultry feeds.
6. Calf meals.
7. Condimental stock remedies or tonics.

Some of these classes may also be divided, as for example, under poultry feeds would be listed the scratch feeds, growing mashes, egg mashes, etc.

Manufacturers frequently make the complete line of mixed feeds. This is advantageous, in that it enables them to supply mixed cars to customers who are unable to buy a carload of any one kind of feed. Other manufacturers specialize on one or a very few kinds of feeds, as cattle fatteners or hog feeds. Most manufacturers make several grades or qualities of each kind of feed they manufacture. Thus manufacturers producing dairy feeds usually make high, medium, and low protein content feeds. This enables them to meet the demands of all classes of purchasers.

Mixed feeds are made for particular purposes, such as to produce milk, put on fat, or to promote the growth of animals, etc.

A mixed feed may contain only two ingredients, as the corn and oats chops and the simple alfalfa molasses feeds, or as many as twenty or more ingredients, as do some calf meals. The number of ingredients in a feed depends upon the kind of feed to be made, the ideas of the manufacturer as to what formula should or can be used and to some extent upon the availability of the different ingredients.

The kind or quantity of the several ingredients in a mixed feed is rarely uniform over a long period. (See Chap. IV, sec. 12.) A few manufacturers, however, have maintained constant formulas for long periods, but the percentages of ingredients of most mixed feeds vary considerably from time to time. This variation is due to several causes, as pointed out in Chapter IV, section 12. So great is this variability that any statement here of the ingredients in a dairy feed, for example, would be of little value.

Different methods of manufacturing mixed feeds are employed. Some feeds are ground very finely, as hog feeds; others coarsely ground, as horse and mule feeds; and still others, as scratch feeds, are not ground at all but consist merely of a mixture of grains and seeds, and at times grit.

DAIRY FEEDS.—These feeds are frequently high in protein and low in fiber, although there are numerous low protein dairy feeds on the

market. Dairy feeds, however, usually contain some of the higher protein feedingstuffs, as oil meal, corn gluten feed, or brewers' grains.

STOCK FEEDS.—Ready mixed stock feeds are used for all kinds of stock. They are usually lower in protein than the dairy feeds and frequently are high in carbohydrates. They generally contain considerable percentages of ground or crushed grains, as corn, oats, and barley, and also very often contain oat feed and screenings.

HORSE AND MULE FEEDS.—The so-called sweet or molasses horse and mule feeds usually are mixtures of alfalfa, corn, oats, and molasses, with other ingredients occasionally included. There are also horse and mule feeds which do not contain molasses and resemble the stock feeds previously mentioned. These feeds, both sweet and dry, are lower in protein than most dairy feeds.

HOG FEEDS.—The ready mixed hog feeds are usually fairly high in protein and fat and low in fiber, the fiber content being much lower than that of most dairy feeds. Naturally such feeds contain the high protein feedingstuffs, as tankage, fish meal, and oil meal. Corn, feed meal, wheat middlings, and alfalfa meal are also frequently used in hog feeds.

POULTRY FEEDS.—Some poultry feeds, as scratch feeds, are simply mixtures of cracked corn and whole grains, as oats, wheat, buckwheat, Kafir, etc. Grit is frequently included in scratch feeds. The mashes are composed of ground material, as oil meal, corn meal, meat scraps, bran, middlings, fish meal, and numerous other ingredients.

CALF MEALS.—These are usually high in protein and are designed to promote the growth of the young animal. They frequently contain many ingredients, some of which are never used in other kinds of animal feeds.

CONDIMENTAL STOCK REMEDIES OR TONICS.—The mixtures known as condimental stock remedies or tonics were not included in the investigation, since they are not considered as feeds, being used merely as tonics or conditioners. They contain many different ingredients, some of the more common ones being anise, capsicum, fenugreek, ginger, and nux vomica.[82]

METHODS OF FIGURING COSTS OF MIXED FEEDS.—Many users of mixed feeds believe that such feeds are sold on the basis of the cost of the highest priced ingredient in the feed. Thus, if a ton of mixed feed contained, among other ingredients, oil meal costing $60 per ton and screenings at $20 per ton, the screenings would be charged for at the rate of the cost of the oil meal.

This may be true in some instances, but in so far as the Commission was able to ascertain, in figuring costs the ingredients in mixed feeds were reckoned at their cost, or market value, at the time of mixing according to their respective proportions. The following statement is made from the cost sheet of a mixed-feed manufacturer and shows the manner in which costs were figured for a dairy ration in May, 1920. The names of several of the commodities have been left out in order to avoid any possibility of identification.

[82] The following ingredients were guaranteed to be present in a well-known stock and poultry conditioner: Juniper berries, black mustard, rosin, coriander seed, gentian, fenugreek, valerian, elecampane, blood root, mandrake, lobelia, poplar bark, ginger, licorice root, sodium sulphate, sodium chloride, sodium carbonate, sulphur, iron sulphate, black antimony, potassium nitrate, alum, flaxseed meal, linseed meal.

Name of commodity.	Cost (market price) per ton day of mixing.	Per cent used per ton.	Amount charged per ton.	Name of commodity.	Cost (market price) per ton day of mixing.	Per cent used per ton.	Amount charged per ton.
Oat feed	$16.00	17	$7.82	———	$70.36	8	$5.63
Oil meal	68.00	5	3.40	———	12.00	1	.12
Cottonseed meal	71.00	24	17.04	Salt		1	.09
Bran	56.00	30	16.80	Bags, milling, and overhead			9.20
Gluten feed	72.75	5	3.64				
Peanut oil meal	77.00	2	1.54				
———	66.67	7	4.67	Total			69.95

This feed sold for less than $80 per ton f. o. b. mill.

The method of figuring costs just outlined is, according to the best information obtainable, quite general. In some instances it is varied by charging for the ingredients at the actual cost to the manufacturer and not at the market price. At times manufacturers who have made fortunate purchases have charged the ingredient into cost at a price above actual cost but below the market price on date of mixing, competition usually being the factor which decides the course taken.

FACTORS CONSIDERED IN PURCHASING MIXED FEEDS.—The ready mixed feeds are commonly purchased by brand. A few farmers buy such feeds because of the chemical analysis or list of ingredients. The recommendation of a neighbor also frequently influences the selection of a feed. Odor and appearance are also taken into account.

The matter of price is a very important factor in the selection of a feed. Farmers do not always seek quality but will frequently purchase the lower grades of feeds because they are cheaper in terms of money.

The extensive advertising campaigns conducted by most mixed-feed manufacturers undoubtedly influence the sale of these mixed feeds.

SECTIONAL DEMAND FOR MIXED FEEDS.—As previously stated, the mixed-feed business is growing rapidly. (Chap. II, sec. 1.) These feeds are used quite extensively in the New England and other Eastern States, where relatively little feed is produced. These States purchase large quantities of the ready-mixed dairy and poultry feeds. The Southern States are large purchasers of ready-mixed feeds, particularly horse and mule feeds and stock feeds. The prairie States do not use as much ready-mixed feeds as do other sections. However, in recent years the use of this type of feeds in this section has increased very greatly, particularly the use of cattle fatteners.

The total production of mixed feeds could not be readily ascertained. No attempt has been made by any organization to secure this information, and after a preliminary survey of the industry the Commission concluded that the expense of gathering these figures would be entirely out of proportion to their value.

Chapter IV.

THE LOW-GRADE FEEDS.

Section 1. Introductory.

The low-grade feedingstuffs are generally known or classed as roughages. As previously stated, roughages may be loosely defined as "the coarser feedingstuffs which are high in fiber and supply a lower percentage of digestible matter,"[1] than the concentrates.

Authorities are quite agreed regarding most of the feeds which should be classed as roughages. There are, however, a few feedingstuffs, such as screenings, which are usually called roughages and yet certain parcels of them are at times actually concentrates. A recent feedingstuffs law enacted by the State of New York includes dried beet pulp among the roughages, although many authorities on feedingstuffs regard this commodity as a concentrate.

Roughages are used for different purposes. Frequently when it is desired simply to carry live stock through the winter they are fed only roughages as a maintenance ration. Animals not at work or those not expected to produce or to put on fat are as a rule fed roughages only. Roughages are used as a source of carbohydrates in a ration, and since they are generally bulky they are used to lighten or give bulk to the feed, whether home or factory mixed.

Feedingstuffs commonly classed as low grade.—The feedingstuffs most frequently classed as low grade, or as roughages, are some screenings, rice hulls, charred humus or peat, dried and ground hays and straws, oat feed, elevator sweepings or dust, oat hulls, sorghum bagasse, ground corncob, peanut hulls, cottonseed hulls, clipped oat by-product, ground cornstalks, barley hulls, flax feed or flax screenings, flax plant by-product, buckwheat hulls, and cocoa shells.[2]

The question of the value of roughages as feedingstuffs is the one around which most agitation and discussion centers. The problem is complicated by lack of sufficient reliable data, such as reports of official feeding tests, concerning many of these feedingstuffs. An additional difficulty encountered is that there are on both sides of the question those who argue chiefly from selfish motives. This makes it exceedingly difficult to draw satisfactory conclusions about several of these products.

It has been pointed out elsewhere that the Commission is not equipped to study the feedingstuffs problem from a chemical standpoint. In discussing the different low-grade feeds, or roughages, advantage has been taken of such scientific studies as the Commission has been able to secure. To these studies have been added the data developed by the Commission regarding the competitive features of the industry and certain deductions made from a study of a large

[1] Henry and Morrison, 17th ed., p. 10.

[2] In addition to most of the roughages enumerated the lists prepared by some authorities frequently contain the clause "Other materials of a similar character." (New York State law.)

mass of data of both a general and specific character, obtained from interviews with representatives of all branches of the business.

Section 2. Roughages not commercially important.

MISCELLANEOUS.—A number of the products given as roughages are not important enough commercially to require extended discussion. Ground cornstalks do not enter into commerce to any extent, although they are used as feed by some farmers producing them. Barley hulls are not important in the Eastern States, though they are used as an ingredient in some mixed feeds. It is understood that on the Pacific coast, where barley is used extensively as feed, the hulls are probably an important commodity. It has been pointed out elsewhere (Chap. I, sec. 1) that a study of conditions on the Pacific coast was not included in this investigation.

Buckwheat hulls and cocoa shells have been used as feeds but are not important commercially. An official of a large buckwheat mill, reputed to be the largest buckwheat milling company in the world, stated that the great bulk of the buckwheat hulls produced by his company is sold to concerns which use them for packing purposes. A few years ago the hulls were either burned or given to farmers. This company has at times sold small quantities of ground buckwheat hulls to feed manufacturers for use as an ingredient in mixed feeds, but the total quantity thus disposed of in any year has not exceeded 10 per cent of its output.

SORGHUM BAGASSE.—A product produced principally in the South, is a residue or pulp from the grinding or crushing of sorghum stalks for sirup with the addition of the ground leaves and tops, and known as sorghum bagasse or sorghum pulp meal. In appearance it is somewhat like brown alfalfa meal. It has not, evidently, been widely used commercially as a feed, although it was offered for sale as a "cheap filler" for mixed feeds in 1918. It has been used by at least one mixed-feed manufacturer as an ingredient in mixed feeds. It is interesting to note that this manufacturer is an opponent of many of the low-grade feeds in so far as they enter into commerce. He does not, however, defend sorghum bagasse, alleging that he uses it because competition with other manufacturers using low-grade products forces him to do so.

FLAX-PLANT BY-PRODUCT.—In the manufacture of rugs from flax there is produced a commodity known as flax-plant by-product. It is a fibrous material and is stated by many authorities to be low in feed value. The composition of this feedingstuff is approximately 75 per cent stems, 15 per cent flaxpods, and 10 per cent flaxseeds. According to the Maryland Agricultural Experiment Station [3] it is very dusty and disagreeable to handle.

In 1912 this experiment station conducted a digestibility test of flax-plant by-product, the results being published in a bulletin.[4] The composition of the feed used in the test was as follows: Protein, 8.29 per cent; fat, 3.93 per cent; fiber, 35.63 per cent; and N. F. E., 35.61 per cent.[5]

[3] Bulletin 168, p. 5, July, 1912.
[4] Bulletin 168, p. 11.
[5] A sample of flax-plant by-product secured by the Commission in June, 1920, was analyzed by the Bureau of Chemistry and showed the following composition: Protein, 8.06 per cent; fat, 2.22 per cent; fiber, 38.02 per cent; and N. F. E., 33.6 per cent.

The experts who made this test reached the following conclusions:

Flax-plant by-product furnished on the average about the same amount of digestible nutrients as timothy hay. It furnishes nearly twice as much digestible protein and fat as is furnished by timothy hay. Flax-plant by-product furnishes more digestible nutrients than corn fodder, but not as much as clover hay. (Md. Agr. Sta. Bul. 168, p. 11, July, 1912.)

There are only a few concerns in the United States producing this product. Practically the entire production of flax-plant by-product is sold to mixed-feed manufacturers who use it as a filler in mixed feeds.

GROUND PEANUT HULLS.[6]—Ground peanut hulls as such are sold to some extent to mixed-feed manufacturers. They are also used as an adulterant in peanut-oil meal and peanut-oil feeds.

Authorities differ regarding the feed value of peanut hulls. The Texas Agricultural Experiment Station [7] in connection with the results of feeding tests of peanut meal stated:

Peanut meal having a larger quantity of hulls would have a correspondingly lower digestibility and lower feeding value, *since the hulls have no value as a feed.*[8]

This view, that peanut hulls have *no* value as a feed, is not general, but there are no authorities who claim more than a low feed value for this product.

Hand-separated peanut hulls have a lower combined protein and fat content and a higher fiber content than commercial peanut hulls, due, probably, to small particles of peanut meats being present in the commercial hulls.

The composition of commercial peanut hulls as compared with the average composition of hand-separated hulls (from Texas peanuts) is shown in the following statement: [9]

	Number of samples.	Protein.	Ether extract.	Crude fiber.	N. F. E.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Commercial	(1)	6.05	2.83	54.03	15.50	[2] 13.54
Hand-separated	58	6.76	1.10	60.83	19.64	4.19

[1] Unknown.
[2] The high ash content of the commercial hulls is due to dirt adhering to the hulls or with them.

FLAX FEED OR FLAX SCREENINGS.—Flax feed consists of flax screenings and is sometimes sold as a straight feed, but more often it is used as an ingredient in mixed feeds. It is a variable product, containing inferior flaxseed, weed seeds, stalks, leaves, pods, and other refuse from the flax plant. As in the case of other screenings, it is recommended that it be finely ground to destroy the viability of all weed seeds. This product is sometimes sold under trade names such as "flax flakes," etc. It contains only half as much crude protein as linseed meal and often has a decidedly bitter taste on account of the weed seeds present.[10]

[6] The outer husks or shells.
[7] Bulletin 215, pp. 14 and 15.
[8] Italics by the Commission.
[9] Tex. Agr. Exp. Sta., Bulletin 222, p. 11.
[10] Henry and Morrison, 17th ed., p. 177.

According to the Kentucky Agricultural Experiment Station [11] the chemical analysis of this product is as follows: Protein, 9.5 per cent; fat, 10.6 per cent; fiber, 14.3 per cent; and N. F. E., 48 per cent.

GROUND CORNCOBS.—The use of ground corncobs as a feed is common with many farmers who grind the cob with the corn and feed it as a part of home-mixed rations. There are some concerns which grind corncobs and sell the ground product to mixed-feed manufacturers, who use it as a filler in their mixtures. Commercially ground corncobs have the appearance of sawdust. The average analysis is as follows: Protein, 2 per cent; fat, 0.4 per cent; fiber, 31.8 per cent; and N. F. E., 54.3 per cent.[12]

The Texas Agricultural Experiment Station conducted several digestion tests with ground corncobs. Commenting on these tests the station states that [13]—

> The corncobs do not contain any digestible protein, but the digestibility of the crude fiber and of the nitrogen-free extract compare favorably with the digestibility of hays and some other roughages. The feeding value of ground corncobs is apparently high for feed of this character, and compares favorably with prairie hay. The productive value seems to be higher than that of some varieties of prairie hay. It apparently has a value of about 83 per cent of alfalfa hay, and 180 per cent of cottonseed hulls. It seems to be a better feed than has generally been supposed.

Section 3. Grain screenings.

It is in connection with the remaining products, generally classed as low grade, that the question of value becomes most complicated and the discussions and arguments extended and at times bitter. Most of these materials are by-products and are produced in large quantities and some of them in many sections of the country.

The term "screenings" is used to denote a product which varies greatly in both chemical and physical composition. There is no grade or standard for screenings and they are always sold by sample and not under any guaranteed chemical analysis. This product varies so widely in composition that some parcels of screenings might, as previously stated, well be designated as concentrates because of their high percentage of digestible matter. Such screenings are usually composed of small, broken, or immature kernels of grain, comparatively little of the chaff, sticks, straw, weed seeds, dirt, and other materials usually found in screenings. In his examination of wheat screenings Dr. J. K. Haywood, of the Bureau of Chemistry, United States Department of Agriculture, has found samples having a fiber content about as low and digestible matter about as high as is found in wheat bran. Such screenings obviously should not be classed as a roughage. The Commission secured a "running" sample of ground and bolted screenings from a mixed-feed manufacturer as the product entered the mixing machine. This was analyzed by the Bureau of Chemistry and showed the following: Protein, 15.53 per cent; fat, 7.76 per cent; fiber, 10.8 per cent; and N. F. E., 49.61 per cent.

This analysis compares favorably with the average analysis of 7,742 samples of wheat bran as shown by Henry and Morrison (17th ed.,

[11] Bulletin 223, p. 89.
[12] Tex. Agr. Exp. Sta. Bul. No. 245, p. 9.
[13] Bulletin 245, pp. 13 and 14.

p. 634), namely: Protein, 16 per cent; fat, 4.4 per cent; fiber, 9.5 per cent; and N. F. E., 53.7 per cent.

However, it must not be understood that the above statements and analysis apply to all screenings or that the average run of screenings is equal to the sample from which the above analysis was made. There are large quantities of screenings sold each year which are very much inferior to the sample analyzed for the Commission. These inferior screenings are usually composed of chaff, stems, hulls, weed seeds, and a very small percentage of broken or immature grain kernels.

The following statement shows the variations found in the chemical composition of grain screenings. The analyses were made by a private chemist for mixed-feed manufacturers and cover a sufficient number of samples to be fairly representative:

	Per cent.
Crude protein:	
High	16.1
Low	10.3
Crude fat:	
High	9.7
Low	2.7
Crude fiber:	
High	21.9
Low	11.3

SOURCES OF SCREENINGS.—There are a few grain farmers in the United States who clean the grains they produce before offering them for sale. The screenings resulting from this cleaning are generally used by such farmers as feed for their stock. The amount of grain thus cleaned by farmers is, however, small.

Many of the country elevators are equipped with grain-cleaning machinery. These elevators frequently clean much of the grain purchased by them and either return the screenings to the farmer to be used as feed, retain them for sale, usually at a terminal market, or in a few instances destroy the screenings as being of little value or because of the presence of a considerable percentage of noxious weed seeds.

The bulk of the country's grain, however, reaches the terminal markets or the consuming converter, such as flour mills, uncleaned. The elevators and converters at these terminal markets are, as a rule, equipped with elaborate machinery for cleaning all kinds of grain. It is here that the bulk of the screenings are produced. The grain elevators sell the screenings by sample, frequently on the trading floors of the grain exchanges. Flour mills usually dispose of their screenings by adding them to the flour offal. If the amount of screenings thus added does not exceed the amount present in the lot or parcel of wheat from which the offal was produced, the mixture is labeled as containing screenings "not to exceed mill run." If more than the mill run of screenings is used, the label must state the name of the offal, as "bran and screenings."

In addition to the screenings obtained in this country, feed manufacturers use large quantities of Canadian screenings.

SEPARATION OF SCREENINGS.—At several of the larger terminal grain markets are firms specializing in grain screenings. Some of these concerns operate elevators at which the screenings are separated.

A car of screenings is put through several processes at a screenings elevator. The wheat kernels—sound, broken shriveled, etc.—are

removed. The remainder is also divided by cleaning machines into different lots. Thus, at a large elevator of this type at Minneapolis, screenings were separated into the following: Shrunken or broken wheat, wild oats, wild mustard, wild buckwheat, weed seeds, and chaff.

These different materials are then disposed of in various ways. The mustard seed, for example, is sold to crushers for its oil content; the chaff, weed seeds, and wild buckwheat are frequently ground, bolted, and then sold to feed manufacturers. The shrunken and broken wheat is usually sold for chicken feed, mixed-feed manufacturers using large quantities in their poultry feeds.

There are, however, large quantities of unseparated screenings purchased by mixed-feed manufacturers. Most of these manufacturers are so equipped that they can either make the separations and grind the weed seeds, or they can grind the entire product. Comparatively few manufacturers of mixed feeds use unground screenings except in poultry feeds.

PRINCIPAL USES OF SCREENINGS.—The two principal classes of consuming purchasers of screenings are mixed-feed manufacturers and stock feeders, the former being by far the more important. Stock feeders do not buy the poorer grades of screenings.

The percentage of screenings used in mixed feeds varies with different companies. They are frequently the base for many feeds; in others they are used only in small quantities. An important manufacturer of mixed feeds during the year ended April 30, 1919, used approximately 98,000,000 pounds of different materials in his mixed feeds, of which about 49,000,000 pounds were screenings. In fact, this manufacturer has built up his business almost entirely on feeds in which grain screenings are the most important single ingredient quantitatively. The following statement shows the amounts of materials used by this concern during the years 1917–1919, inclusive, together with the amounts of screenings and the percentage of the screenings to the total amounts of materials:

Year.	Screenings.	Total materials.	Per cent of screenings to total materials.
	Pounds.	*Pounds.*	
1917	60,300,666	87,487,064	68.9
1918	66,675,157	110,032,426	60.5
1919	48,925,655	97,599,875	50.1
Total	175,901,478	295,119,365	59.6

VIABILITY OF WEED SEEDS.—One of the principal objections to the use of screenings as a feed which does not apply to other feeds is that grain screenings usually contain more or less weed seeds. In some screenings weed seeds are present in large quantities.

Considerable apprehension is felt by agricultural authorities concerning the spreading of weed seeds and the consequent contamination of farms by the use of screenings. Many agricultural experiment stations have conducted experiments with weed seeds from screenings to test their viability, and the results have often shown that screenings contain many weed seeds which germinate and

grow rapidly. Laws have been passed by a number of States prohibiting the sale of mixed feeds if they contain weed seeds in excess of a stated amount—2 per cent by weight in the case of Vermont.[14]

Some States, as South Carolina,[15] have refused to register feeds containing weed seeds even when ground.

The bulk of the screenings sold direct to feeders go to hog and sheep raisers. The weed seeds contained in these screenings are unlikely to germinate, inasmuch as sheep and hogs grind very finely and assimilate such seeds, and their viability is thus destroyed. On the other hand, cattle and horses fed grain screenings containing weed seeds do not always destroy the growing properties of weed seeds entirely, as has been shown in numerous tests. However, the amount of screenings fed as such to cattle and horses is comparatively small.

One cause of complaint against mixed feeds originated in the fact that some of these feeds contained grain screenings in which weed seeds were present, and it was further asserted that the viability of these seeds had not been destroyed. This was undoubtedly true of many feeds, and the trouble was due to the faulty grinding and bolting of such seeds or to an utter lack of such treatment by some mixed-feed manufacturers. Other manufacturers are equipped with efficient machinery and can and do destroy all life in the weed seeds by grinding and bolting and, in rare instances, by heating or cooking. Then, too, some of the larger dealers in screenings are equipped with facilities for devitalizing weed seeds, and many mixed-feed manufacturers buy their screenings from these dealers.

The use of modern machinery has reduced the risk of contaminating farms with weed seeds, as is attested by the following statement of the Massachusetts station:

> Formerly one objection to their use [molasses feeds containing screenings] was due to the fact that they contained many whole weed seeds which would pass through the animal without having their vitality impaired and become a source of weeds on the farm. With the improved process of manufacturing molasses feeds, the screenings are finely ground and their germinating property destroyed.[16]

Harmful weed seeds in screenings.—Occasionally screenings contain weed seeds which are injurious to animals. This fact has been used as an argument against the use of screenings but has not been seriously considered by authorities. Rarely, if ever, are sufficient deleterious weed seeds present in a parcel of screenings to cause harm. It would seem, therefore, that this objection may be disregarded.

Illegal use of screenings.—It has been alleged that the use of screenings in mixed feeds makes deception easy on account of the many products generally present in the screenings. Elevator dust or sweepings may be added to ground screenings without fear of detection, since the two are very similar. Other fibrous materials may also be used to adulterate screenings. It is not required that the names of the ingredients in the screenings be stated, and this makes it possible to practice deception. It would be impracticable,

[14] A provision, however, contained in the Vermont law reads "unless a statement of such use of wheat screenings or materials containing weed seeds is plainly marked or indicated upon the packages containing the same," etc. (Sec. 4987 Public Statutes as amended.)

[15] Annual Report S. C., 1916, p. 97.

[16] Mass. Bulletin 142 (1912), p. 46.

however, to compel such a declaration because of the wide and constant changes in the composition of screenings.

Opinions of brokers as to the value of screenings.—Screenings from grains are handled largely by brokers, grain commission men, and jobbers. Many of them have only in recent years begun to buy and sell screenings as a side line to their regular business, usually grain.

Only a few of these dealers in screenings that were interviewed by the Commission's agents had any knowledge of the feed value of screenings or had even seen analyses of them. Most of them condemned the use as feed of much of the material sold as screenings. Some of these dealers stated that they did not believe in the traffic but had bought and sold screenings because there was a market for them. It is evident that this impression was gained merely from the general appearance of the product and not from any actual data in regard to its chemical composition. The physical appearance of many lots of screenings is uninviting and conveys to the uninitiated an impression of worthlessness, which, however, is not always justified.

Section 4. Elevator dust.

A product resembling ground screenings in appearance, and almost as variable in its composition, is that known by some as elevator by-product, but more widely known as elevator dust or sweepings.

In most of the large grain elevators and mills the dust from the grains is collected by suction as the grain is dumped into the elevator garners. Dust is also collected from the various cleaning and separating machines. It is then blown to a collector in the dust house. Formerly it was not saved but was blown into the air outside of the elevator. Aside from this dust there is a constant accumulation of other dust about the mill or elevator, on floors, walls, and superstructure, which is also gathered and finally sold. This cleaning of the mills and elevators is due to two reasons, (1) it is dangerous to allow the dust to accumulate because of its highly explosive and inflammable character; (2) the dust has a commercial value as an animal feed.

Elevator dust is light and fluffy and uninviting in appearance. It is largely composed of grain dust, with an occasional kernel of grain and some light chaff and hulls. Since floor sweepings are included, it also contains a percentage of actual dirt. Dust from a flour mill is of much greater value than that collected at a grain elevator. The mill dust contains a small quantity of flour. The mills in most instances dispose of their dust by adding it to the feeds produced by them as by-products from the manufacture of flour.

The feed value of elevator dust is by no means constant. A sample of this product obtained by the Commission was submitted to the Bureau of Chemistry for analysis with the following result: Protein, 15.12 per cent; fat, 2.63 per cent; fiber, 16.89 per cent; and N. F. E., 43.97 per cent.

The above analysis is not presented as the average for this product. It is merely given as the analysis of a sample from a lot or parcel of elevator dust about to be added to a mixed feed. It is not un-

likely that some of the odium attached to the product is due to its name.

Elevator dust is sold to mixed-feed manufacturers. Many of these manufacturers collect the dust from their own plants and add it to their feeds. A mixed-feed manufacturer making feeds of very high reputation stated that he used elevator dust from his own plant as an ingredient in his feeds.

While elevator dust is extensively used as an ingredient in mixed feeds its presence is rarely declared by manufacturers. This is, of course, misbranding, but since it is a very difficult matter to detect its presence, few if any penalties have been imposed.

Section 5. Clipped-oat by-product.

Clipped-oat by-product comes from grain elevators and oatmeal mills. It is produced by clipping oats to increase their weight per bushel, since heavy oats usually command a better price. By means of machines known as "oat clippers" the light ends and some of the hulls are broken off. By this process oats may be raised in weight from, say, 32 pounds per bushel to 38 pounds per bushel. The light ends, hulls, chaff, and other residue from the clipping process are collected, and it is this product which is known as clipped-oat by-product.

This product is light, bulky, and of a chaffy and fibrous character. An analysis by the Bureau of Chemistry of a sample secured by the Commission was as follows: Protein, 7.28 per cent; fat, 1.90 per cent; fiber, 27.58 per cent; and N. F. E., 43.98 per cent.

Large quantities of clipped-oat by-product are produced annually, and practically the entire output is used in mixed feeds. Because of its light, bulky character it serves to lighten a ration. It is used frequently in feeds containing molasses, as it is a good absorbent. Usually the product is ground and bolted before being added to feeds. It is one of the products the use of which as a feed is frequently criticized.

Section 6. Rice hulls.

The outer coating or hull of the rice grain is a tough, fibrous substance. At intervals on the surface are minute spines, transparent, like glass, and composed of silica. The jagged edges of the hulls feel rough to the fingers.

In the milling of rice for human consumption the hulls are removed from the rice grains. The quantity of hulls produced is enormous, and their disposal presents a serious problem to the rice millers. Rice hulls are used as fuel, for packing crockery, as a filtrant, in the manufacture of explosives, as an adulterant of rice bran, and as an ingredient in mixed feeds. It is with the last two uses that this investigation is concerned.

Most authorities agree that rice hulls have a very low feed value and if fed in too large quantities are injurious and may prove disastrous to the animal.

The general belief that rice hulls are injurious to animals has led to the prohibition of their sale as feeds in a number of States. Several States, as Texas and California, permit the use of this material provided the tags and labels show the actual percentage of hulls

present. The Texas officials hold that ground rice hulls in small quantities have not been proved to be deleterious, and therefore their sale in that State has not been prohibited. The Texas Agricultural Experiment Station [17] states that the results of a digestion experiment with two sheep showed that "the feeding value of rice hulls is very low, being about 48 per cent of cottonseed hulls and 23 per cent of alfalfa." The average analyses of 14 samples of rice hulls by the Texas station showed: Protein, 3.56 per cent; fat, 0.93 per cent; fiber, 39.05 per cent; N. F. E., 29.38 per cent; and ash, 18.59 per cent. Dr. Dalrymple, of the Louisiana State Agriculture College, says that he would not recommend any proportion whatever in a feed, since it would have about the same effect as feeding the animal so much ground glass.

Rice bran contains a small amount of rice hulls and its sale is permitted in most States. While the addition of hulls to the bran improves its keeping qualities and thus affords some pretext for adding hulls, it has also led to adulteration. If, however, rice bran contains an undue amount of fiber (more than 13 per cent) it is an indication that the bran has been adulterated. The fiber content is thus used as an index of the quality of the bran.

Aside from the feeds sold in Texas and California, rice hulls do not appear to be extensively used in animal feeds. The formulas of two mixed feeds manufactured in Texas showed that each of them contained slightly over 700 pounds of rice hulls in each ton of feed.

Prior to 1914 large quantities of ground rice hulls were exported to Germany, Holland, Denmark, Cuba, and Belgium. It is stated that these hulls were to be used as feeds. This export trade wholly ceased during the war and has not been resumed.

According to most authorities rice hulls are the one product commonly classed as a roughage that is possibly injurious to animals.

Section 7. Peat.

According to Webster's New International Dictionary (Merriam), 1920, peat is "a carbonaceous substance formed by partial decomposition in water of various plants, especially mosses of the genus Sphagnum."

This substance is the same as that used for fuel with the exception that for feeding purposes the peat is not in such an advanced state of decomposition as that used for fuel. Before being used as a feed it is prepared by drying and charring. The composition of a sample of peat analyzed by the Texas Agricultural Experiment Station [18] was as follows: Protein, 17.12 per cent; ether extract, 0.83 per cent; crude fiber, 10.01 per cent; N. F. E., 34.9 per cent; and ash, 27.05 per cent.

Peat has been used abroad as an animal feed for a good many years. It is comparatively recently, however, that peat has been used as a feed in this country, and most authorities do not look with favor upon its use in a ration.

There are few tests of the feed value of peat. The peat for which the above analysis is given was used by the Texas authorities in a

[17] Bulletin 245, p. 15.
[18] Bulletin 203, p. 8.

digestion experiment. The experts who made the test stated the following conclusions:

This peat was furnished by the Weidmer Chemical Co., of St. Louis, and is a natural deposit which is dried and heated to a comparatively high temperature. The manufacturers do not claim a feeding value for this material, but claim that it acts as an absorbent to take up or counteract the bad effects of molasses or sweetened animal food. The material was labeled "humus for fertilizer and stock food." It had the appearance somewhat of finely ground charcoal, except that it contained some finely divided brown to gray material.

The digestion experiment showed that this material was not only not digested but that it apparently decreased the digestibility of the alfalfa hay with which it was fed.[19]

Bull [20] states that "Peat has a nutritive value about half that of straw."

On the other hand, some cattle feeders assert that a small amount of charred peat is beneficial in that it aids digestion. Many feeders allow their cattle access to charred peat at all times in the same manner as salt is kept available. The manufacturers using peat as an ingredient in their mixed feeds assert that it serves a very useful purpose in counteracting the acidity of the molasses with which it is almost always used. Manufacturers using this product allege that if the use of peat as a feed is prohibited the prices of their feeds would increase, as they maintain they would be obliged to use charcoal, which is more costly. Another reason for its use is that it is said to be a good absorbent for molasses.

The fact that much peat comes from the sphagnum moss plant accounts for the occasional appearance of the name "sphagnum moss" in the lists of roughages or low-grade feeds, microscopists commonly identifying peat as sphagnum moss. The sphagnum moss plant is not, according to the best information available, used in feeds until it has changed to peat.

Section 8. Cottonseed hulls.

Cottonseed hulls are produced in the process of extraction of oil from the cotton seed when the kernels and hulls are separated. Such hulls contain numerous small particles of the kernels and some small or immature seeds. The hulls are thick, black, and hard, and are high in fiber content. It is undoubtedly true that much of the protein and fat in a parcel of hulls is supplied by the small particles of kernels or meats and the small entire seeds.

Henry and Morrison [21] give the following as the average percentage composition of cottonseed hulls as determined by 66 analyses: Protein, 4.6 per cent; fat, 1.9 per cent; fiber, 43.8 per cent; and N. F. E., 37.3 per cent.

The principal uses of cottonseed hulls as feeds are, to make cottonseed feed, to "adulterate" cottonseed meal, as a roughage, and as a filler in mixed feeds.

Cottonseed feed, as defined by the Association of Feed Control Officials of the United States, is a mixture of cottonseed meal and cottonseed hulls containing less than 36 per cent of protein (see Appendix 2). Inasmuch as there is no provision regulating the minimum amount of protein, cottonseed feed varies widely in its composition. Henry and Morrison [21] give the following as the average per-

[19] Bulletin 203, p. 15.
[20] Principles of Feeding Farm Animals (1916), p. 300.
[21] 17th ed., p. 635.

centage composition of cottonseed feed, as determined by 406 analyses: Protein, 24.5 per cent; fat, 6.3 per cent; fiber, 21.4 per cent; and N. F. E., 34.6 per cent.

The use of the hulls as an adulterant in cottonseed meal is a source of much trouble to State and Federal feed-control officials. It is alleged that the cottonseed crushers frequently add a quantity of hulls to the meal in order to dispose of the hulls. Many of the crushers maintain that they return to the meal only the proportion of hulls found in the uncrushed seed. Other crushers allege that the hulls are added because farmers do not demand high-grade meals. Moreover many mixed-feed manufacturers prefer to purchase the lower protein content meals. This practice of adding hulls to cottonseed meal is not confined to the oil crushers. Many of the larger dealers of the Southern States handling cottonseed meal buy cottonseed hulls, grind them, and add them to their meal, and thus reduce the protein content to any point they desire. (See also Ch. III, sec. 5.) This adding of hulls, of course, reduces the protein and fat content and increases the amount of fiber in the meal.

In Southern States cottonseed hulls are used extensively as a roughage for stock, and in fact are highly regarded in that region for this purpose. Many feeders buy the straight hulls from the oil crushers, and when delivering seed to the crushers many cotton growers demand the return of the hulls and use them for feed.

Cottonseed hulls are used as a filler or ingredient in some mixed feeds. While it has been frequently asserted by some mixed-feed manufacturers that much of the cottonseed meal on the market contains unduly large percentages of cottonseed hulls, some mixed-feed manufacturers evidently do not find the "adulteration" sufficient. Several State bulletins show the liberal use of straight cottonseed hulls as an ingredient in mixed feeds which also contain cottonseed meal.

Section 9. Oat feed and oat hulls.

Introductory.—In the manufacture of oatmeal and other breakfast foods from oats there are produced three by-products—oat hulls, oat shorts, and oat middlings. According to the definitions of feeding stuffs adopted by the Association of Feed Control Officials of the United States these three products are defined as follows:

Oat hulls are the outer chaffy coverings of the oat grain.

Oat middlings are the floury portions of the oat groat obtained in the milling of rolled oats.

Oat shorts are the covering of the oat grain lying immediately inside the hull, being a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats.

In the manufacture of oatmeal the oats, after being cleaned and heated, are sent to the hulling stones, which consist of two circular emery stones parallel to each other, the top one revolving and the bottom stationary. These stones remove the hulls and also grind off some of the finer particles from the oat groat. From the hulling stones the entire mass goes to the bolting reels, where the finer particles removed by the hulling stones are separated from the groats and coarse hulls.

This finer material is then conveyed directly to a feed house and binned. The groats and coarse hulls go to aspirators or air machines which separate the coarse hulls from the groats. The coarse hulls are then sent to the feed house, where they are ground and then mixed with the finer material which has previously been conveyed to the feed house.

Inasmuch as the shorts and middlings have a higher feed value and consequently a higher commercial value than the bare hulls, some oatmeal millers occasionally do not mix the finer particles with the ground hulls, but bin them separately and dispose of them as separate products. Other millers assert that they never dispose of these products separately. They maintain that the oat hulls and the finer particles are brought together in the feed house in exactly the same proportions as they existed in the original oats. The reason assigned by millers for making the temporary separation is that it permits them to grind more economically.

These three by-products are generally mixed together by the producers. Some oat shorts and oat middlings are sold as such, but the quantity is relatively small.

The combined by-products are now commonly called oat feed, largely because a Federal court decision held that this term was permissible in connection with the total by-product of oatmeal milling.[21a] However, this name is not always used in referring to this commodity. A number of the producers and a few others frequently refer to it as "oatmeal mill by-product." Those who oppose the use of this commodity call it oat hulls, a name which carries with it a suggestion of worthlessness. But this latter term is used even by a few producers.

In this report when referring to the combined by-product from the manufacture of oatmeal the term oat feed is used. Feed-control officials in general recognize oat feed as describing the combined by-product from oatmeal milling. The term oat hulls, according to these officials, should not be applied to the combined by-product, since they recognize it as descriptive of the oat hulls without the shorts and middlings.

It should be pointed out that these three terms—oat hulls, oatmeal mill by-product, and oat feed are very often loosely used as applying to the combined by-product from oatmeal milling.

If either of the names oat feed or oatmeal mill by-product is used in describing the combined by-product of the oatmeal mills when offered for sale, feed-control officials generally require that the tags or labels shall bear the descriptive phrase "oat hulls, oat shorts, and oat middlings" immediately following the name used.

Oat hulls.—The quantity of oat hulls sold in the United States is small as compared with oat feed. Oat hulls do not contain the shorts and middlings except the slight quantity which can not be economically separated. Oat hulls are lower in feed value than oat feed because of this separation. Since oat hulls proper are relatively unimportant as a commercial feedingstuff, the discussion of the by-products of oatmeal milling has been largely confined to oat feed. It will be noted in the following discussion that the terms have not been used interchangeably, but to denote different commodities.

[21a] Notice of Judgment No. 990, issued Aug. 15, 1911, by the Bureau of Chemistry, U. S. Department of Agriculture.

OAT FEED.—A great many analyses have been made of oat feed. The following table presents the results of a few of these analyses, which are fairly typical of all:

TABLE 15.—*Results of chemical analyses of oat feed by various chemists.*

Analyst.	Number of analyses.	Protein.	Fat.	Fiber.	N. F. E.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Henry and Morrison [1]	16	4.0	1.7	29.2	52.3
Public chemist	7	5.2	2.3	29.5	.....
Quaker Oats Co.[2]	46	5.2	1.8	30.8	.....
New York Agricultural Experiment Station [3]	4	4.6	1.7	27.8	.....
Public chemist	6	5.7	2.0	[4] 34.6	.....

[1] 17th ed., p. 634. Described as oat hulls.
[2] Akron, Ohio, and Cedar Rapids, Iowa, plants.
[3] New York Agr. Exp. Sta. Bul. 455, p. 123, December, 1918.
[4] The high average fiber content is due to the excessive fiber content of two of the samples, viz, 43.6 per cent and 43.44 per cent, which were probably oat hulls.

The analyses in the above table which show the highest average fiber content were made for a mixed-feed manufacturer who had started to use the product as an ingredient in one of his mixed feeds. The results of these analyses were so unsatisfactory that the manufacturer discontinued the use of the product as an ingredient in his feed. In fact, this manufacturer believed that some producers of oat feed from whom he had secured his supply had saved out the shorts and middlings and sold him only the hulls. A further reason advanced by this manufacturer for not using the product was that it was produced by competitive mixed-feed manufacturers and that he did not care to run the risk of playing into the hands of his competitors.

It is claimed that heating the oats before they are hulled adds to the digestibility of the fiber in the oat hulls. Efforts are being made to increase the digestibility, which is now, according to Henry and Morrison,[22] about 60 per cent. Much of the feed value of oat feed depends upon the efficiency of the milling process, and this causes a marked difference in the composition of oat feed produced by the various concerns. From a miller's standpoint the more efficient the milling the lower the quality of the by-product.

Feed value of oat feed. —The value of oat feed as a feedingstuff is a very much disputed question. There are very few, if any, scientific data on the subject. There has been but one series of feeding tests made officially in recent years with this product. This series consisted of a maintenance test with three animals and a digestion test with one made by the Maryland Agricultural Experiment Station in 1912.[22a] The results of these tests and the reasons for their being made are very interesting. A mixed-feed concern desired to have public tests made of oat hulls in order to have authentic data to use in decrying the value of this product as a feed. Because of lack of funds for making the tests the experiment station could not purchase the oat hulls and the manufacturer desiring the tests made, supplied them. The experiment station authorities, however, insisted that no matter what the results of the tests might be, they were to be per-

[22] 17th ed., p. 647.
[22a] At the time of these tests the product now known as oat feed was commonly called oat hulls.

mitted to make them public. H. J. Patterson, of the Maryland Experiment Station, stated that in all tests made by the institution the right is always reserved to state whatever the experiments may disclose. In the experiments with the oat hulls the men who made them did not know where the oat hulls came from or whether the institution paid for them or not. Every precaution was taken by Dr. Patterson that the tests be made with the usual care exercised in such matters.

The results of the tests made of the car of oat hulls were published in a bulletin.[23] According to this bulletin the oat hulls used in the test "appeared to be light in weight, of good color, and extremely dusty." There were also considerable oat germs present. The analysis of this lot of oat hulls showed (p. 26):

Analysis as sampled.[24]

	Per cent.
Moisture	8.220
Ash	6.300
Protein	4.318
Fat or ether extract	3.040
Crude fiber	28.750
Other carbohydrates	49.372

In the first test of the oat hulls three animals were used—a young pig, a mature mule, and a mature Jersey bull. This was purely a maintenance test.

The pig was fed on oat hulls for 41 days and at the end of that period had lost 21 pounds, or a loss of 28 per cent. Commenting on this test the bulletin says (p. 23):

> It will be seen, however, that the excessive loss was partially due to the limited amount consumed and not entirely to the poor food value in itself. At the end of the period, however, the pig was very weak and would probably have died in a short time on this exclusive diet.

The mule was fed for 41 days and aside from the oat hulls received hay as a part of the ration. According to the bulletin (p. 24):

> In this test it would seem that with hay the oat hulls would have supported the animal fairly well at light work. The general condition of the mule was good throughout the entire period.

The comment regarding the test with the bull was as follows (p. 25):

> At the end of the 41 days' period the bull had gained 29 pounds in weight. During the first nine days, however, he received hay in addition to oat hulls, and when hay was discontinued he had up to this lost apparently 15 pounds. This was an error, probably due to his having been watered shortly before the initial weighing. For the remainder of the time he gradually improved on an exclusive oat hull diet, and at the end of the period was in excellent condition in every respect.

It has been asserted that the results of the above series of tests were so satisfactory that the manufacturer instituting them was unable to use the data to decry his competitors' feeds.

Oatmeal millers and mixed-feed manufacturers who use oat feed in their feeds, commenting on these tests, stated that in their opinion the pig would have done much better had the oat hulls been finely ground.

[23] Maryland Agricultural Experiment Station Bul. 168, July, 1912.
[24] Cf. analyses p. 83.

Immediately after the maintenance test with the bull was finished a digestion test with the exclusive oat hull diet was carried on for a period of 16 days. Commenting on the results of this digestion test the station [25] states:

> It was determined, therefore, that this bull kept in condition and gained slightly in weight on a ration consisting of:
>
> 9.17 pounds dry matter.
> .21 pound digestible protein.
> 4.32 pounds digestible carbohydrates.
> .23 pound fats.
>
> Having a nutritive ratio of 1 : 22 : 6.

Approximately 170,000 tons of oat feed were produced in 1919. (See Chap. III, sec. 2.) A comparatively small percentage of the total production is sold to feeders to be used as a part of a home-mixed ration; the balance is used by mixed-feed manufacturers as an ingredient in their feeds. It is the common practice to grind it to the desired degree of fineness before mixing.[26] Oat feed is used for its carbohydrate content and to give bulk, or to lighten a ration.

The following summary of statements of three Illinois feeders who jointly purchased a car of oat feed is of interest. The car of oat feed was purchased through a local dealer at $27 per ton, in sacks.

The first feeder interviewed usually mixed and fed the following ration:

> 100 pounds corn ground with the cob.
> 100 pounds bran.
> 100 pounds ground oats and barley.

Six of his best cows were selected and fed this mixture for one week. The milk and feed for each cow were carefully weighed during the test.

Three days after the above test was made, and after all the above mixture was out of the cows' systems, he substituted 100 pounds of oat feed for the 100 pounds of bran and a similar test was made, covering one week. The new mixture was somewhat more bulky because of the lightness of the oat feed.

A comparison of the results of the two tests showed that as good a flow of milk had been obtained from the mixture containing oat feed as from the other, in fact the feeder stated that the tests showed that 2 pounds more of milk were produced during the week when the oat feed was used. The milk was not tested during either period so it is not known whether there was a difference in the quality.

The saving per ton of feed to the feeder by using oat feed in place of bran was quite marked. He had paid $43 per ton for one parcel of bran and $47 per ton for another lot, while the oat feed had cost but $27 per ton.

Notwithstanding the apparently good results obtained this feeder did not believe he would advocate the use of oat feed. He also doubted if he would ever use it again and stated he certainly would not at a price higher than that which he had paid, namely, $27 per ton. He believed the product contained only hulls and mill sweepings and that the best part of the oat had been removed, but at the price he paid the product was worth the money. According to his

[25] Bulletin 168, p. 27.

[26] The grinding depends upon the character of feed in which the oat feed is to be used. Thus, for hog feed the product is ground more finely than for a horse feed.

belief oat feed was valuable principally as a filler when heavy feeds were used. He believed it to be as good as his average timothy hay.

Just why this feeder would not use the product again is not clear, nor was he positive on the point. He stated that his cows would not eat oat feed when fed alone and that the product was so light that it would blow and scatter all over his farm. It is not improbable that the local cow testing official had had some effect on this feeder's judgment, since this official, who was also interviewed, was very much opposed to low-grade feeds in general and advised feeders, including the one interviewed, not to use them.

A second feeder taking a part of the same car of oat feed, also used the product as a substitute for bran or middlings to lighten his feed. While he did not know but that the mixture containing oat feed would produce as much milk as the one in which bran or middlings were used, he stated that he would never buy oat feed again. He did not believe that the oat feed could be as beneficial to the cow as bran. His cows, too, would not eat the oat feed alone, although they would eat the bran when it was fed alone.

The farmer who had persuaded the two feeders just mentioned to join him in purchasing the car of oat feed, stated that in his opinion oat feed had proved to be just as satisfactory as bran. This feeder did not base his opinion on the one test but had used oat feed in the spring of 1919 as well as in the winter of 1919–20. Not only was the milk flow as large as when bran was used, but from the appearance of the cows they were in as good condition. Furthermore, this feeder estimated that by using oat feed a saving of $20 per ton had been effected.

When asked why the other feeders interviewed had discontinued using oat feed the third feeder stated that many people were prejudiced against oat feed and that even a careful test showing good results would not convince them that the product had value.

An analysis of oat feed used by these three feeders is not available. Below is given the analysis of a sample of the same brand of oat feed as was used by these three feeders as determined by a state experiment station: Protein, 5 per cent; fat, 2 per cent; fiber, 28 per cent.

Another Illinois feeder who had tried 2 tons of oat feed stated that he could not be induced to use it again at any price. He called it a worthless product. However, this feeder used considerable quantities of a ready-mixed feed (about two carloads per year) which contained on an average over 25 per cent of oat feed and he believed it to have been "worth the money."

Manufacturers of mixed feeds containing oat feed claim that in making their feeds the properties and values of the oat feed are recognized and properly used in their mixed feeds. They supply the carbohydrates and lighten the rations in which they are used.

The percentage of oat feed used by manufacturers in their mixed feeds differs with the various feeds. It is, however, used in a more constant quantity in these mixtures than most of the other ingredients and is varied only when absolutely necessary since it is the product used as the base, or filler, in most of the mixtures in which it is found. It is for this reason that the manufacturer varies the proportion of the other ingredients rather than the amount of oat feed. However, changes in the percentage of oat feed in mixtures

are frequently necessary. Oat feed is present in some feeds in as small an amount as 5 per cent and in others in an amount as high as 28 per cent. In one instance, at least, as high as 40 per cent was used in a dairy feed for a short time and then the amount was reduced to the usual percentage, about 25 per cent.

ILLEGAL USE OF OAT HULLS AND OAT FEED.—Oat hulls and oat feed are at times used as adulterants. They become adulterants, for example, when the mixture is said to contain crushed oats when as a matter of fact only the hulls or oat feed is present. It is also an easy matter, in so far as detection is concerned, to omit these products from the statement of ingredients of a feed which contains both crushed oats and oat hulls or oat feed, provided the quantity is not unduly excessive. Since it is difficult and frequently impossible to determine the fact that a feed is adulterated with oat hulls or oat feed, the extent to which this practice exists can not be stated, though it is probable that most manufacturers do not follow it.

The difficulty of detecting this form of adulteration is illustrated by the case of a manufacturer who through an error in his registration of a feed for sale in Texas declared only one-half the quantity of oat feed actually present in the feed. This feed was shipped into Texas for a year under this erroneous registration, and although inspected and analyzed, the presence of the excess of oat feed was evidently not detected, since the manufacturer was not penalized.

Critics and defenders of oat feed are found among all branches of the business. The criticisms range from the unsupported assertions that it is a worthless product, to the carefully guarded statements of scientific men that oat feed is of value if sold at a proper price. Those who defend the product do not contend that it is unequalled as a feed or that it is a fully efficient feed of itself, but rather that it is a valuable commodity especially as a source of carbohydrates, and as such serves a useful purpose and has been grossly maligned.

Section 10. Controversy over use of oat feed.

CRITICISMS OF OAT FEED.—The feeling against oat feed is often expressed in very bitter terms. Manufacturers of feeds that do not contain this product frequently refer to it as "junk," "trash," "worthless," or "adulterant." Many feed manufacturers advertise that their feeds do not contain "cheap fillers (roughage), such as oat hulls, ground screenings, etc." One manufacturer stated in an advertisement:

> We do not buy nor use any oat hulls, cottonseed hulls, rice hulls, or other low-grade feeding materials of any description.

It is interesting to note that this manufacturer used as an ingredient in a mixed feed unhulled peanut meal which contained peanut shells, a product admittedly much inferior to oat feed.

Feeders frequently voiced their opinions of oat feed in strong terms, similar to the above. Agricultural college authorities, feed control officials, and representatives of the Bureau of Chemistry, were not as a rule as outspoken. Men of this last group more often called it a "cheap"[27] or "low-grade" product, but few would say that its use should be prohibited. Practically all such authorities believe oat feed to have a place provided the product is sold at prices

[27] "Cheap" in that it is of little feed value.

commensurate with its feed value and in proper relation to the prices of the recognized high value feeds. In fact, the severest condemnation of oat feed made by most agricultural authorities was that the price at which the product sold was out of proportion to its feed value. This situation has existed, apparently, for many years, since in November, 1898, the Massachusetts Agricultural College stated that "Such feeds have a very inferior feeding value and are not worth over one-half as much as corn meal."[28]

Prof. L. A. Maynard, of the New York State College of Agriculture, in an address before the Association of Feed Control Officials of the United States, November 19, 1920, said:

> The New York farmer * * * can not afford to buy oat hulls until he has fed all his oat straw, and rather than feed his dairy animals on either one he had better get rid of them, for he is losing money.

However, one of the large producers of this product takes issue with such statements and submits data compiled by his company showing the relative prices of 12 leading feed materials, including several mixed feeds, based on total digestible nutrients. According to these data oat feed,[28a] from January 1, 1914, to October 1, 1919, was frequently the cheapest source of digestible nutrients among the feeds listed and seldom worse than the second or third cheapest in the list. A mixed feed containing oat feed averaged about the fifth cheapest on the list.

The opposition of at least some feed manufacturers to oat feed must be viewed with suspicion. Undoubtedly one of the principal reasons for opposition from this source to the use of oat feed is the fact that the larger producers of this product use it in mixed feeds and that they can and do sell these mixtures at prices which are frequently below those of competing manufacturers. Add to this the fact that mixtures containing oat feed have the largest sale of any mixed feeds, and it is readily understood why the opposition to the product is so widespread and persistent.

Some of the manufacturers who are opposed to the use of oat feed have advocated that its shipment and sale be prohibited. These manufacturers, however, have admitted that the product could be utilized to good advantage by feeders and farmers near the source of supply—in this instance the oatmeal mills. In other words, a farmer near Cedar Rapids, Iowa, could haul oat feed from a large mill near that point to his farm and feed it to good advantage. But these manufacturers contend that it is a great economic waste for a farmer located in Virginia or any point far removed from an oatmeal mill to buy and transport oat feed from such distant points, because the feed value of the oat feed is relatively too small to stand the transportation costs.

Defense of oat feed.—Those who defend the product point to the series of tests made by the Maryland Agricultural Experiment Station as partial proof of the value of oat feed. They also compare the chemical composition and digestibility of oat hulls with that of timothy hay, as presented in the following table, and ask why oat feed, which is better than oat hulls, should be condemned and not timothy hay.

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[28] Bulletin 56, p. 19.

[28a] The price figures were taken from the Boston Chamber of Commerce statistics for "reground oat hulls," which are probably the same as oat feed.

TABLE 16.—*Average chemical composition* [1] *and digestibility* [2] *of oat hulls as compared with timothy hay.*[3]

	Protein.	Digestible protein.	Fat.	Digestible fat.	Fiber.	Digestible fiber.	N. F. E.	Digestible N. F. E.	Total digestible nutrients per 100 pounds.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*
Oat hulls	4.0	50	1.7	77	29.2	60	52.3	53	50.1
Timothy hay	6.2	48	2.5	50	29.9	50	45.0	62	48.5

[1] Average of 16 analyses of oat hulls and 221 analyses of timothy hay.
[2] One test of oat hulls and average of 58 tests of timothy hay.
[3] Henry and Morrison, 17th ed.

Users of oat feed contend that, in the interest of conservation, all products having a feed value should be utilized. They state that it is more economical that oats be milled and the offal, or oat feed, fed to stock and the oatmeal to mankind than that whole oats should be fed to stock. In support of this contention these supporters of oat feed cite Dr. Henry Prentiss Armsby, director of the Institute of Animal Nutrition of the Pennsylvania State College. In his book, The Conservation of Food Energy, Dr. Armsby gives the percentage recovery of energy from feeding whole oats direct to stock as compared with the percentage recovery of energy from milling oats and feeding only the offal, or oat feed, to stock and using the oatmeal as human food, as follows:

	Recovery of energy.			
	Cattle.	Sheep.	Hogs.	Dairy cows.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Oats fed direct	15	17	38	42
Oats milled	58	58	64	64

As a final argument for the use of oat feed the mixed-feed manufacturers using it point to the many thousands of testimonials from satisfied customers who have used mixtures containing oat feed for years and who have obtained satisfactory results. Many of these were entirely unsolicited. Owners of prize herds frequently tell in these testimonials of the beneficial results secured from mixtures containing oat feed.

Section 11. The problem of low-grade feeds.

The use of the low-grade materials previously discussed as feed for animals has been the cause of a great deal of controversy. The more important angles of the controversy are set forth in the following sections, and such conclusions and recommendations as the Commission believes pertinent are also given.

Apparently little has been done to determine definitely the merits of the arguments. It must be concluded that scientific data regarding the utility of these materials do not exist, since even the most outspoken opponents of low-grade feeds were unable to furnish or even suggest the source from which proof for their assertions might

be secured. Similarly, the most ardent supporters of these low-grade feeds were in most instances without authoritative data with which to support their claims. Much of the material secured by the Commission consisted largely of criticisms based on selfish grounds. This was particularly true of some of the information given by manufacturers. It is natural that producers of these materials would vigorously defend them, but the bitterness with which some manufacturers attacked their use was startling, especially so as many of their criticisms were not substantiated. In view of the fact that the business is highly competitive, the Commission has concluded that much of the opposition to the low-grade feeds is due to this competition.

Aside from the above factors personal prejudices have much to do with the attitude taken, and this is particularly true in the case of farmers. Locality also has much to do with the opinions held by various opponents of the so-called low-grade feedingstuffs. Feeders and agricultural experiment station authorities in New England are practically agreed that cottonseed hulls should not be fed in that section of the country. They hold that since this product has a very low feed value the transportation charges from the South to New England make it a very expensive feed, aside from the initial price of the product. On the other hand, cottonseed hulls are very highly prized as a roughage by southern feeders, and their use is advocated by most southern agricultural experiment station authorities, provided the price at which they can be secured is sufficiently low. Southern manufacturers, as a rule, are not willing that the sale of this product should be prohibited.

The use of ground corncobs in a mixed feed, for example, is opposed by many feeders, agricultural experiment station authorities, and some manufacturers. Yet these same feeders and agricultural authorities believe farmers should grind their corn with the cob and feed both as a part of a home-mixed ration, as is frequently done. The criticism in this case is that when buying a mixed feed containing corncobs the farmer is purchasing a roughage of which he frequently has, or should have, a sufficient supply, if not a surplus, and that he may be paying an unduly high price for this roughage.

Relation of prices to feed values.—It is often alleged by those opposing the use of low-grade feeds that the prices at which they are sold are entirely too high, feed value considered. It is, of course, impossible to state the actual feed value of these low-grade feeds since there are no recognized scientific data upon which such statements may be based. However, while the charge is one that might be expected during the past few years of high prices, this complaint has existed for many years. Since most of these low-grade feeding stuffs are by-products, it is maintained by some that to have sold them at lower prices would have meant higher prices for the principal product.

It is frequently alleged that purchasers of mixed feeds containing oat feed, or any other of the products commonly listed as roughages, pay for the oat feed or other feed of a similar nature at a rate per ton equal to the price of the mixture. Thus, if a mixture containing oat feed sold at $50 per ton, many believe they would be paying $50 per ton for the oat feed. It may be stated with absolute assurance that such is rarely, if ever, the case. Competitive conditions in the industry will not permit following such a practice. Reference to

Chapter III, section 9, will show the method followed by practically all manufacturers in figuring their costs.

If the chemical analysis were a proper standard by which the feed value of a feed could be measured it certainly would substantiate the assertions that some of these low-grade feeds, or roughages, have been sold at comparatively high prices. For example, oat feed, which analyzes low in protein and fat and high in fiber, at $50 per ton would be, for some purposes at least, a poor purchase compared with corn gluten feed, which analyzes much higher in fat and protein and much lower in fiber, at $80 per ton. But oat feed is not intended as a substitute for corn gluten feed and is not sold or used as such. The defenders of oat feed contend, and rightly so, that for some purposes corn gluten feed would be valueless and oat feed would meet the requirements.

USE OF LOW-GRADE MATERIALS AS ADULTERANTS.—It is alleged by some that the low-grade materials are frequently used as adulterants in mixed feeds. Since these materials are usually cheaper than high-grade products, it is to be expected that when adulteration is practiced the former or cheaper materials would be used.

The adulteration of feeds is discussed elsewhere in this report. It may be stated here, however, that the reply made by mixed-feed manufacturers to the charge of adulteration is that manufacturers can not afford to adulterate their products; that they are in business permanently and can not imperil their investments by such practices. They admit using some low-grade materials in their mixtures, but not as adulterants, contending that such ingredients are used for other specific purposes.

ADVISABILITY OF FARMERS BUYING ROUGHAGES.—Agricultural authorities maintain that farmers should produce and not purchase their roughages. Many of these authorities contend that a farmer who does not produce sufficient roughages to meet his requirements is not farming efficiently.

Although it might be better if farmers produced all the roughages necessary to feed their stock, the fact remains that there are many who do not and who therefore must purchase them. Liverymen and dwellers in and near cities owning a few animals are often practically forced to purchase all, or nearly all, their feeds, including roughages. This is also true of many large dairymen, particularly those in the Eastern States, where farms are small and cities and towns are numerous. Dr. Patterson, of the Maryland Agricultural Experiment Station, has stated that in Maryland there are many such dairymen, and in his opinion the same condition exists in practically all the States of the northeast section of the country.

USE OF LOW-GRADE MATERIALS IN MIXED FEEDS.—While as has been previously pointed out, there is a manifest lack of scientific or authoritative data to support many of the criticisms of low-grade feeds, the agitation against their use in mixed feeds is to be expected when the formulas of some mixed feeds are examined. It is true that most of such feeds are made to meet a demand and that they probably are used for specific purposes, which they fill. Nevertheless, if it is necessary to manufacture mixtures containing 50 per cent, 60 per cent, 70 per cent, and even 80 per cent, of these low-grade materials to meet the demands of certain purchasers, it would seem desirable so to label these mixtures as to prevent the purchase of them by those who

are inclined to believe that such mixed feeds are not economical or fit for their purposes.

It is, evidently, mixtures containing low-grade ingredients to the extent shown below that have had much to do with the opposition to mixed feeds. Clipped oat by-product 30 per cent and ground flaxseed screenings 40 per cent, a total of 70 per cent low-grade ingredients; screenings 44 per cent, oat feed 30 per cent, a total of 74 per cent; clipped oat by-product 50 per cent, and 30 per cent of flaxseed screenings, in all 80 per cent of low-grade materials, are but a few instances of many mixed feeds sold which have undoubtedly been responsible for much of the opposition. Lacking any other standard of measurement it would seem that mixtures with such high percentages of low-grade materials as are given above might well be called low-grade mixed feeds.

In buying some mixed feeds the purchaser does not know what he is buying. It is claimed that it is his right to know how much of each ingredient the mixture contains. Mixed-feed manufacturers frequently answer such assertions with the reply that it is asking for information which would be of no benefit to the farmer because, they say, he is too ignorant, usually, to know what he needs. Such answers are, of course, beside the point, unjustifiable, and unworthy of consideration. A knowledge of the percentage of ingredients in a mixture may not interest some purchasers of mixed feeds. Others, however, may need this information if for no other reason than to enable them to discriminate in purchasing such products.

Section 12. Proposals for settlement of the low-grade feed problem.

It is to be expected that numerous solutions would be advanced in a matter over which there is so much controversy. The most frequently proposed solutions are given below in brief form and each is discussed later. None of the solutions is advanced by the Commission. They have been proposed by men directly interested in the animal feeds business.

1. To prohibit the shipment and sale of the low-grade products.

2. To limit the shipment and sale of the low-grade products to a short distance from the point of production.

3. To require mixed-feed manufacturers using any of the low-grade feeds in their mixtures to state on tags and labels one of the following:

(*a*) The percentage of each of the low-grade ingredients in the mixture.

(*b*) The percentage of each ingredient in the mixture.

(*c*) To use a tag of a distinctive color, as yellow, or red, on each parcel of feed containing certain low-grade materials.

(*d*) A combination of (*a*) and (*c*) or (*b*) and (*c*).

(*e*) To list the ingredients in the order of their preponderance.

The first solution given above is not highly regarded even by most of the opponents of the low-grade products. It would not be possible to prevent the shipment and sale of these low-grade commodities without a great change in the existing laws. It is advanced by only a few factors in the business, and in the absence of proper data as to the feed value or lack of feed value of low-grade feeds can not be successfully maintained. This proposal is usually advanced for competitive reasons and is given here merely to show how extreme are the positions taken.

The suggestion that the sale and shipment of certain commodities listed as roughages be limited to a territory near the point of production is equally open to objection. Briefly stated, the proposition is that it is uneconomic to add the burden of any appreciable transportation charges to the first cost of some of these low-grade products. In other words, it is contended that there is a point beyond which their shipment should not be permitted.

Even if it were legal thus to limit the shipment of these materials, it would be practically impossible to draft such a law because, as has been so frequently pointed out, the feed value of these feeding stuffs has not been definitely determined. A Federal law, for instance, which would prohibit or restrict the use of certain roughages or low-grade feeds would certainly meet with strenuous opposition in many States.

The solution of the low-grade feeds problem which has been most frequently advanced has taken form in the various plans for stating the percentages of the ingredients in mixed feeds. A number of laws, both Federal and State, have been proposed embodying one or another of the several plans. There are at the present time laws embodying some of these features in effect in several States.

One of the reasons advanced for requiring the statement of the percentages of ingredients is that such a provision would enable farmers to discriminate in their purchases of mixed feeds. It is believed by some that if a farmer knew that a feed contained a high percentage of roughages or low-grade feeds he would not purchase it, and that this in itself would tend to curtail the sale and use of the low-grade feeding stuffs. It is also the belief of those favoring such a plan that it would give to the feeders and farmers information to which they are entitled.

The statement of the percentages of the ingredients in a mixed feed would not necessarily diminish the sale of feeds containing low-grade commodities. There is no indication that the sale of mixed feeds containing low-grade commodities is decreasing to a great extent in the States where such feeds must be sold under an open formula.

The objections to the percentage of ingredients proposals are numerous, and some of them of such importance as to justify careful consideration. The feed manufacturers who use some low-grade products in their mixtures urge that it would be unfair to them to require the statement of the percentages of only low-grade products, since it would tend to center attention on these products at the expense or to the disadvantage of any high-grade ingredients used in the mixture. They believe that if the percentages of any ingredients are to be stated, then the statement should cover all the ingredients and should apply to all mixed feeds.

Many feed-control officials agree with the feed manufacturers that it is not feasible to state the percentages of the ingredients in mixed feeds. A law requiring such statements is objected to on the following grounds:

(1) It sets up a double standard, which can not be met by the manufacturers.

(2) It would increase the price of feeds to the consumer.

(3) It would be placing a penalty on the honest feed manufacturers.

(4) It could not be enforced.

If manufacturers of feeds are required to guarantee the percentages of each ingredient in a mixture, it is asserted that they will not be able to maintain that guaranty and at the same time maintain the guaranteed chemical analysis of the feed. This is due to the fact that few, if any, feeding stuffs are constant in their chemical analysis. Several are of fairly uniform composition, analyzing within a narrow range at practically all times. Most feeds, however, vary widely, and this variation is found in the high-grade products as well as in the low-grade products. These variations are due to several causes, the chief ones being the fact that many of the raw materials from which the feeds are produced vary in composition. Then, too, the efficiency of the conversion processes influences to a great degree the chemical composition of a product, with the result that a given product from one plant may differ materially from that from another.

If a mixed-feed manufacturer guaranteed one of his feeds to contain 20 per cent protein and he customarily used, for example, a 41 per cent cottonseed meal to secure the bulk of the protein in his mixture, he would of necessity vary the percentage of cottonseed meal in the mixture if he was unable to secure 41 per cent cottonseed meal and was forced to use 36 per cent cottonseed meal, or meal containing 48 per cent protein. Such variations would, of course, mean a change in the percentages of the ingredients. If, on the other hand, the manufacturer did not change the percentage of cottonseed meal in his feed, the use of 36 per cent cottonseed meal would result in a violation of his guaranteed chemical analysis or necessitate constant changes in his registrations.

That such variations as cited for cottonseed meal are found in other products is shown by the following statement, which is merely illustrative:

Commodity.	Protein.	
	Low.	High.
	Per cent.	*Per cent.*
Bran [1] with mill run of screenings	12.40	18.70
Linseed oil meal [2]	32.81	46.75
Corn gluten feed [2]	23.13	33.88
Tankage [2]	28.94	69.88

[1] N. Y. Agr. Exp. Sta. Bul. 455, pp. 154–161.
[2] Penna. Dept. of Agr. Bul. 342.

Feed manufacturers attempt to maintain their formulas as constant as possible. They find it more economical from an operating standpoint and for commercial reasons to have their product run uniformly. Many concerns strive to use ingredients of as even composition as possible, as, for example, some attempt to buy only 41 per cent cottonseed meal. There are some concerns that do not vary their formulas at all for long periods; in a few instances the feeds have been the same since their inception. Such feeds, as a rule, are composed of comparatively few ingredients. The majority of mixed-feed manufacturers find it necessary, or expedient, frequently to change their formulas. These changes are at times very marked. For example, in 1919 one mixed-feed manufacturer made at least 14 changes of importance in one of his formulas. Even in prewar years

changes were frequent, this same manufacturer making at least 10 changes in 1913.

The changes in the formula of a well-known dairy ration over a period of years were submitted to the Commission. The following table presents three typical changes in five of the years. Some of the ingredients are omitted in order to avoid making public the formula.

TABLE 17.—*Typical changes in the formula of a well-known dairy feed, 1913–1915, 1919–20.*

Commodity.	Pounds per ton.														
	1913			1914			1915			1919			1920		
	Jan. 8.	Feb. 3.	Feb. 11.	Aug. 11.	Sept. 9.	Sept. 15.	Sept. 3.	Oct. 6.	Dec. 8.	Nov. 6.	Nov. 29.	Dec. 19.	Mar. 4.	Mar. 11.	Apr. 2.
Wheat middlings	200	100	100	....	150	....	100	100	200	50	275	355	405	405	405
Corn	335	585	635	485	130	180	230	180	80	....	....	....	....	....	....
Cottonseed meal	150	200	250	200	300	350	300	150	100	100	175	175	150	150	150
Corn gluten feed	700	500	450	450	250	300	200	400	450	400	10	10	100	100	100
Ground screenings	....	....	....	150	200	200	250	250	250	....	....	....	....	....	....
Ground corn	....	....	....	....	....	....	....	....	....	280	280	280	330	405	355
Linseed-oil meal	....	....	....	....	....	....	....	....	....	150	240	240	200	200	200
Ground barley	....	....	....	....	....	....	....	....	....	100	100	20	20	20	20
Molasses	....	....	....	100	150	200	250	250	250	250	250	250	125	50	100
All other ingredients	615	615	565	615	820	770	670	670	670	670	670	670	670	670	670

It will be noted from the above that not one of the ingredients named was present in the same quantity throughout the period.

Many of the changes shown were made to meet a situation when prices of some commodities were out of line with the prices of other materials of a similar composition. Most manufacturers of mixed feeds attempt to keep the prices of their feeds as low as possible because of competition. If the price of an ingredient in a mixture should increase to the point where it was out of line with the price of another similar commodity, the cheaper one would be used in the mixture. A few of the changes were due to scarcity of commodities, the most notable example being shown in the columns for November 29, 1919, and December 19, 1919, when only 10 pounds of corn gluten feed were used to each ton of mixed feed. This scarcity of corn-gluten feed was due to coal strikes, which prevented the manufacturer from securing a supply of this commodity. The 10 pounds were used in order to meet the registration of the feed which claimed corn-gluten feed as an ingredient. This same reason probably explains the use of only 20 pounds of ground barley per ton.

If the manufacturer of the feed for which formula changes are shown had been required to maintain any one of those formulas, his mixture would have varied widely in its chemical composition and undoubtedly would have necessitated a much higher price being charged. As a matter of fact the guaranteed chemical analysis was maintained fairly constant.

In view of the present limited ability of microscopists and chemists to determine the presence of the various ingredients in a mixed feed the opponents of legislation requiring the statement of the percentage of ingredients maintain that such a law is nonenforceable. It is conceded that the percentages of the ingredients in some mixtures,

as chop feeds or a mixture of two or three coarse commodities, may be determined with a fair degree of accuracy. However, these objectors maintain there are thousands of tons of mixtures sold which are ground very fine and contain a large number of different ingredients. It is toward this latter class of feeds that legislation of the sort under discussion is especially directed. They cite the fact that the science of microscopy has not developed to the point where even all the ingredients in a mixed feed can be detected, much less the percentage of each ingredient. This objection is given further weight by the results of a recent test conducted by the Bureau of Chemistry, United States Department of Agriculture. The details of this test, given below, are from the report on Feed Adulteration by Miss B. H. Silberberg, of the Bureau of Chemistry, submitted at the annual meeting of the Association of Official Agricultural Chemists in November, 1919. Dr. C. L. Alsberg, Chief of the Bureau of Chemistry, stated that the list of collaborators on the horse-feed test, while not including all the chemists or microscopists engaged in this line of work, represented the most active and presumably most capable ones. It is also to be noted that samples of the horse feed were sent to two chemists who claimed to be enforcing a clause in their State laws requiring the declaration of percentages of ingredients in mixed feeds, and yet no replies were received from them.

REPORT OF REFEREE ON FEED ADULTERATION, ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS, 1919.

The phase of feed analysis which has been most prominent during the past year or two is that of the quantitative determination of percentage of ingredients, particularly of mixed feeds. It was therefore considered desirable to confine this year's work under feed adulteration to investigations along this line. In this connection two samples were sent to the collaborators—one a cottonseed meal for determination of hulls, according to a method devised by the referee, and the other a molasses feed or horse feed.

PART I.—COTTONSEED MEAL.

This was in a sense a continuation of the work done two years ago on hull determination in cottonseed meal. The low results on hull content obtained by the collaborators at that time were thought to be largely due to the use of a rough mortar. The use of a glass mortar and pestle was therefore recommended and the directions were slightly revised. As was stated in the last report, an ordinary commercial sample was used, since it is impossible to simulate manufacturing processes under laboratory conditions. The exact hull content of the sample was therefore unknown. Of the 16 collaborators some were using the method for almost the first time, while others had had quite a little experience with it. The results as shown by the table varied from 16 per cent of hulls to 25.3 per cent of hulls. This, needless to say, indicates that the personal element introduces so large a factor of error as to make the method impracticable for general use. Probably the fact that the meal contained a great deal of lint made it more difficult to work, but it must be conceded that a method which is not adaptable to any type of sample is not worthy of general adoption.

One cause of the variation in results appears to be the method of drying the hulls after separation. Air drying to constant weight seems to be the most desirable method, but in some sections of the country where the humidity is high this is too prolonged an operation. It is evident from the character of the results that if any method similar to this one is used, very definite instructions which will take into consideration the varying atmospheric conditions in different parts of the country must be given.

Two of the collaborators each suggested another method. One was based on the determination of the crude fiber figure. The other method is one which involves the actual separation of the hulls from the meal and sounds very promising. It is to be hoped that during the next year these methods, and possibly others, may be given a thorough trial.

PART II.—HORSE FEED.

This particular type of molasses feed was chosen for two reasons: (1) Because it is probably the commonest type of mixed feed, and (2) because it is the easiest type in which to identify the ingredients and possibly to determine their approximate percentages. At any rate, if the percentages of ingredients in such a sample could not be determined with a fair degree of accuracy, it would be reasonable to assume that it would be an impossibility to do so in any other kind of mixed feed. In fact, one of the collaborators wrote in protesting against the use of this kind of feed as a basis for conclusions on this subject, claiming that it was much too simple to be representative of the average type of mixed feed presented to the analyst. Nevertheless, this analyst failed to find two of the ingredients most easily identified microscopically, and reported twice as much of one of the others as was actually present. The principal ingredients were ordinary commercial products purchased from feed stores. The cracked corn was fairly clean and was a mixture of white and yellow corn; the oats were practically free from weed seeds, but contained a slight trace of barley; the alfalfa was an ordinary sample of meal of good color; the cottonseed meal was of prime quality (39.8 per cent protein); the cottonseed hulls were ground delinted hulls; the peanut shells were ground to pass through a 1 mm. (20-mesh) sieve, and the molasses was cane, commonly called blackstrap. The chemical analysis was worked out according to the ingredients and amounts present from Henry and Morrison's Feeds and Feeding and the guaranty based thereon.

The following information was given the collaborators upon which to base their identification of ingredients and their approximate percentages. This represents an adulterated molasses feed with the following chemical guaranty and declared list of ingredients:

Protein, 12 per cent; fat, 3 per cent; crude fiber, 20 per cent. Ingredients: Corn, oats, barley, alfalfa, cottonseed meal, and molasses.

This is very similar to samples which have come under the referee's notice.

The ingredients were mixed in the customary manner employed in mixed-feed plants; that is, the warm molasses was mixed with the dusty, dry ingredients and the grains added afterwards. Each ingredient was carefully weighed and an exact percentage added. The feed was kept thoroughly mixed in order that each subsample should be uniform.

The reports of the collaborators show an eager and earnest spirit of cooperation, and without question represent the best efforts of feed analysts from various parts of the country who are considered most active and competent in this field of work. The results are therefore of particular interest. The feed contained 20 per cent of corn; the results of the collaborators varied from 11 per cent to 21.5 per cent. There was 15 per cent of oats present; reports varied from 10 per cent to 19 per cent, although three reported the oats correctly. No barley was added, but a slight trace was present as a contamination of the oats. It is more than likely that some subsamples contained no barley. The highest amount reported was 0.9 per cent. Twenty-five per cent of alfalfa was present; the reports varied from 24.6 per cent to 35 per cent, although all but the one high one were remarkably close. The amount of cottonseed meal added was 10 per cent; only two of the collaborators found any cottonseed meal, one reporting 4 per cent and the other 35.9 per cent. There was also 10 per cent of cottonseed hulls used in addition to the meal; reports on these ranged from none to 30.3 per cent, all but the one reporting 20 per cent or over. Five per cent of peanut shells were added, and not one of the collaborators discovered these. This is of special interest in view of the fact that one of the proposed laws relative to mixed feeds contained a clause providing that when 5 per cent or over of a low-grade ingredient was used, the percentage present should be stated on the label. The amount of molasses present was 15 per cent; reports ranged from 2 per cent to 25 per cent.

These results speak for themselves, but it is impossible to resist a few comments. In the first place one surprising and outstanding fact is that in practically every case the work, even the identification of the ingredients, was done by chemists instead of microscopists and apparently without the use of a microscope. Of course, there is nothing to prevent anyone with chemical training from also taking special training in plant histology, including microscopy. But the results show how utterly out of the question it is for one without such special training, no matter how good a chemist he may be, to do the microscopic work; that is, the identification of ingredients in feeds. I know of no one ingredient of feeds which is more easily identified microscopically than cottonseed meal. A few years ago I showed an analyst how to identify cottonseed meal in a mixed feed and he afterwards identified it positively in a feed which contained less than a hundredth of a per cent. This horse feed contained at least 7 or 8 per cent of hull-free cottonseed meal, and yet only two analysts found any present, and several of the others specifically stated in their reports that they

saw no evidence of the presence of cottonseed meal. While 5 per cent of some ingredients in certain mixtures would be difficult to identify, even for a microscopist, there are at least three distinctive types of tissue which would enable the plant histologist to identify peanut shells.

This whole question is not original or new, nor is it the first time it has been presented at a scientific meeting. Dr. A. L. Winton in a paper entitled "The Microscopical Examination of Vegetable Products As An Adjunct to Their Chemical Analysis," reprinted in the American Journal of Pharmacy, March, 1913, from original communications, Eighth International Congress of Applied Chemistry (Vol. XVIII, 361–366), says: "Without a certain amount of botanical training, * * * a chemist is no more fitted to take up microscopical analysis than a botanist without chemical training is fitted to work at quantitative analysis."

The inevitable conclusion is that unless a prodigy can be found who has been trained both as a chemist and a plant histologist or microscopist, the chemist and microscopist must work together for efficient feed analysis, for the one can not do the work of the other.

With regard to the work for the ensuing year it seems advisable that, in view of the suggestions made by collaborators, the work on hull determination in cottonseed meal be continued. A few years ago work was begun on methods of sampling scratch feed containing grit or shell. The results so far obtained show that the methods of mixing commonly used do not insure a homogeneous sample. A method which will do this is most necessary, and it is suggested that work along this line be continued. Several years ago it was recommended that a key or outline for the qualitative detection of various products used in feeds be presented. Such an outline has been made by the referee for the information sheets of the Bureau of Chemistry, United States Department of Agriculture, on the microscopic examination of feeds and feeding-stuffs and may be had on application to the referee.

TABLE I.

Analyst.	Proportion of hulls reported, showing number of determinations made by each analyst.					Average.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
A	22.0	21.8				21.9
B	24.4	24.8	21.0	22.4		23.15
C	16.2	15.9	16.4	15.5		16.0
D	24.6	24.0				24.3
E	18.3	18.2	18.3			18.3
F	20.4	21.3				20.85
G	19.3	19.2				19.25
H	20.7	19.4	20.5			20.3
I	16.1	17.8	16.3			16.7
K	19.2	18.6	19.3	18.9	19.4	19.1
L	21.7	23.5	23.9			23.0
M	23.2	20.8				22.0
N	20.0					20.0
O	23.3					23.3
P	20.2					20.2
Q	25.8	24.8				25.3

TABLE II.

Ingredients.	Percentages present.	Percentages reported by analysts— A.	B.	C.	D.	E.	F.	G.
Corn	20	15	11.4 10.4	14.8	19	21.5	20	21.3
Oats	15	15	10.0 11.6	11.7	19	18.9	15	15.9
Barley	(1)	(2)	.9	.3				0
Alfalfa	25	25	28.7 27.0	27.8	26	24.6	35	24.9
Cottonseed meal	10		0 0	0	0		4	35.9
Cottonseed hulls	10	20	28.9 24.7	19.9	20	30.3	20	
Peanut shells	5							
Molasses	15	25	21.5 24.1	24.0	16	4.7	6	2.0

[1] Trace; contamination of oats. [2] Trace.

The State of Texas has a clause in its feed law requiring, under certain circumstances, the statement of the percentages of low-grade ingredients in a mixed feed. F. D. Fuller, chief of the division of feed control service of Texas, at a hearing in Washington before representatives of the Department of Agriculture, on February 12, 1919, made the following statement:

I think it is a debatable question as to whether the percentage of composition of the feed can be actually determined. On some mixtures I think it is feasible—mixtures containing two or possibly three ingredients—but I have yet to be shown that in case of a mixture containing a large number of ingredients, or possibly three or four ingredients derived from corn, for instance, like hominy feed, yellow hominy feed [it is possible],[29] to do it. Personally, as a chemist, it would be impossible for me to make that separation with any degree of accuracy. In the enforcement of our Texas feed laws I must rely absolutely on the evidence presented to me by the chemist, and I have not yet felt that I was justified in instituting cases in courts which were based entirely on such evidence.

Dr. ALSBERG. You have been able to do it where there were only two or three ingredients?

Mr. FULLER. Yes, sir. It can be done with a fair degree of accuracy. We have brought cases where the manufacturer had guaranteed 2 per cent of grit, and we have found an excess of grit, in some instances, of 18 per cent. That was a very simple matter, but it may be that the State of Texas is very fortunate in having a chemist who is able to give us the information desired which will enable us to secure conviction in the local courts. As evidence of the fact that the manufacturers are complying with that provision of the act, I would like to submit for your information these tags, which are official tags. They have been used in Texas with the sale of feeds.

Mr. HAYWOOD. That is, Mr. Fuller, you would say they are putting on the percentage of each ingredient and the protein, fat, and fiber, but in a good many cases you don't know whether they are true or not.

Mr. FULLER. I haven't received that information from the chemist. I might say, furthermore, our chemist assures me that it can be done with a sufficient degree of accuracy to enable the enforcement of the act.

It may be noted in connection with Mr. Fuller's statements that the mere fact that manufacturers give percentages of ingredients on the tags is not proof that the manufacturers use the precentages given in compounding their mixtures, as Dr. Haywood, of the Department of Agriculture, says. The Texas chemist may feel certain that the percentages may be determined sufficiently close for enforcement purposes, but the tests made by the Department of Agriculture would indicate that such assurance is not well founded. The case previously alluded to of a manufacturer using twice as much oat hulls as was declared may serve as a further illustration.

The objection to the statement of the percentages of each ingredient in a mixture on the grounds that it would be placing a penalty on the honest manufacturer is closely allied to the other objections. If it is not possible to determine the percentages after the mixture is made, then an honest manufacturer who states the true percentages of the ingredients in his mixture would be forced to compete with the dishonest manufacturer who would, for example, give a statement of percentages and then exceed the amount he specified for the low-grade commodity in his feed.

However, honest manufacturers are now forced to withstand competition of a somewhat similar nature, for it is possible, without stating them as ingredients, to add a small percentage of oat hulls or oat feed, for example, to a mixture containing crushed oats, or to add a small quantity of elevator dust to a mixture without fear of detection.

[29] Inserted by Commission.

The fact that the statement of the percentages of the ingredients would be to make public the formulas which are regarded by some as a business secret is advanced as an objection to such legislation. This, however, is not always sincerely advocated, for it is admitted by several manufacturers that they do not believe that their feeds could be duplicated from the formula printed on the tag. This is because of the variations in the chemical composition of the different ingredients. Merely to know that a feed contained, say, 20 per cent of cottonseed meal would not be sufficient, since cottonseed meal varies materially in its chemical composition. This variation is found in practically every commodity, as has been previously stated.

Probably one of the reasons why manufacturers who use low-grade products take the position that if open formulas are required the law should apply to all feeds is to be found in the fact that if all mixed-feed manufacturers are required to state the percentage of each ingredient in their feeds the opposition to such proposals would be increased and strengthened, and thus the main issue, namely, the fight against low-grade feeds, becomes of secondary importance. By requiring mixed-feed manufacturers to state the percentages of all ingredients the users of the low-grade ingredients are not compelled to stand alone. By including all mixed-feed manufacturers the issue becomes widespread, and stating the percentages of the low-grade ingredients is no longer the debated point, since manufacturers in general quickly combine to fight such proposals. Comparatively few manufacturers are willing to state the percentages of ingredients in their feeds. These manufacturers do not as a rule make mixtures containing many ingredients. It is also true that they do not use the low-grade products to a great extent.

It has been suggested that tags attached to mixed feeds containing low-grade materials be of a distinctive color, as yellow or red. The idea is that such tags would serve as a warning of the presence of low-grade materials in the mixture. Minnesota requires such mixtures to carry a yellow tag with red printing. Feed manufacturers opposing such requirements assert that a mixture may contain low-grade materials and yet be a highly useful feed and that the farmer is not interested in the composition of the feed but in the results which he obtains from its use.

The statement of the ingredients in a mixed feed in the order of their preponderance has been suggested as a possible solution of the low-grade feed problem. However, such a plan is subject to a large extent to the same objections as those given against stating the percentages of all ingredients in mixed feeds.

Section 13. Conclusions.

The study of the low-grade feed problem has led the Commission to the following conclusions:

1. That the argument for and against low-grade feeds has been based to a great extent upon hearsay and personal opinion, and that sufficient data of a scientific nature upon which to base conclusions as to the value of the low-grade feeds do not exist.

The above conclusion is supported by statements of feed manufacturers and scientific men interested in the industry. Practically all parties interviewed agreed that there are few data concerning the feed value of many of the low-grade products. The very small

quantity of such material offered by the opponents and proponents of the low-grade feeds indicates that such data do not exist.

2. That the controversy has been clouded and confused by statements and allegations of mixed-feed manufacturers on both sides of the question, who argue from selfish motives, and by farmers, feeders, and many of their supporters, who make charges and assertions not supported by proof.

3. That the objections to these feeds are largely due to the prices at which they sell.

The prices of low-grade feeds have advanced very materially in recent years, like most other commodities, but no evidence has been found of any manipulation or combination responsible for such increases. The prices of the high-grade feedingstuffs have also increased greatly in recent years. It does not appear, furthermore, that farmers and feeders have been forced to purchase the low-grade feeds or the mixed feeds containing them, since there are the high-grade feeds, both mixed and straight, which can be purchased.

4. That it does not appear feasible, at least at the present time, to pass a law prohibiting (or restricting) the use of these feeds. Even if such a law were constitutional, to pass it now with the limited data available regarding the feed value of these products would be unwise.

5. That while it is desirable to give the consumer as much information as is possible regarding these feeds, a law requiring the statement of any or all percentages of ingredients, or the listing of ingredients in a mixed feed in order of their preponderance, would be difficult to enforce.

Before the controversy over the low-grade feeds can be settled and a satisfactory conclusion arrived at the Commission believes that a series of feeding tests of the most exhaustive nature should be made with each of the low-grade feeds, and probably combinations of the low-grade feeds with certain high-grade feeds. Such tests should be made by a disinterested body, preferably the United States Department of Agriculture, assisted by the various State agricultural college and feed-control officials. The work of educating and encouraging farmers in the proper feeding of their stock also should be continued.

It should also be definitely determined by cooperative experiments between the Bureau of Chemistry, United States Department of Agriculture, and the various State feed-control officials whether known ingredients in mixed feeds, similar to those sold in the United States, can or can not be quantitatively determined.

CHAPTER V.

WHOLESALE PRICES

Section 1. Introductory.

The Commission endeavored to secure representative price records of most of the principal by-product straight feeds and also of typical ready-mixed feeds in each of the main subgroups named in Chapter III, section 9, viz, dairy feeds, stock feeds, horse and mule feeds, hog feeds, calf meals, and poultry feeds. The number of brands of ready-mixed feeds is enormous. Some are sold only locally, but even those which are generally advertised and widely distributed are so numerous that it was out of the question to secure prices for any considerable part of them. However, it is believed that price records were obtained for a sufficient number of widely distributed feeds in each group of the ready-mixed feeds to be representative of that group, and that consequently a fair picture of the price movement of the entire class of mixed feeds is presented.

CHARACTER OF STATISTICS AND METHOD OF TREATMENT.—The statistics of prices were collected partly by the Commission's agents from the records of manufacturers and jobbers, and partly through correspondence with manufacturers, who compiled the statistics and furnished them directly to the Commission. Statistics were also secured from published sources, chiefly trade papers, and averages were computed from them. This material was used to check the figures from other sources, and in a few cases averages derived from the published figures have been used to supplement the latter. However, it has been considered desirable to use in this chapter, as far as practicable, the figures obtained from manufacturers and jobbers as probably more nearly representing the actual price situation than the published figures, which in some cases may not represent actual transactions.

In any study of price statistics it is desirable to have true averages computed by dividing the total proceeds from sales of the given commodity during a certain period (e. g., a month) by the total quantity sold during the period. It was found that feed manufacturers rarely have statistics of this character compiled for their own use, and the Commission could not undertake the great amount of work which would have been involved in tabulating such statistics for a large number of feeds. It was necessary, therefore, to confine the compilation of price statistics to certain days in each month, in order to bring the clerical work within a reasonable compass. Accordingly it was decided to secure the statistics of prices for the 1st, 10th, and 20th of each month. The prices for these three dates were averaged and the resulting figures are presented in the tables in this chapter and in the appendix tables in the form of monthly average prices.

In some instances it was found practicable to take off the prices for all transactions on the selected days, together with the corresponding tonnages. In such cases weighted averages were computed, but for the most part the tables present simple averages of the prices on the selected dates.

When published sources were used, the price for a certain day of each week was generally taken and averages of these weekly figures were used.

In times of very rapidly fluctuating prices it is possible that the average of three quotations a month may not give as accurate a measure of the price situation in that month as would be desirable, but it was necessary to reduce the number of prices to a workable basis, and the dates selected seemed, on the whole, sufficient.

The price records of some manufacturers had either not been preserved for any considerable period or were not kept in such condition that statistics could be readily compiled from them. In some cases of this sort quotations were furnished instead of actual prices, but these were used only when the Commission was assured that these quotations represented substantially the prices on actual sales. Most manufacturers of mixed feeds assert that all of their sales of a given brand on a given day are made substantially at the same price, and in general the statistics furnished by the mixed-feed manufacturers give one price only as representative for each selected date (1st, 10th, and 20th).

In presenting prices of the straight feeds, figures are given for a leading market or for two or three markets which were deemed to be typical. It is undoubtedly true that unusual conditions in particular localities will cause the price of a given feed to run out of line with prices of the same feed in other markets. Such conditions, however, are generally of relatively short duration, and it is the purpose of this report to show only the broad general movement of prices of the straight feeds and of typical mixed feeds.

Period covered by the statistics.—The Commission sought, so far as was practicable, to secure price records both for straight feeds and ready-mixed feeds beginning with January, 1913. The object in going back as far as the year 1913 was to extend the price study back to a period before the outbreak of the war in Europe, when presumably general conditions in the feed industry, as in most other lines of business, were fairly normal. The figures for the year 1913, which was free from the disturbing conditions accompanying the war, may be taken as a basis from which the price movement may be traced through the war period and the period of even higher prices which followed the armistice.

While it was attempted to secure price records both for straight and ready-mixed feeds going back as far as the beginning of 1913, it was by no means possible to do this in every case, particularly as regards the mixed feeds, chiefly because many manufacturers do not preserve the records showing their prices for so long a period, while the manufacture and sale of some of the leading mixed feeds for which prices were obtained, did not begin until later than 1913. However, for practically all the most important straight feeds and for one or more mixed feeds in all of the groups except hog feeds

and calf meals price statistics were secured beginning with January, 1913.

The work of gathering price statistics was substantially finished during the summer of 1920. For this reason the price records secured, with few exceptions, did not extend beyond the end of June, 1920, and the price tables in this report, except the one mentioned in the next paragraph, do not extend beyond June, 1920.[1]

The last six months of 1920, and particularly the last four months, were noteworthy as a period of rapidly declining prices, and a study of price movements which ends with the middle of the year is obviously incomplete. It was not feasible to extend the field work of the investigation so as to secure complete price statistics for the last half of 1920. But to avoid leaving this very remarkable and interesting period without comment, a section at the close of this chapter (sec. 23) gives a brief survey of the course of prices of a few of the most important straight feeds from July to December, 1920, as shown in quotations from published sources. Prices of the ready-mixed feeds were not available from these sources. Accordingly prices for the end of December, 1920, were secured through correspondence from most of the manufacturers who had previously furnished price records. This makes possible a comparison of the prices of December with those of June, 1920, for a number of typical mixed feeds. This comparison is also given in section 23, and while it does not show the successive steps in the decline of prices of mixed feeds, it gives the total decline during the six-months' period and furnishes the basis for comparing the relative decline in prices of ready-mixed feeds with the fall in prices of straight feeds.

Straight feeds.—In sections 4 to 15 of this chapter will be found a discussion of the prices of a large number of straight feeds, for most of which tables of monthly average prices are given either in this chapter or in the appendix. The list of straight feeds for which prices are given is as follows: Corn, oats, wheat bran, standard middlings, wheat-mixed feed, flour middlings, red dog, rye middlings, hominy feed, reground oat hulls, rice bran, rice polish, corn-gluten feed, corn-oil meal, cottonseed meal, cottonseed hulls, linseed meal, dried-beet pulp, cane blackstrap molasses, digester tankage, and alfalfa meal.

The comparison of prices of different straight feeds or groups of straight feeds with one another will be found in section 2 of this chapter.

Mixed feeds.—Sections 16 to 22 are devoted to the discussion of prices of ready-mixed feeds, based on tables of monthly average prices of leading brands in each of the subgroups already mentioned, viz., dairy feeds, stock feeds, horse and mule feeds, hog feeds, calf meal, and poultry feeds.

The comparison of prices of commercial mixed feeds with the straight feeds is made in section 3 of this chapter.

Food Administration Regulations.—Various regulations of the Food Administration applied to manufacturers, importers, and distributors of feeds. These lines of business were brought under the licensing system by presidential proclamations, as follows:

August 14, 1917.—Wheat and rye elevators and millers.

[1] In some cases the statistics are not brought down as far as June, 1920.

September 7, 1917.—Manufacturers of sugar, sugar sirups, and molasses.

October 8, 1917.—Persons, firms, corporations, and associations engaged in the business of operating elevators, warehouses, or other places for the storage of corn, oats, barley, beans, rice, cotton seed, cottonseed cake and meal, or peanut meal.

Persons, firms, etc., engaged in importing, manufacturing (including milling), or distributing barley, oats, corn, rice, cotton seed, cottonseed cake and meal, peanut meal, or soya-bean meal.

January 10, 1918.—All persons, firms, corporations, and associations engaged in any of the following lines of business:

1. Importing, manufacturing, storing, or distributing any commercial mixed feeds.

2. Manufacturing feeds from or importing, storing, or distributing any of a long list of feeds or feed ingredients.

3. Importing, manufacturing, storing, or distributing as feed any products or by-products of various grains and other commodities, except products or by-products whose importation, manufacture, storage, or distribution had already been covered by a license held by any such person, firm, corporation, or association.[2]

The Food Administration by special regulation (issued Jan. 28, 1918, amended Oct. 1, 1918, and repealed Jan. 10, 1919) provided that licensees under the proclamation of January 10, 1918, should take no more than a reasonable profit on the sale of any feeding stuff over the average cost of the licensee's stock of any commodity on hand or under control not at that time contracted to be sold.[3]

By this ruling and by other similar regulations the general principle that no more than a reasonable profit should be realized on sales of feeds was applied by the Food Administration to all feeds.

Other more specific regulations dealing with the prices of certain feeds were issued. The more important of these special regulations are mentioned in connection with the discussion of the prices of the particular feeds.

Section 2. Comparison of prices of straight feeds with one another and with farm products and all commodities.

In this section the prices of different straight feeds are compared with one another, and since it would be confusing to extend the comparison to include all the feeds for which price tables are given, a selection has been made of 10 important feeds. The tables of monthly average prices of these feeds will be found in the later sections of this chapter or in the appendix. The yearly averages for the years 1913 to 1919, inclusive, and the averages for the first six months of 1920 are summarized for convenience in Table 18.

Besides the comparison of the prices of the selected feeds with one another, they are also compared with the prices of "farm products" and "all commodities," as published by the Bureau of Labor Statistics of the United States Department of Labor. This bureau compiles statistics of wholesale prices of 327 commodities, "covering a wide range of raw and manufactured products," and publishes index

[2] United States Food Administration Special License Regulations I–B–1 and XXV–A–1; also Rules and Regulations governing the importation, manufacture, storage, and distribution of food commodities for domestic trade by persons subject to license, pp. 4–6, and Amendments and additions to same, pp. 25–27.
[3] United States Food Administration Special License Regulations XXV–D, 5, 6, 7 (Rule 7).

numbers of prices for all commodities combined and also for nine subgroups, one of which is the "farm products" group.[3a]

In order to make the comparison of the prices of the selected feeds with the prices of farm products and all commodities as shown in the index numbers of the Bureau of Labor Statistics, the monthly average prices of each feed have been reduced to relatives, using the same base as the Bureau of Labor Statistics, viz, the average price for the year 1913. In other words, the average price for each selected feed for the year 1913 was taken as equal to 100 and the prices relative to this base were computed from the monthly and yearly average figures. The relatives as derived from the yearly averages are given in Table 18 following.

Simple averages of the relative prices of the 10 feeds were computed, since there is no satisfactory basis for weighting the prices of the different feeds in accordance with their relative importance. These figures will be found in Appendix Table 1,[3b] and the movement of relative prices as represented by these averages is shown graphically in the diagram opposite page 110, which also shows the curves for prices of "all commodities," the "farm products" group, and the average of 12 typical mixed feeds.

TABLE 18.—*Average prices of 10 selected straight feeds in tons and relative prices, together with relative prices of all commodities and farm products, by years, 1913–1919, and for the first half of 1920.*

Year.	All commodities.	Farm products.	Corn.	Oats.	Wheat bran.	Hominy feed.	Corn gluten feed.	Rice polish.	Reground oat hulls.	Cottonseed meal.	Linseed meal.	Alfalfa meal.	Average of 10 feeds.
1913	.....	.....	$22.31	$23.48	$18.63	$21.66	$20.96	$21.77	$16.30	$25.63	$25.87	$17.79	.....
1914	.....	.....	24.96	26.21	21.34	24.90	23.38	24.16	16.19	24.98	28.73	17.04	.....
1915	.....	.....	26.23	30.68	20.36	26.05	22.08	24.44	20.11	25.40	33.11	15.92	.....
1916	.....	.....	29.58	28.85	20.98	27.53	23.51	26.27	19.79	30.73	34.22	17.19	.....
1917	.....	.....	59.01	39.97	32.94	49.84	38.06	[1] 40.25	27.49	40.41	48.02	27.96	.....
1918	.....	.....	57.37	48.38	30.37	55.17	45.44	[1] 56.41	25.90	50.71	54.73	31.37	.....
1919	.....	.....	57.68	44.69	39.50	60.69	55.21	59.50	31.04	61.32	67.22	34.96	.....
1920 [2]	.....	.....	60.99	62.69	47.67	64.58	[3] 64.91	[4] 57.96	42.87	67.30	72.70	35.33	.....
RELATIVE PRICES.													
1913	100	100	100	100	100	100	100	100	100	100	100	100	100
1914	100	103	112	112	115	115	112	111	99	97	111	96	108
1915	101	105	118	131	109	120	105	112	123	99	128	89	113
1916	124	122	133	123	113	127	112	121	121	120	132	97	120
1917	176	189	265	170	177	230	182	[1] 185	169	158	186	157	188
1918	196	220	257	206	163	255	217	[1] 259	159	198	212	176	210
1919	212	234	259	190	212	280	263	273	190	239	260	197	236
1920 [2]	259	243	273	267	256	298	[3] 310	[4] 266	263	263	281	199	268

[1] Average for 11 months only.
[2] Average January–June.
[3] Not including June.
[4] January to April only.

[3a] The two subgroups which seem most suitable for comparison with feeds are the "farm products" group, embracing 32 commodities, and the "food, etc.," group, which is made up of 91 commodities. The index numbers of the food group, however, in the main follow rather closely the index numbers for all commodities. Hence the comparison with this group has been omitted, and index numbers are given only for "all commodities" and "farm products."

The method by which the index numbers of the Bureau of Labor Statistics are computed is described as follows:

"In computing the index numbers the average monthly or yearly price of each article is multiplied by the estimated quantity of that article marketed in the census year of 1909. The different results are then added for each group and for all groups combined, giving the approximate total value of commodities in the month or year in question. These sums are then reduced to percentages of the 1913 sum, taken as the base. In this way each article has an influence on the result proportionate to its importance in the country's markets." (Monthly Labor Review, September, 1920, pp. 65–66.)

[3b] It was not considered necessary to show also the relative prices by months for each of the 10 selected feeds, since the absolute figures for each are given in tables either in the later sections of this chapter or in the appendix.

The table shows that the price of "all commodities" remained practically stationary from 1913 to 1915, but that there were marked increases in the years 1916 to 1919, inclusive, and in the first half of 1920. The greatest increases were from 1916 to 1917 and from 1919 to the first half of 1920.

The farm products group showed a nearly similar movement from 1913 to 1916, with more marked advances than those of all commodities in 1917 and 1918. The increase in the index numbers of the two groups was about the same in 1919, but in the first half of 1920 the increase in the price of farm products was slight as compared with that of all commodities. The index numbers for the first half of 1920 were 243 for the farm products group and 259 for all commodities. It appears from these figures that the price of all commodities for the first half of 1920 was slightly more and that of farm products slightly less than two and a half times as high as the 1913 level.

The price movement of the 10 selected feeds for which prices are shown in Table 18, with one exception (rice polish),[4] also reached the maximum in the first half of 1920.

The highest relative prices for these feeds, as shown in this table, ranged from 199 for alfalfa meal to 310 for corn gluten feed. The relative increase in the price of alfalfa meal, however, was much less than for the other feeds, and if this is left out of consideration, the range in maximum prices as shown in the relative numbers was from 256 to 310. It will be noted that in the period of maximum prices (first half of 1920) all the feeds except alfalfa meal reached higher relative prices than the farm products group and all except alfalfa meal and wheat bran higher relative prices than all commodities. Corn gluten feed and hominy feed were about three times as high as in 1913, and linseed meal, corn, and rice polish (year 1919), about two and three-quarters times as high, while oats, reground oat hulls and cottonseed meal[5] were only slightly higher than all commodities, and wheat bran was slightly lower.

The price movement for the 10 feeds combined as represented in the simple averages of their relative prices was strikingly like that of the farm products group except for the first half of 1920, when the index number for the feeds group was considerably higher than the farm products group.

Prices of all the feeds increased greatly in 1917, as did also the prices of all commodities and the farm products group. Much the greatest advance was made in the price of corn, which doubled in 1917, the next largest relative increase being in the price of hominy feed. In 1918, corn, wheat bran, and reground oat hulls declined in price, while all the other feeds made substantial advances. The price of wheat bran under the Food Administration regulation was generally conceded to be very low, quality considered, as compared with most other feeds. (See sec. 5.) There was a substantial increase in the price of this feed in 1919. The price of oats fell somewhat in that year, corn prices remained almost stationary, and the prices of all the other feeds increased. As already stated all the feeds except rice polish reached maximum prices in the first half of 1920.

[4] This may be only an apparent exception, since prices of rice polish for May and June, 1920, are lacking.

[5] As pointed out below (p. 122), the prices of cottonseed meal for January, 1913, to June, 1916, were for 41 per cent protein meal, and from July, 1916, to June, 1920, for 36 per cent protein meal. The increase in prices in the later years, therefore, is somewhat understated in the tables in this report.

Considerable differences appear in the movement of prices of different feeds, but these might naturally be expected, considering the diversity in the kinds of feeds represented in the table. It may be pointed out that in any year one or more feeds may be relatively abundant, while the supply of others is below normal. However, the increase in the price of a relatively scarce feed is likely to be materially checked on account of the facility with which one feed may be substituted for another within fairly wide limits. It may be said, in fact, that the price of any feed depends to an important degree upon the prices of other feeds which may be substituted for it.

It is interesting to note in connection with the prices of by-product feeds that high prices in consequence of heavy demand do not necessarily stimulate production, since normally the production of the by-products is dependent chiefly on the demand for the primary product or products. For example, the quantity of wheat feeds produced depends almost entirely upon the demand for flour. Consequently, it is quite possible to have a heavy demand for wheat feeds, accompanied by relatively high prices, without very much effect in encouraging an increased production of the feeds, if this strong demand for the by-products happens to coincide with a period of relatively slack demand for flour, the primary product of the mills.

Section 3. Comparison of prices of commercial mixed feeds with prices of straight feeds, farm products, and all commodities.

It would be practically out of the question to make a satisfactory comparison of the prices of any brand of mixed feed with the prices of the ingredients of which it is composed for any long period of time. Even if the ingredients were not numerous, changes in their prices are much too frequent, not to speak of the difficulty which would arise from frequent changes in formulas. (See sec. 16.) No such comparison has been attempted in this report. However, a comparison satisfactory for broad, general purposes may be made by bringing together the relative prices of a representative number of commercial mixed feeds and the relative prices of the selected straight feeds. A further comparison with the index numbers of prices of farm products and all commodities will be useful.

In order to make this comparison the relative prices of 12 leading and well-advertised brands of commercial mixed feeds were computed from the monthly average prices on the same basis as the relative prices of the 10 straight feeds considered in the preceding section, i. e., by using the average price of the year 1913 as a base or equal to 100.[6]

The relative prices of the 12 brands were also averaged by months. In the absence of any satisfactory method of weighting, simple averages were computed, as in the case of the 10 selected straight feeds. These monthly averages will be found in Appendix Table 1, while the yearly averages of the relative prices of the 12 mixed feeds are given in Table 19 which follows, in connection with the relative prices of each brand.[7] Table 19 also shows the averages of the relative prices of the 10 selected straight feeds by years and the

[6] In selecting these brands it was of course necessary to take only those for which the price records were complete back to the beginning of the year 1913. The selection was therefore rather restricted because several manufacturers were unable to furnish records of prices beginning as early as January, 1913. For this reason also hog feeds and calf meals are not represented in the relative prices.

[7] The monthly relative prices for the several brands have been omitted.

corresponding index numbers for the farm products group and all commodities. It is possible to follow the averages of the relative prices of the 12 mixed feeds in detail by months in the diagram facing page 110, which likewise shows the curves for the group of 10 straight feeds and for the farm products group and all commodities.

TABLE 19.—*Average prices of 12 brands of commercial mixed feeds in tons and relative prices, together with relative prices of 10 straight feeds, all commodities and farm products, by years, 1913–1919, and for the first half of 1920.*

Year.	Dairy feeds.[1]		Stock feeds.[2]		Horse feeds.[3]		
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
1913	$30.43	$30.87	$25.58	$26.54	$24.35	$26.22	$25.54
1914	32.67	32.40	26.27	29.25	26.03	28.09	27.67
1915	33.03	32.24	26.20	30.57	26.90	27.57	28.29
1916	34.69	34.52	28.17	32.19	29.88	30.16	31.81
1917	52.06	51.94	40.92	53.06	50.00	43.39	51.69
1918	64.26	62.40	53.90	57.75	55.18	58.62	57.43
1919	72.85	69.92	50.48	60.32	55.21	52.85	55.47
1920[7]	79.42	75.66	57.44	67.75	61.81	64.65	60.86
RELATIVE PRICES.							
1913	100	100	100	100	100	100	100
1914	107	105	103	110	107	107	108
1915	109	104	102	115	110	105	111
1916	114	112	110	121	123	115	125
1917	171	168	160	200	205	165	202
1918	211	202	211	218	227	224	225
1919	239	226	197	227	227	202	217
1920[7]	261	245	225	255	254	247	238

Year.	Scratch feeds.[4]			Mash feeds.[5]		Average, 12 mixed feeds.[6]	Average, 10 straight feeds.[6]	Farm products.[6]	All commodities.[6]
	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.				
1913	$34.52	$31.48	$28.98	$37.14	$34.48				
1914	37.44	33.88	31.64	38.61	36.88				
1915	39.87	35.40	33.57	39.17	37.55				
1916	42.25	38.17	35.99	40.21	39.85				
1917	71.86	66.23	64.49	58.83	59.32				
1918	78.22	73.60	70.79	72.13	68.28				
1919	74.14	74.32	69.71	73.26	74.88				
1920[7]	81.14	78.27	77.75	81.67	80.90				
RELATIVE PRICES.									
1913	100	100	100	100	100	100	100	100	100
1914	108	108	109	104	107	107	108	103	100
1915	115	112	116	105	109	109	113	105	101
1916	122	121	124	108	116	118	120	122	124
1917	208	210	223	158	172	187	188	189	176
1918	227	234	244	194	198	218	210	220	196
1919	215	236	241	197	217	220	236	234	212
1920[7]	235	249	268	220	235	244	268	243	259

[1] Appendix Table 7, brands Nos. 1 and 2.
[2] Appendix Table 9, brands Nos. 5 and 6.
[3] Appendix Table 10, brands Nos. 1, 3, and 4.
[4] Appendix Table 13, brands Nos. 1, 3, and 4.
[5] Appendix Table 15, brands Nos. 1 and 2.
[6] Appendix Table 1.
[7] Average January-June.

No great importance is to be attached to the comparison of the absolute prices of different brands of mixed feeds with one another on account of the great differences in their composition. A serious

obstacle to the comparison even of the relative prices of these feeds is found in the fact that most manufacturers frequently change the formulas of their feeds, so that a feed with a given brand name is not necessarily the same at one time as at another, and in fact may be much different at different times, although the same guaranteed chemical analysis may be maintained for a long period. The significance of differences in the prices of various feeds can be understood only when the exact composition of each is known. Keeping these limitations in mind, the following points, brought out by an inspection of Table 19, may be noted:

Average prices in 1913 for the brands shown in the table ranged from about $25 to $35, with one brand as high as $37. No radical changes occurred in the next three years, though there was some advance in the price of all brands. As in the case of straight feeds, the year 1917 marked the first great advance in the price of mixed feeds. Average prices in that year ranged from about $41 to $72. By 1919 the price of nearly every brand was at least double that of the 1913 average, while most brands showed even greater increases. All brands made substantial advances in the first half of 1920 over the average price for the year 1919. Feeds which sold for about $25 per ton in 1913 brought, on the average, around $60 to $65 in the first half of 1920. The highest priced feeds shown in the table advanced from about $35 in 1913 to over $80 in 1920.

These advances are recorded in the index numbers, which ranged for the year 1919 from 197 to 241, and for the first half of 1920 from 220 to 268. The corresponding index numbers for the 12 brands combined were 220 and 244, respectively. In 1919 just half the brands had index numbers higher than the average, and for the first half of 1920 there were seven above the average.

The table shows a striking correspondence between the movement of relative prices of the group of 12 mixed feeds and the farm products group, the only difference worth noting being in 1919, when the index number for the farm products group was 14 points higher than that of the mixed-feed group.

The relative prices of the mixed-feed group also show close correspondence with those of the group of 10 straight feeds from 1914 to 1918, inclusive, though straight feeds were somewhat lower relatively in 1918. In 1919 the advance in the relative price of the mixed-feed group was considerably less and in the first half of 1920 much less than in the straight-feeds group.

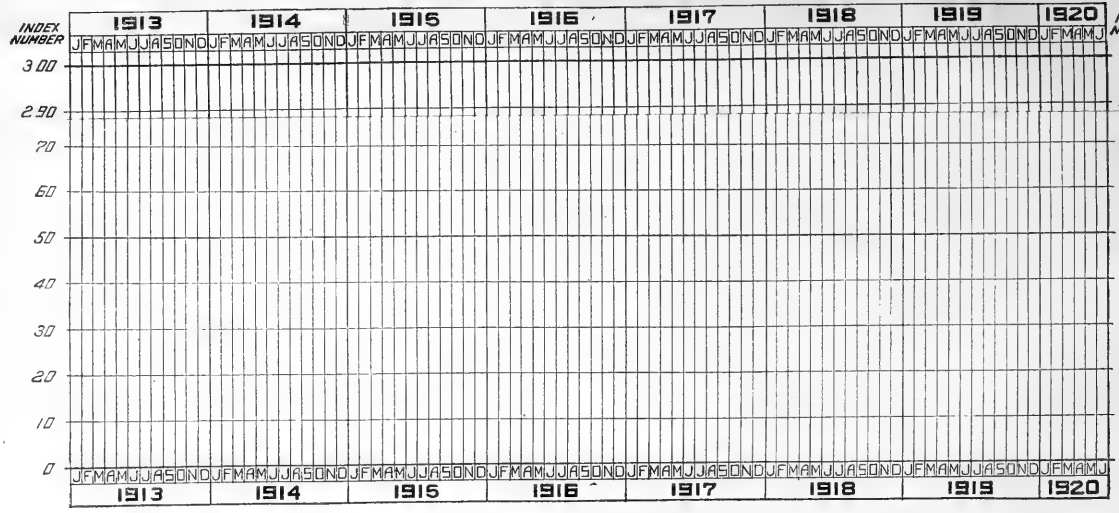
Prices of mixed feeds showed advances relatively greater in 1917 and 1918 than those of all commodities, but in the first half of 1920 the advance in the relative price of all commodities was much greater than in the mixed-feed group.

The movement of the relative prices of these different groups is shown graphically and in detail by months in the diagram opposite.

Section 4. Prices of corn and oats.

Corn and oats are of great importance in the feed business. The prices of corn are of particular importance, since the extent to which other feeds are used is largely dependent upon them. Therefore corn prices are frequently referred to as a barometer of prices of other feeds. Oats are not only widely used as a straight feed, but furnish by-products which are used in large quantities in mixed feeds.

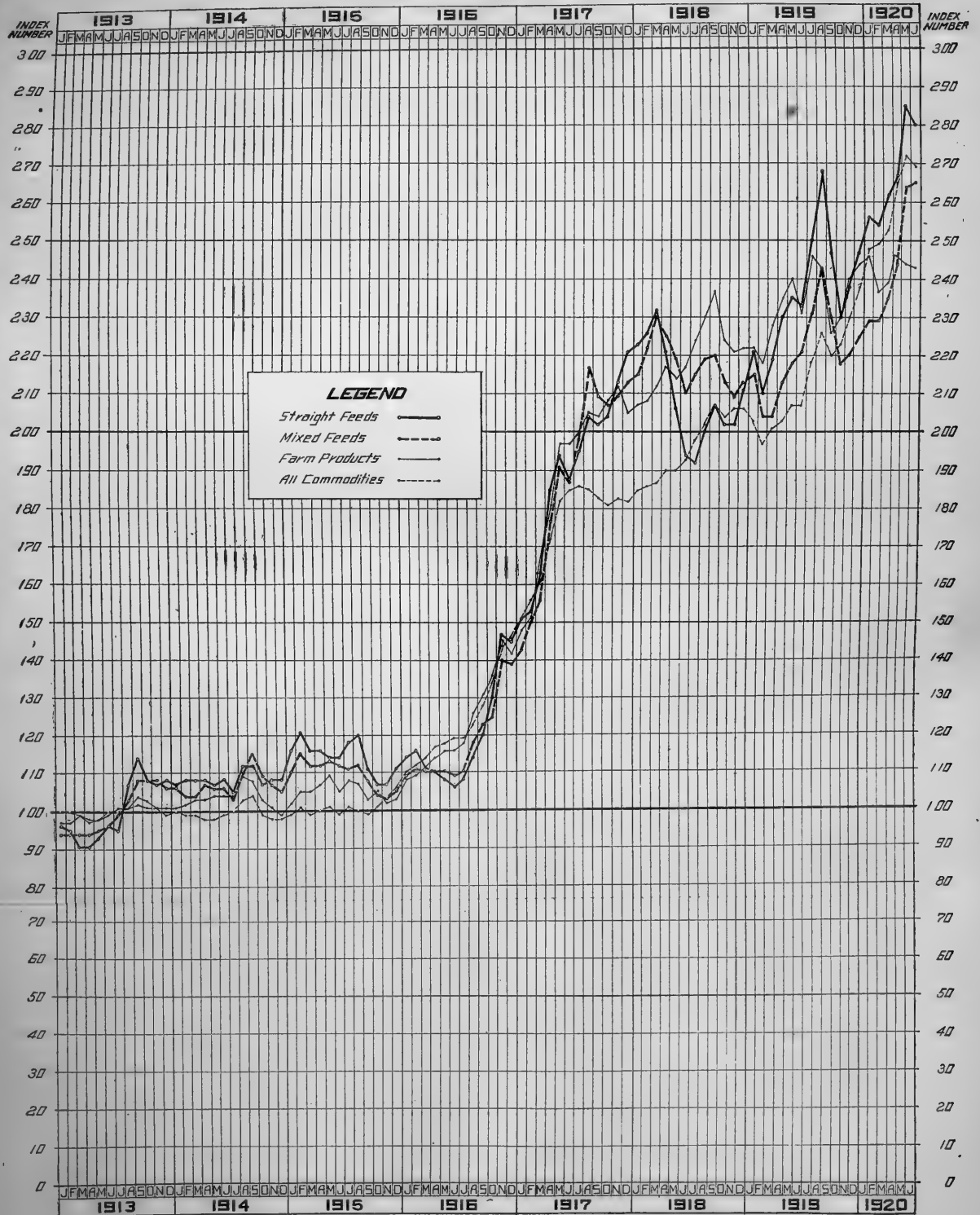
DIAGRAM 1 *Index Numbers (1913 base) of Wholesale Prices of Straight Feeds, Commercial Mixed Feeds, Farm Products, and All Commodities, by months. January, 1913–June, 1920.*



42976°—21. (To face p. 110).

DIAGRAM 1

Index Numbers (1913 base) of Wholesale Prices of Straight Feeds, Commercial Mixed Feeds, Farm Products, and All Commodities, by months. January, 1913–June, 1920.



The following table gives monthly average prices of cash corn and oats of contract grade on the Chicago market, the figures being simple averages of the means of the daily low and high quotations as published in the annual reports of the Chicago Board of Trade.

TABLE 20.—*Average prices per bushel of cash corn and cash oats of contract grade on the Chicago Board of Trade, by months, January, 1913, to June, 1920, inclusive.*

CORN.

Month.	1913	1914	1915	1916	1917	1918	1919	1920
January	$0.49	$0.62	$0.72	$0.76	$0.99	$1.78	$1.42	$1.53
February	.50	.62	.78	.76	1.01	1.75	1.32	1.48
March	.51	.66	.72	.74	1.12	1.72	1.50	1.61
April	.56	.67	.76	.76	1.45	1.66	1.64	1.73
May	.57	.70	.76	.75	1.64	1.63	1.76	2.01
June	.61	.71	.74	.74	1.71	1.59	1.79	1.90
July	.62	.71	.79	.81	2.04	1.66	1.98	.....
August	.74	.81	.79	.86	1.97	1.69	1.97	.....
September	.75	.78	.73	.87	2.09	1.59	1.54	.....
October	.70	.73	.64	.96	1.98	1.39	1.42	.....
November	.73	.71	.65	1.00	2.10	1.37	1.53	.....
December	.71	.65	.72	.92	1.73	1.45	1.52	.....
Year	.62	.70	.73	.83	1.65	1.61	1.62	[1] 1.71

OATS.

January	$0.33	$0.38	$0.53	$0.48	$0.56	$0.81	$0.67	$0.88
February	.33	.39	.58	.47	.54	.86	.60	.87
March	.33	.39	.57	.44	.58	.91	.64	.94
April	.35	.38	.57	.46	.66	.88	.71	1.04
May	.38	.40	.53	.46	.69	.76	.70	1.12
June	.40	.39	.48	.39	.66	.77	.70	1.17
July	.39	.37	.54	.41	.76	.76	.78	.....
August	.41	.42	.55	.44	.62	.70	.75	.....
September	.42	.48	.37	.46	.59	.72	.70	.....
October	.39	.47	.37	.49	.59	.69	.72	.....
November	.38	.49	.38	.55	.65	.73	.75	.....
December	.39	.48	.43	.51	.76	.72	.84	.....
Year	.38	.42	.49	.46	.64	.78	.71	[1] 1.00

[1] Average January–June.

PRICES OF CORN.—The monthly averages of the daily mean prices of corn from the beginning of 1913 to the middle of 1916 ranged from 49 cents to 81 cents per bushel, while the yearly average increased from 62 cents in 1913 to 73 cents in 1915. Prices advanced considerably in the last half of 1916, bringing the average for that year up to 83 cents. The year 1917 was marked by a very great increase in prices, the average for the year being double that of the year 1916, while the average price for November reached $2.10 per bushel. The following causes have been assigned for the high prices of 1917: The small corn crop of 1916 and the small amount shipped from the farms, the demand for hogs, the demand by distillers, and the short wheat crop of 1916 in the United States and also the short corn crop in Argentina.

While prices of corn declined in 1918, the prices of the first three months were much higher than those of the corresponding months of 1917, and the yearly average was only slightly lower than that of the preceding year. The 1917 crop was large, but of very poor quality, with only 60 per cent merchantable, as compared with 84 per cent for the previous crop. The amount shipped from the farms

was large, but shipments were late on account of shortage of freight cars and cold weather.[8]

The range in monthly average prices was greater in 1919 than in the preceding year, but the yearly averages were almost identical for the two years. The 1918 corn crop was even smaller than that of 1916. The proportion merchantable was about the same for the two crops, and much greater than for the 1917 crop. However, the percentage of the crop which left the county in which it was grown was very low for the 1918 crop, viz, 14.5 as compared with 22.1 per cent for the 1917 crop and 17.6 per cent for the 1916 crop. Corn prices were very high in the first half of 1920, though the 1919 crop was not much smaller than the record crop of 1917 and the proportion merchantable was the largest in 10 years (86.9 per cent).[9] On the other hand, only 16.3 per cent of the crop left the county where grown, largely on account of the car shortage in the spring of 1920. The average price for May, 1920, reached the $2 mark, the highest average shown in the table except for three months in 1917.

Prices of oats.—The average price of oats ranged between 33 cents and 49 cents per bushel in the years 1913 and 1914, with yearly averages of 38 cents and 42 cents, respectively. Prices were high in the first eight months of 1915, on account of the short supply, but there was a decided break when the new crop came on the market in the fall. The average price for the year 1915 was considerably above the prices of 1913 and 1914, while the average for the year 1916 was slightly lower than that for 1915. There was a decided advance in prices in 1917, there being a notable increase in April and May, following the declaration of war,[10] while the average price in July went to 76 cents per bushel.

There was a good crop in 1917 and the quality was very high, but prices in 1918 were on a high level. The monthly averages ran as high as 91 cents for March, and the average for the year was 78 cents per bushel.

The 1918 crop was only slightly smaller than that of the preceding year, and the quality was very good, though not as high as for the 1917 crop. Prices on the whole were somewhat lower in 1919 than in 1918, with a maximum monthly average of 84 cents and a yearly average of 71 cents.

The 1919 crop was considerably smaller than that of the two years immediately preceding and about the same as that of 1916. The quality (84.7 per cent) was lower than it had been for several years and much lower than the quality of the 1917 and 1918 crops.[11] Prices in the first half of 1920 reached record heights, the average for the six months being $1, while the June average was $1.17 per bushel, or three and a half times the price of the early months of 1913.

The principal cause of these high prices was the shortage of cars.[12]

Section 5. Prices of flour-mill by-products.

The great importance of the by-products or offal of the flour mills both as straight feeds and as ingredients of commercial mixed feeds

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[8] War Industries Board, Price Bulletin No. 10, pp. 8 and 9.
[9] Department of Agriculture Yearbook, 1919, p. 513.
[10] War Industries Board, Price Bulletin No. 11, pp. 6 and 7.
[11] Department of Agriculture Yearbook, 1919, p. 535.
[12] The following statement was made in the Department of Agriculture's Market Reporter, June 19, 1920 (p. 394): "The trade generally believes that but for the car shortage the advance in the oats market would have been impossible. Certainly the prices paid for cash oats would not have been paid but for the light receipts."

has already been noted. (Chap. III, sec. 2.) Among these by-products wheat bran and standard middlings are particularly important on account of the large production.

The Commission secured price statistics of mill feeds from one of the leading Minneapolis millers for the period January, 1914, to June, 1920, inclusive. This record covers five wheat-flour by-products and rye middlings, and is made up of prices on the 1st, 10th, and 20th of each month. These are base prices or so-called "limits." The meaning of this term will be made clear by the following description of the method followed by the company, and presumably by the other large millers of Minneapolis, in selling mill by-products:

The miller who receives a large order for flour knows that when this is manufactured he will have a large quantity of offal which he must market almost immediately, since storage facilities are limited.

This offal will amount approximately to 30 per cent of the weight of the wheat used in making the flour. (See Chap. III, sec. 2.) The price of the flour will be made taking into consideration the current prices of mill feeds. Taking these prices as a basis for quotations, the miller gets into touch with prospective buyers, and feeling out the market, sells at the best price he can get the quantities of the different feeds he expects to turn out in filling the order for the flour. If the market is in his favor, the price made may be slightly higher than his base price, while if the demand is relatively slack, he may be forced to take a price slightly lower than this base price.[13]

While these "limits" are not necessarily the actual selling prices, it is understood that the actual prices do not differ from them on the average more than 50 cents a ton.

The figures furnished by this company were converted into monthly averages and supplemented for the year 1913 by average prices computed from low and high quotations for Wednesday of each week, published by the Minneapolis Daily Market Record.[14] These monthly averages are shown in Appendix Table 2. The yearly averages for each year, 1913–1919, inclusive, and the averages for the first half of 1920, are summarized in the following table:

TABLE 21.—*Average prices per ton of mill feeds, sacked, f. o. b. Minneapolis, by years, 1913–1919 inclusive, and for the first half of 1920.*

Year.	Wheat bran.	Standard middlings.	Wheat mixed feed.	Flour middlings.	Red dog.	Rye middlings.
1913	$18.63	$19.68	.....	$22.57	$24.55	.....
1914	21.34	21.89	$23.76	25.61	27.51	$21.68
1915	20.36	21.89	23.86	26.48	29.28	22.05
1916	20.98	22.71	24.17	27.25	30.19	22.61
1917	32.94	36.44	38.97	45.39	51.53	36.89
1918	30.37	32.44	33.05	34.85	37.34	41.55
1919	39.50	45.11	49.22	51.89	58.56	43.86
1920 [a]	47.67	51.78	53.42	57.89	63.67	51.47

[a] Average January–June.

[13] It is not to be understood that the entire output of the large mills is sold in this way. They dispose of part of their output on long-time contracts calling for future deliveries.

[14] A comparison of average prices from the two sources for the years 1914 and 1915 shows in the main a close correspondence for these years, and indicates that the Record prices are satisfactory for use in supplementing the figures furnished by the milling company. Figures for wheat mixed feed and rye middlings are not given in the table for the year 1913, since quotations on these feeds are not published by the Minneapolis Daily Market Record.

PRICES OF WHEAT BRAN AND STANDARD MIDDLINGS, MINNEAPOLIS MARKET.—*Period prior to Government control.*—The prices of wheat bran and standard middlings fluctuated within rather narrow limits from the beginning of 1913 until near the close of 1916. About the middle of 1916 a rapid increase in the prices of these feeds began which culminated in April, 1917, in prices about double those of the preceding July. There was a reaction in prices, greater in bran than in standard middlings, following the entrance of the United States into the war. This was followed by a recovery in July and August, and in the latter month the price of standard middlings went to a very high point (average $45.33), but this increase was of short duration.

Period of Government control.—On August 14, 1917, wheat and rye elevators and millers were required to be licensed.[15] Under rules and regulations promulgated August 24, 1917, governing the conduct of flour millers operating under agreement with the United States Food Administrator, it was provided that no miller should thereafter take any profit on feed in excess of 50 cents per ton.[16]

By regulation of the Food Administration, effective December 25, 1917, it was provided that no licensed flour miller should sell wheat mill feeds at prices in excess of figures to be determined as follows: The bulk prices of bran per ton of 2,000 pounds at the mill, in carloads, in no case should exceed 38 per cent of the average cost to such mill of one ton of wheat at the mill, which cost of wheat should be the average cost as shown by the previous month's record of that mill. Differentials above the price of bran were provided as follows: Shorts or standard middlings, $2; mixed feeds, $4; flour middlings, $9; red dog, $15 per ton.[17]

It was further provided by regulation also effective December 25, 1917, that no licensed flour miller should use more than 264 pounds of 58 pounds to a bushel or heavier clean wheat in making a barrel (196 pounds) of flour.[18] A schedule was published further fixing the maximum amount of wheat of other test weights to be used in making 196 pounds of flour.[19]

This increase in the percentage of extraction of flour from wheat materially reduced the quantity of middlings and red dog produced, and in May, 1918, the differentials on flour middlings and red dog were reduced to $2 per ton and the differential on mixed feed to $1.25 per ton.[20] The price of bran was still to be determined as provided under rule 19, which became effective December 25, 1917, but a flat differential of $2 was to be added to this price for standard middlings, flour middlings, and red dog.[21]

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[15] U.S.F.A. Special License Regulations No. II, preface-1.

[16] U.S.F.A. Milling Division Circular No. 1 B; also "Rules and regulations governing the importation, manufacture, storage, and distribution of food commodities for domestic trade by persons subject to license"—Rule 13 relating to grain elevators, grain dealers, and grain millers (Series B, effective Nov. 1, 1917).

[17] Amendments and additions to rules and regulations governing the importation, manufacture, storage, and distribution of food commodities and feeds for domestic trade by persons subject to license. Series B, supplement, rule 19, p. 9.

The reason for establishing this rule was given as follows:

"This rule aims to establish a relation between the price of mill feeds and the price of wheat. It is made necessary by the unusually high price of coarse grains, which has caused unprecedented demand for mill feeds." (Feedingstuffs, January, 1918, p. 42.)

[18] Amendments and additions to rules and regulations governing the importation, manufacture, storage, and distribution of food commodities and feeds for domestic trade by persons subject to license. Series B, supplement, rule 17, p. 9.

[19] U. S. F. A. Special License Regulations No. II–A, rule M. S. 4.

[20] U. S. Food Administration press release No. 954, May 20, 1918.

[21] Food Administration press release No. 954, May 20, 1918; Price Current Grain Reporter, May 29, 1918, p. 43; Feedingstuffs, May, 1918, p. 33.

By regulation effective July 22, 1918, the Food Administration adopted the plan of issuing to flour millers maximum fair-price schedules for flour and feed "established with relation to the guaranteed price basis for wheat." Any sales of flour or feed in excess of these fair prices were regarded as a violation of the rule against sales of flour or feed at more than a reasonable advance over the average purchase price of the wheat.[22] Under this plan Minneapolis prices August 1, 1918, on carload lots, bulk, at mill, were as follows: Bran, $23.36; mixed feed, $24.61; middlings, shorts, and red dog, $25.36.[23]

The effect of the limitations of the margins of profit on wheat feeds in August, 1917, is seen in the prices of these feeds from September to November as compared with August, but the price of bran advanced sharply in December, that of standard middlings and wheat mixed feed much less, while there was a slight increase in the prices of flour middlings and red dog.[24]

This advance in prices was checked by the Food Administration's ruling (effective Dec. 25, 1917) relating to prices of flour and mill feeds, to which reference has already been made. The effect is seen in the average prices for January, 1918, as compared with those for December, 1917. Bran declined from an average price of $40 to $32.43, and standard middlings from $40.67 to $34.43. The other mill feeds showed marked reductions, the most decided decrease being in the average prices of red dog, from $58 to $46.77. (Appendix Table 2.)

The full effect of the action of the Food Administration was not felt, however, until about May, 1918. A combination of circumstances was responsible for this condition. The flour millers were allowed to fill outstanding contracts at the higher prices stipulated in the contracts. Under normal conditions the bulk of the feeds delivered under these contracts would have been out of the way within 60 days and much of it within 30 days. However, the extremely bad transportation situation in the early months of 1918 resulted in a short supply of wheat at the mills and consequently in greatly reduced production of flour and feeds, and there was much delay in deliveries on these contracts. As a result high-priced wheat feeds were still on the market through February, March, and April, and in many sections into May. G. A. Chapman, head of the Food Administration's feed division, referring to this situation, said:

> Between the oversales on the part of the mills and the delay in the railroads in delivering to dealers it seemed as though there would be no end to these high-priced wheat feeds.[25]

The general effect of the Food Administration's regulations in 1918 may be gathered from a comparison of the average prices for that year with the averages of the years 1917 and 1919. (Table 21.) The average prices of these feeds in 1918 were kept below those of 1917 in the face of a very heavy demand.

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[22] U. S. F. A. Special License Regulations, No. II–A, rule M. S. 11 and note on "Fair price schedules."

[23] Feedingstuffs, August, 1918, p. 29. It should be noted that these are prices for feeds in bulk, while the prices in Table 21 and Appendix Table 2 are for sacked feeds. At this time the cost of sacks would account for a difference of about $5 per ton between the two prices. (See Feedingstuffs, July, 1918, p. 26.)

[24] The Northwestern Miller, commenting on the situation in the Minneapolis market, in its issue of December 5, 1917, p. 734, said:

"Mill feed is exceedingly strong and active. At a time when price reductions are usually seen, the market has strengthened and each succeeding day witnesses further advances. Mill quotations, however, are no criterion as to current values. Few have anything to offer, and asking prices show a wide range. Some of the larger milling companies have not a pound of feed to offer. Heretofore they have been selling a little in mixed cars with flour, but within the last week they have notified their salesmen not to accept any more orders."

[25] Feedingstuffs, July, 1918, p. 25. Presumably these high prices on delayed shipments on contracts are not reflected in the figures in Appendix Table 2, since these are understood to be base prices for new business.

Period following withdrawal of Government control.—The Food Administration announced December 19, 1918, that all flour-milling regulations, including fair price schedules, were canceled.[26]

This announcement had an immediate effect on the prices of mill feeds. The prices of bran at once advanced $10 to $15 a ton and some grades of middlings as much as $25 a ton. These advances were referred to in the trade press as the sharpest on record in mill feeds.[27] The prices went still higher before the end of the month, and on January 2, 1919, both bran and middlings were selling at $50.[28]

It should be pointed out in this connection that the price of bran under the Food Administration regulations was generally conceded to have been very low as compared with other feeds. Mr. Chapman made the statement that wheat feeds were really "a gold dollar for 70 cents," if feed values were taken into consideration.[29]

The extremely high prices of January, 1919, stimulated the use of substitutes, particularly corn and oats, which declined in price at this time. Unusually mild weather, which permitted the grazing of cattle in some sections, also contributed to the falling off of the demand for wheat feeds.[30] The price of bran and standard middlings declined from $50 per ton on January 20 to $42, February 1, and $37, February 20. Standard middlings reached an even higher level in August and September, 1919, than in January, the average price for August being $53. On the other hand, bran did not again advance during that year beyond a monthly average of $41.33. (Appendix Table 2.) Taking the year as a whole bran prices were about $9 higher in 1919 than in 1918 and standard middlings more than $12 higher.

The first half of 1920 was marked by still higher prices for bran and middlings, the averages for this period being, respectively, $47.67 and $51.78. The highest prices for the whole period of seven and a half years were reached in May, when the averages were $52.67 for bran and $57.33 for standard middlings. These figures may be contrasted with the minimum monthly averages of the year 1913, viz, $16.35 for bran and $16.70 for standard middlings. It will be noted that the maximum prices of 1920 were more than three times as high for bran and nearly three and a half times as high for standard middlings as the minimum prices of 1913.

PRICES OF WHEAT MIXED FEEDS, FLOUR MIDDLINGS, AND RED DOG, MINNEAPOLIS.—Wheat mixed feeds, flour middlings, and red dog are all higher-priced products than bran and standard middlings, but quantitatively they are of much less importance.[31] It is there-

[26] U. S. F. A. Special License Regulations II, title 1 (*a*).

[27] Modern Miller, Dec. 21, 1918, p. 36; Weekly Northwestern Miller, Dec. 25, 1918, pp. 1117, 1118.

[28] The Minneapolis correspondent of the Modern Miller, commenting on this advance in prices, said: "Never before in the history of the Minneapolis flour trade has bran reached present prices, and although the trade is complaining of the advance, the mills are unable to take care of the requirements of the present." (Modern Miller, Jan. 11, 1919, pp. 37, 38.)

[29] Feedingstuffs, July, 1918, p. 16. A flour miller commenting on the mill-feed situation during the period of Government control made the following statement, which is also interesting in this connection: "During the period of Government control, when the prices of wheat feeds were fixed at a basis so much materially lower than coarse grain feed, buyers were in the market very extensively who never had previously handled mill feeds and probably never will handle them again. This is now a thing of the past, however." (Modern Miller, Jan. 11, 1919, p. 37.)

[30] Modern Miller, Jan. 25, 1919, p. 38, and Feb. 1, 1919, p. 43.

[31] The figures of production of the several wheat flour by-products are not available for the Minneapolis market as a whole, but the milling company which furnished the prices which are averaged in appendix Table 2 also gave its production statistics for the several mill feeds for a period of years.

The figures show that of the aggregate production of wheat feeds by this company the total output of mixed feed, flour middlings, and red dog combined was as follows: 1914, 14.7 per cent; 1915, 12.1 per cent; 1916, 11.8 per cent; 1917, 9.8 per cent; 1918, 8.9 per cent; 1919, 13.6 per cent; and 1920 (first 5 months) 12.5 per cent.

fore not necessary to discuss the price movements of these feeds at length. However, a general comparison of their prices with those of the last-named feeds may be of interest.

The following table shows the relation between the prices of the several wheat-flour by-products as shown in yearly averages. The yearly average prices of wheat bran are given, and the amount and per cent by which the average price of each of the other feeds exceeded the price of bran. This table shows that when the prices of these feeds reached the high levels (1917 and 1919), the spread between the prices of the other wheat feeds and bran not only increased in absolute amount, but also that the per cent of the spread to the base price of bran was higher in those years than in the earlier years, when conditions were more nearly normal. This indicates a relatively high demand or short supply (or both) of the other wheat feeds as compared with bran in the years of high prices—1917 and 1919. The increase in the percentages for red dog in these years was particularly marked. It is further noteworthy that for the first six months of 1920, while the high prices still continued, the percentage of spread between the other feeds and bran were more nearly like those of the earlier years.

TABLE 22.—*Comparison of the prices per ton of wheat bran with the prices of other wheat feeds, by years, 1913–1919, inclusive, and for the first half of 1920.*[1]

Year.	Average price wheat bran.	Excess of price over price of wheat bran.							
		Standard middlings.		Mixed feed.		Flour middlings.		Red dog.	
		Amount.	Per cent.	Amount.	Per cent.	Amount.	Per cent.	Amount.	Per cent.
1913	$18.63	$1.05	5.6	.....	.....	$3.94	21.1	$5.92	31.8
1915	21.34	.55	2.6	$2.42	11.3	4.27	20.0	6.17	28.9
1915	20.36	1.53	7.5	3.50	17.2	6.12	30.1	8.92	43.8
1916	20.98	1.73	8.2	3.19	15.2	6.27	29.9	9.21	43.9
1917	32.94	3.50	10.6	6.03	18.3	12.45	37.8	18.59	56.4
1918	30.37	2.07	6.8	2.68	8.8	4.48	14.8	6.97	23.0
1919	39.50	5.61	14.2	9.72	24.6	12.39	31.4	19.06	48.3
1920[2]	47.67	4.11	8.6	5.75	12.1	10.22	21.4	16.00	33.6

[1] Based on figures in Appendix Table 2. [2] Average January–June.

Section 6. Prices of hominy feed.

Statistics of prices of white hominy feed in bulk were secured from two of the leading manufacturers. The statistics furnished by both these companies are in the form of monthly averages, and are stated to be true averages computed by dividing the total proceeds from the month's sales by the tonnage sold. These two companies operate plants at middle-western points. One furnished statistics of prices f. o. b. mill at Indianapolis; the other gave prices on the New York City freight rate basis. The statistics furnished by these two manufacturers are given in Appendix Table 3. This table also gives a record of prices on the Boston freight rate basis, the figures being simple averages of quotations (1913 and 1914) and of actual sales prices (1915–1920) on the 1st, 10th, and 20th of each month, furnished by a leading jobber.

The following is a summary of the yearly averages of prices f. o. b. Indianapolis: 1913, $21.66; 1914, $24.90; 1915, $26.05; 1916, $27.53; 1917, $49.84; 1918, $55.17; 1919, $60.69; 1920 (January–June), $64.58.

It will be noted that there was a gradual advance in prices of hominy feed from 1913 to 1916, inclusive, the increase in the yearly averages being nearly $6, or more than 25 per cent. From the beginning of 1913 to the middle of 1916 the range in average monthly prices f. o. b. Indianapolis was from $18 to $28.35. (Appendix Table 3.) About the middle of 1916 a rapid increase in prices began, which lasted with few interruptions until March, 1918. In June, 1916, the average price f. o. b. Indianapolis was $24.25. This had doubled by April, 1917, and by March, 1918, it had advanced 160 per cent, reaching $63.55. There was a sharp break in prices in April, and the May average was $16 per ton under the high March average. Prices fluctuated considerably in the later months of 1918, and the average for the year was over $5 a ton above the average for 1917.[31a]

The year 1919 was marked by wide fluctuations in the prices of hominy feed. The average price of $75.15 reached in August of that year was the highest of the entire period of seven and a half years covered by the table. In the next two months there was a decline of $25.65 per ton, or more than 34 per cent. The price advanced again at the close of 1919 and in the early months of 1920, reaching an average of $70 in May, 1920.

While the prices in the first half of 1920 did not reach the high point of August, 1919, the level for this period was even higher than for the year 1919 as a whole.

Section 7. Prices of reground oat hulls.

The following table gives simple monthly average prices of reground oat hulls for the period January, 1913, to June, 1920, inclusive, as computed from weekly quotations (mean of low and high) published in the Boston Chamber of Commerce Weekly Market Report:

TABLE 23.—*Average prices per ton of reground oat hulls,*[1] *Boston market, by months, January, 1913, to June, 1920, inclusive.*

	1913	1914	1915	1916	1917	1918	1919	1920
January	$14.80	$17.69	$17.75	$20.00	$23.90	$30.60	$27.30	$34.25
February	15.25	16.13	20.00	20.13	25.75	28.00	28.19	36.25
March	15.38	16.63	19.00	20.00	29.00	33.33	28.75	37.80
April	16.00	16.40	18.13	20.00	32.75	31.50	32.20	42.00
May	16.13	16.00	20.75	19.60	34.20	23.80	37.63	52.13
June	16.75	16.00	21.40	18.25	28.63	19.88	35.38	54.80
July	15.30	15.80	22.88	17.63	25.00	21.80	29.60	.....
August	17.00	15.88	24.50	17.80	27.70	21.75	33.25	.....
September	18.00	16.50	19.00	18.50	23.75	22.75	31.75	.....
October	16.65	16.50	18.38	20.25	26.20	26.00	29.20	.....
November	16.69	15.13	19.13	21.80	24.63	25.63	28.50	.....
December	17.60	15.65	20.45	23.50	28.38	25.75	30.70	.....
Year	16.30	16.19	20.11	19.79	27.49	25.90	31.04	[2] 42.87

[1] Probably oat feed. [2] Average January–June.

[31a] A special regulation of the Food Administration (issued July 20, 1918, amended Nov. 1, 1918, and repealed Dec. 17, 1918) provided that licensed corn millers should not sell hominy feed produced as a by-product of the manufacture of edible corn at a price per pound in excess of the purchase price per pound of the grain from which it was manufactured. (U. S. F. A. Special License Regulations III–B 5, 6, and 5, 6 *b*.)

The table shows few marked fluctuations in prices from 1913 to 1916, inclusive, but rapid changes and wide ranges in the averages from 1917 to 1919. The yearly averages during the first four years ranged from $16.30 to $20.11 per ton. There were times in the period from the beginning of 1913 to the middle of 1916 when the price was almost stationary for several months together. A steady advance began in July, 1916, and culminated in May, 1917, the price almost doubling in these few months. A pronounced break followed in June and July. Prices were high in the first four months of 1918, generally above $30, but in June the average had fallen below $20.[31b] There was another period of continuous advance from November, 1918, to May, 1919, inclusive, the increase being $12, or nearly 50 per cent.

Perhaps the most striking feature of the table is the very rapid and continuous advance from November, 1919, to June, 1920, the price increasing in this period by $26.30, or 92 per cent. The average of $54.80 for June, 1920, was the maximum for the entire period of seven and a half years, and 270 per cent above the minimum of $14.80 for January, 1913.

Section 8. Prices of rice bran and rice polish.

Monthly average prices of rice bran and rice polish for the period January, 1913, to April, 1920, are given in Appendix Table 4. The figures in this table are weighted averages of all wholesale spot and prompt transactions, f. o. b. mills, computed from records furnished by five concerns, three at Houston, Tex., and two at New Orleans, one of the latter being the largest rice-milling concern in the United States. Sales of the rice by-products are ordinarily very light in May, June, and July, and for the earlier years some prices on contract sales were used in connection with spot and prompt prices in order to make the table complete for these periods of infrequent sales. The following statement, summarized from Appendix Table 4, gives the average yearly prices of rice bran and rice polish with the margins between them:

	1913	1914	1915	1916	1917	1918	1919
Rice polish	$21.77	$24.16	$24.44	$26.27	$40.25	$36.41	$59.50
Rice bran	16.21	15.30	14.80	17.17	31.67	36.36	38.81
Margin	5.56	8.86	9.64	9.10	8.58	20.05	20.69

There were marked differences in the relation between the prices of these two feeds in different years. In 1913 the average price of rice polish was only about $5.50 above that of rice bran, while in 1918 and 1919 the difference was more than $20.

It will be noted that there was a continuous advance in the yearly average price of rice polish from 1913 to 1919, but that rice bran declined in price in 1914 and 1915. The advance of $37.73 in the price of rice polish between 1913 and 1919 amounted to 173 per cent, while rice bran increased from 1915 to 1919 by $24.01 or 162 per cent.

[31b] A special regulation of the Food Administration (issued July 20, 1918, and repealed Dec. 17, 1918) provided that licensees should not sell oat feed produced as a by-product of the manufacture of oat products at a price per pound in excess of the purchase price per pound of the grain from which it was manufactured. (U. S. F. A. Special License Regulations III-B-5, 6 (Rule 5).

There was a marked increase in prices both of rice bran and rice polish in the latter part of 1916 and the early months of 1917. (Appendix Table 4.) The price of rice bran increased continuously from July, 1916, to April, 1917, and after a decline in May, went still higher in June, the increase from July, 1916, to June, 1917, being 180 per cent. From August, 1916, to June, 1917, the price of rice polish advanced 119 per cent, though the increase was not unbroken. Prices of both feeds remained nearly stationary during the fall of 1917, but advanced considerably in December and stood at a high level during the first half of 1918.

Under a uniform agreement with the United States Food Administration, all rice millers agreed to sell rice polish at not to exceed $50 per ton, and rice bran at not to exceed $36 per ton, packed in customary manner, car lots, f. o. b. mills.[32]

In the summer and early fall of 1919 prices were very high for both rice bran and polish, the maximum prices for the entire period covered by the tables being reached in August, 1919, with an average price of $43.97 for rice bran and $68.59 for rice polish. These prices showed an advance over the lowest prices of the series of 230 per cent for rice bran and 280 per cent for rice polish.[33]

Section 9. Prices of starch and glucose by-products.

It has been pointed out above (Chap. III, sec. 3) that in the manufacture of commercial starch and glucose, important by-products are produced which are valuable protein feeds. Corn gluten feed is the most important of these by-products by reason of the quantity produced, though it is considerably lower in protein content and brings a lower price than corn gluten meal. Corn oil meal or corn germ meal, while lower in protein than corn gluten feed, is high in fat content. It is a valuable feed but in quantity produced is relatively unimportant as compared with corn gluten feed.

PRICES OF CORN GLUTEN FEED.—The following table gives the monthly average prices of corn gluten feed and corn oil meal in bulk, f. o. b. Chicago, as furnished by an important producer. The figures are true averages derived by dividing the total proceeds from the sales of the given feed in each month by the tonnage sold, and presumably represent the actual market more closely than simple averages of prices for selected dates.[34]

[32] U. S. F. A. Special Regulations XXV–C, 1, 2, 3, (*a*), note. (Sept. 26, 1918.)

[33] Minimum prices, rice bran $13.33 (November, 1915); rice polish, $18 (July, 1913).

[34] The Commission secured statistics of prices of corn gluten feed from four of the leading producers, including the Corn Products Refining Co. In the statement which follows these companies are designated, respectively, by the letters A, B, C, and D. The prices in all cases are on bulk shipments f. o. b. Chicago, it being the custom of the trade to make Chicago the basing point in all price quotations on corn gluten feed.

As stated in a later chapter (Chap. VII, sec. 7) it is commonly admitted in the trade that other manufacturers of corn gluten feed generally follow the prices of the leading producer. The fact that the list prices of the four companies from which price statistics were secured have differed very little over a long period of years is brought out by the following comparisons. Company A not only furnished a record of its true average prices, but also gave its price list showing quoted prices from January 18, 1913, to June 22, 1920, inclusive.

Company B furnished a table of monthly average prices which it describes as "average prices without reference to the amount sold, averaged on the number of different prices made during the month." The company asserts that its sales are fairly uniform and that the averages furnished would differ little from true averages.

Companies C and D furnished records of their prices on the 1st, 10th, and 20th of each month, the record for company C beginning with January, 1913, and that for company D with January, 1916.

From the price list furnished by company A average prices were computed on the same basis as company B's averages, i. e., a simple average of the several prices in force each month. A comparison of these monthly averages for the two companies shows very close correspondence, the figures being exactly the same for 43 of the 90 months covered. The maximum difference for any month was $2, and only 6

TABLE 24.—*Average prices per ton of corn gluten feed and corn oil meal, in bulk, Chicago basis, by months,[1] January, 1913, to May, 1920, inclusive.*

CORN GLUTEN FEED.

Month.	1913	1914	1915	1916	1917	1918	1919	1920
January	$20.85	$23.50	$24.16	$22.24	$32.73	$48.25	*$48.15	$63.76
February	21.53	24.82	24.96	23.72	33.10	49.13	49.47	64.82
March	19.63	24.66	22.52	23.54	32.55	49.97	47.11	64.55
April	18.40	23.20	21.10	22.99	35.20	48.08	48.66	65.57
May	18.42	22.48	21.56	19.72	37.97	46.84	51.79	66.75
June	19.07	22.64	21.65	20.73	37.17	35.16	53.27	.....
July	19.49	22.69	22.31	21.19	37.67	40.13	55.66	.....
August	20.53	23.51	21.89	21.75	37.89	42.22	61.15	.....
September	22.93	23.16	22.42	23.12	43.87	45.79	63.48	.....
October	23.30	22.48	20.98	24.97	43.74	46.90	58.75	.....
November	23.51	23.56	21.15	27.55	45.32	46.59	60.33	.....
December	22.95	23.33	21.16	31.81	45.08	47.43	59.28	.....
Year	20.96	23.38	22.08	23.51	38.06	45.44	55.21	[2] 64.91

CORN OIL MEAL.

Month.	1913	1914	1915	1916	1917	1918	1919	1920
January	$24.55	$22.79	$23.15	$23.36	$33.58	$52.90	$51.64	$66.40
February	24.63	22.19	23.97	24.06	33.68	53.57	49.93	64.86
March	23.16	22.22	22.59	22.85	34.30	55.42	39.37	61.07
April	19.38	21.72	21.70	20.85	36.64	58.20	48.96	64.06
May	20.18	21.93	22.13	20.64	36.17	57.38	53.47	68.99
June	19.96	22.02	23.47	20.67	43.69	41.08	56.26	.....
July	19.48	23.61	22.33	21.22	42.55	44.75	59.37	.....
August	21.53	23.44	23.26	22.27	49.24	44.82	67.48	.....
September	23.18	22.60	23.52	25.82	50.37	48.57	70.28	.....
October	23.85	22.57	22.39	27.03	50.12	52.75	55.17	.....
November	23.10	21.97	21.73	26.30	48.00	50.22	59.90	.....
December	23.26	21.65	23.76	27.03	49.69	47.42	63.75	.....
Year	22.16	22.38	22.85	23.50	41.70	50.66	56.93	[2] 64.95

[1] True averages. See p. 120.
[2] Average January–May.

There were no great fluctuations in prices of corn gluten feed during the first three and a half years covered by the table. The price level was somewhat higher in 1914 than in 1913 or 1915. Prices advanced very greatly from May, 1916, to March, 1918, from an average of $19.72 in the earlier month to $49.97 in the later, an increase of more than 150 per cent. From this high point the price dropped to an average of $35.16 in June, 1918, a decline of nearly 30 per cent. Another period of advancing prices ensued, and continued with little interruption until an average price of $63.48 was reached in September, 1919. After a slight decline in the last quarter of that year, a period of very high prices followed in the early part of 1920. The average price of $66.75 for May, 1920, was the maximum for the

months showed differences of $1 or more. The maximum difference in year averages was 22 cents. This comparison indicates that companies A and B have substantially the same quoted prices.

The list prices of company A may be compared with the prices furnished by company C for the 1st, 10th, and 20th of each month for the period January 20, 1913, to June 20, 1920. The figures for these two companies may also be compared with the prices of company D for the 1st, 10th, and 20th of each month, for the period January 10, 1916, to May 20, 1920, inclusive.

The total number of days (1st, 10th, and 20th of the month) for which the prices of companies A and C may be compared is 268. The prices of the two companies agree exactly for 240 of these days, or in practically 90 per cent of the cases. In 7 of the 28 cases in which the prices of the two companies differed, the difference was only 25 cents per ton, and in only 9 cases was there a difference of $2 or more per ton. The figures for company D may be compared with those of companies A and C for a total of 158 days. On all but 13 of these days the figures for company D agree with those of one or both of the other two companies. In 131 cases, or more than 80 per cent of the total of 158, the prices of the three companies were identical.

This comparison indicates substantial agreement in the prices of companies A, C, and D, and a similar agreement between the figures of companies A and B has already been shown.

entire table, marking an increase of more than 260 per cent over the minimum price of $18.40 for April, 1913. The very high prices in the first half of 1920 were due to a marked scarcity of corn gluten feed accompanied by a brisk demand. This scarcity was attributed by the market press chiefly to car shortage, which made it difficult for manufacturers to secure a sufficient supply of corn. According to press reports the principal producer of this feed was forced to suspend grinding at some of its plants and to curtail production at others on account of the shortage of cars and corn.[35] The heavy demand for corn gluten feed at that time was attributed in part to purchases by those who had formerly used distillery and brewery grains.[36]

PRICES OF CORN OIL MEAL.—The general level of prices of corn oil meal, as shown in year averages, did not vary greatly from that of corn gluten feed for the earlier years covered in Table 24, though there were considerable differences in the prices of the two feeds in particular months. It will be noted also that the price of corn oil meal was sometimes higher and at other times lower than that of corn gluten feed. In 1917 and 1918 the price of corn oil meal was almost continuously considerably higher than that of corn gluten feed. The differences ran as high as $10 or more in three months and the differences in the year averages were $3.64 for 1917 and $5.22 for 1918. The average difference for the year 1919 was much smaller, but there were some wide variations between the averages for some months, the price of corn gluten feed being occasionally higher than that of oil meal. The average price of the two feeds was practically the same for the first five months of 1920 as a whole.

The price of corn oil meal, like that of corn gluten feed, was fairly constant up to the middle of 1916; then an advance began, which continued with slight interruptions until a maximum price of $58.20 was reached in April, 1918. This was an increase of more than 180 per cent over the price of May, 1916. Prices fluctuated considerably during the remainer of 1918 and in 1919. The highest price of the entire period of seven and a half years was reached in September, 1919, when the average was $70.28. The prices of the first five months of 1920 were also very high.

Section 10. Prices of cottonseed by-products.

PRICES OF COTTONSEED MEAL.—The bulk of the cottonseed meal used for feeding purposes is sold under brand names with the minimum protein content guaranteed.

The prices of cottonseed cake and meal prior to 1917 were dominated by the export market, but since that year have been controlled almost entirely by domestic conditions.

Prices of cottonseed meal were obtained from two of the largest jobbers, covering the period January, 1913, to March, 1920, inclusive. Prior to July, 1916, the standard brands contained a minimum of 41 per cent protein. About that time meal containing a minimum of 36 per cent protein became the standard.[37] The figures secured for January, 1913, to June, 1916, inclusive, therefore, were for brands

[35] Feedingstuffs, March, 1920, p. 49.
[36] Western Grain Journal, Feb. 26, 1920, p. 47.
[37] See Chap. III, sec. 5, for explanation of cause of this reduction in guaranteed protein content.

with a guaranteed minimum protein content of 41 per cent, and those for July, 1916, to March, 1920, inclusive, for brands carrying a guaranty of 36 per cent protein.[38] Prices shown in the following table are averages of jobbers' selling prices for car-lot transactions for the 1st, 10th, and 20th, of each month, and are mostly for prompt sales f. o. b. the oil mills. In some months prices on a few contract sales for shipment within 60 or 90 days were used in computing the averages. The averages are weighted by tonnage sold on the days for which prices were secured.

TABLE 25.—*Jobbers' average selling prices per ton of cottonseed meal, f. o. b. mills, by months, January, 1913, to June, 1920, inclusive.*

[41 per cent protein January, 1913, to June, 1916, inclusive; 36 per cent protein July, 1916, to June, 1920.]

Month.	1913	1914	1915	1916	1917	1918	1919	1920
January	$25.77	$26.81	$23.97	$28.49	$35.20	$46.44	$56.17	$69.14
February	24.67	26.65	24.52	30.12	34.62	46.55	56.08	71.71
March	23.95	25.98	25.29	29.58	34.10	45.95	56.44	69.37
April	24.29	26.75	26.02	28.41	36.02	46.92	57.04	[2] 64.81
May	25.86	27.75	25.21	29.24	37.39	47.12	57.24	[2] 65.13
June	26.14	27.41	24.33	[1] 28.95	37.77	48.09	56.79	[2] 63.63
July	25.19	26.36	24.92	25.94	42.57	49.23	61.49	.....
August	25.49	25.63	25.59	26.70	43.57	48.90	65.96	.....
September	27.46	24.17	26.63	27.88	42.95	53.00	64.76	.....
October	26.55	24.11	25.89	32.34	44.21	53.74	66.36	.....
November	24.86	23.47	27.75	33.04	45.78	54.51	66.88	.....
December	26.36	23.68	27.57	33.27	46.00	55.90	66.15	.....
Year [3]	25.63	24.98	25.40	30.73	40.41	50.71	61.32	[4] 67.30

[1] Sales of 41-per cent protein meal continued for several months—average prices July to December, 1916, were as follows: July, $28.61; August, $30.38; September, $29.34; October, $32.78; November, $37.02, December, $38.69.

[2] Simple averages of weekly prices of 36 per cent protein meal on the Memphis market, as published in the Weekly Market Reporter of the Department of Agriculture.

[3] Weighted averages, 1913-1919. Simple average for first half of 1920.

[4] Average January–June.

Prices of cottonseed meal did not fluctuate very widely from January, 1913, to the middle of 1916, the extreme range in monthly average prices of 41 per cent protein meal during this period being from $23.47 to $30.12. The price of 36 per cent protein meal advanced rapidly, with occasional slight declines, from July, 1916, to September, 1918. The increase in this period was more than 100 per cent, or from about $26 to $54 per ton. In a single year, from August, 1916, to July, 1917, the increase was nearly 60 per cent.

A presidential proclamation of October 8, 1917, required that cottonseed crushers and importers and distributors of cottonseed products should be licensed.[38a] By special regulation issued November 1, 1917, the Food Administration provided that crushers should not sell the products of cotton seed at more than a reasonable advance over the average cost of the seed from which the products were manufactured.[38b] A special regulation issued August 1, 1918, provided that licensed dealers should not sell cottonseed cake and meal or cottonseed hulls at more than a reasonable advance over actual cost of the particular commodity sold, without regard to the market or

[38] The figures from the sources mentioned were supplemented in Table 25 for the months of April, May, and June, 1920, by averages of weekly quotations on 36 per cent protein meal on the Memphis market, as published in the Weekly Market Reporter of the Department of Agriculture.

[38a] "Rules and regulations governing the importation, manufacture, storage, and distribution of food commodities for domestic trade by persons subject to license," pp. 4-6.

[38b] U. S. F. A. Special Regulations IX-B-8, 9 (Rule 8).

replacement value at the time of sale. This regulation also specified the maximum jobbers' and wholesalers' margins on resales of these commodities which would be considered reasonable.[39]

On September 26, 1918, the Food Administration arranged for a price of $53 per ton for 36 per cent protein cottonseed meal and screened cracked cake, in any quantity, in sacks, f. o. b. point of manufacture (except for Oklahoma, Texas, and California). This arrangement was carried out under the stabilization program of the Food Administration, based on the price of cotton seed at the average agreed upon by the producers and the Food Administration.[39a] This regulation remained in effect until May 31, 1919. The average prices shown in Table 25 for this period range from $53.74 for October, 1918, to $57.24 for May, 1919.

Prices in the latter half of 1919 were higher than in the first half, though they were nearly stationary during the last three months—between $66 and $67. The maximum monthly average shown in the table, viz, $71.71 for February, 1920, was three times the minimum price of $23.47 for November, 1914.

PRICES OF COTTONSEED HULLS.—Appendix Table 5 gives monthly average prices of merchantable cottonseed hulls from February, 1913, to April, 1920, inclusive. These averages were computed from low and high quotations on the 1st, 5th, 10th, 15th, 20th, and 25th of each month, as shown by the records of the Memphis Merchants' Exchange.

The table shows wide fluctuations in prices in some of the years—e. g., the range of monthly averages for the year 1915 was from $4.25 to $11.92, the minimum being in September and the maximum in December; in 1919 the range was from $5.96 (July) to $11.50 (January).

The yearly averages increased from $6.70 per ton in 1914 to $20.29 in 1918, but the average for 1919 was only $8.01, or less than the average for the year 1913. One of the most striking features of the table is the very low level of prices from March to December, 1919, inclusive. This is in marked contrast with the figures in the other price tables.

The Food Administration (Sept. 26, 1918) arranged for a price of $20 per ton for cottonseed hulls, bulk or loose, f. o. b. cars at point of manufacture. This arrangement was made under the stabilization program above mentioned. Although this arrangement was in effect until May 31, 1919, the figures in the table show that during most of the period the prices were very much below the permitted maximum.

Section 11. Prices of linseed meal.

Wholesale prices of linseed meal containing a minimum guaranty of 32 to 34 per cent protein and 5 to 6 per cent fat f. o. b. oil mills Minneapolis, Minn., were secured for the period January, 1913, to June, 1920, inclusive. Prices shown in the table below are weighted averages of all sales on the 1st, 10th, and 20th of each month for one concern for the years 1913 to 1917, and for four concerns from 1918 to June, 1920.

[39] U. S. F. A. Special Regulations XXV-D-1, 2, 3 (Rule 1 and note).
[39a] U.S.F.A. Special Regulations XXV-D-1, 2, 3, note.

TABLE 26.—*Average prices per ton of linseed-oil meal, f. o. b. Minneapolis, by months, January, 1913, to June, 1920, inclusive.*

Month.	1913	1914	1915	1916	1917	1918	1919	1920
January	$27.30	$28.00	$35.09	$35.00	$43.39	$55.85	$59.72	$79.41
February	26.72	28.42	36.25	34.80	42.67	55.52	59.27	78.98
March	24.92	27.08	32.65	30.91	42.25	56.01	61.28	75.21
April	23.88	27.32	30.75	28.29	42.45	56.03	62.53	68.08
May	23.22	26.83	29.00	26.91	45.29	55.46	63.61	64.35
June	23.50	29.46	29.82	27.61	43.90	53.32	64.97	63.12
July	24.82	29.17	32.36	31.45	46.50	53.23	73.56	.....
August	27.72	29.38	34.29	33.67	53.48	55.85	86.61	.....
September	31.03	29.00	35.17	35.27	51.00	56.00	79.95	.....
October	28.22	26.75	35.17	36.71	54.50	55.34	68.62	.....
November	27.10	29.83	34.55	42.42	53.15	53.96	72.49	.....
December	27.27	31.65	34.40	43.83	56.93	54.44	75.50	.....
Year	25.87	28.73	33.11	34.22	48.02	54.73	67.22	[1] 72.70

[1] Average January–June.

The table shows only a slight range in the monthly averages in 1914 ($4.90) and 1918 (only $2.80), and a moderate range (between $7 and $8) in 1913 and 1915. On the other hand, the range was wide in 1916, 1917, 1919, and the first half of 1920, particularly in 1919, when the difference between the lowest and highest monthly averages was $27.34.

The movement of prices as shown in the yearly averages was steadily upward during the entire period covered by the table. The absolute increases were greatest from 1916 to 1917 and from 1918 to 1919, amounting to $13.80 and $12.49, respectively. Much the greatest relative increase in any year was from 1916 to 1917, viz, nearly 40 per cent. The yearly average for 1919 was $67.22 per ton as compared with $25.87 for 1913, an increase of almost 160 per cent. Prices more than doubled in the period from May, 1916, to April, 1918, advancing from about $27 per ton to about $56. There was an almost uninterrupted increase in prices from November, 1918, to August, 1919, from an average of $53.96 to $86.61, or 60 per cent. This was followed by a sharp decline to $68.62 in October, 1919. Another advance brought the average price to $79.41 in January, 1920, from which point it fell steadily to $63.12 in June, 1920.

The estimated yearly production of linseed cake and meal in the years 1913–14 to 1916–17, inclusive, as shown in Table 10, p. 54, was from 405,000 tons to 484,000 tons. In 1917–18 and 1918–19 the production declined to a yearly average of about 365,000 tons, while in the year 1919–20 the output increased to 525,000 tons. During the four years ending with 1916–17 from 60 to more than 75 per cent of the total production was exported each year, but in the three succeeding years exports ranged from only 21 per cent to 32 per cent.

The slight range in prices in 1918 was doubtless due in large measure to the regulations of the Food Administration.[40] The removal of these regulations in January, 1919, at a time when there was a shortage in the production of linseed cake and meal, was fol-

[40] A Presidential proclamation of Jan. 10, 1918, required persons importing, manufacturing, storing, or distributing various feeds, including linseed oil cake and meal, to be licensed, and the Food Administration, by regulations of Jan. 28, 1918, repealed Jan. 10, 1919, provided that such licensees should not takemore than a reasonable profit over average cost on the sale of such feeds. (U. S. F. A. Special Regulations XXV-A-1 and B, 5, 6, 7, Rule 7.)

lowed by high prices in the year 1919. Exports were light at this time, but domestic demand was heavy. The use of linseed meal by feeders in this country had been developed by the relative scarcity of feeds during the war period. The decline in prices from January to June, 1920, may be accounted for in part by the greatly increased production. It will be noted that this marked decline in prices from January to June, 1920, shows a much different movement than appears in the price statistics of most of the other feeds.

Section 12. Prices of dried-beet pulp.

Average prices of dried-beet pulp on the Syracuse freight-rate basis are shown in the following table for the years 1913 to 1919. These average prices were furnished by the Larrowe Milling Co., of Detroit, which handles the greater part of this product. (Chap. VII, sec. 7.) The bulk of the product is handled under contract and the price remains at the same figure for several months at a time, generally for the crop year.

TABLE 27.—*Average prices of dried-beet pulp per ton, Syracuse freight-rate basis, by months, 1913–1919, inclusive.*

Month.	1913	1914	1915	1916	1917	1918	1919
January	$23.60	$25.40	$24.40	$24.40	$24.90	$40.00	$45.53
February	23.80	25.40	24.40	24.40	24.90	40.00	45.53
March	23.90	25.40	24.40	24.40	24.90	49.00	45.53
April	23.90	25.40	24.40	24.40	24.90	49.00	45.53
May	23.90	25.40	24.40	24.40	24.90	(1)	45.53
June	23.90	25.40	24.40	24.40	(1)	(1)	(1)
July	(1)	25.40	24.40	24.40	(1)	(1)	(1)
August	(1)	25.40	24.40	(1)	(1)	(1)	(1)
September	(1)	23.90	24.40	(1)	(1)	(1)	(1)
October	25.40	23.90	24.40	24.90	39.00	45.53	54.60
November	25.40	23.90	24.40	24.90	39.00	45.53	54.60
December	25.40	24.40	24.40	24.90	40.00	45.53	54.60

[1] Supply exhausted.

The price during the first six months of 1913 was slightly under $24 per ton. For the crop year 1913–14 it was advanced to $25.40. During September, October, and November, 1914, the price was reduced to $23.90, while from December of that year to July, 1916, it was uniformly $24.40. An advance of 50 cents per ton in October, 1916, held until May of the following year.

The supply was exhausted from June to September, inclusive, 1917, consequently no prices are available. In October the price advanced to $39, in December to $40 and in March, 1918 to $49. The supply was again exhausted from May to September, 1918, inclusive.

The Food Administration by regulation issued June 15, 1918, and repealed January 26, 1919, provided that manufacturers should not sell dried-beet pulp at more than a fair and reasonable advance over cost, and on September 27, 1918, declared that sales at a price above $40 per ton, sacked, f. o. b. factory, would be regarded as a violation of this regulation.[41]

Under this regulation the price of $45.53, Syracuse freight-rate basis, was in effect from October, 1918, to May, 1919, inclusive,

[41] U. S. F. A. Special Regulations VI–C–1, 2(*a*) rule 2, note.

when the supply was again exhausted. During the last three months of 1919 the price was $54.60. This price marked an advance over the low price of January, 1913, amounting to $31, or 130 per cent.

Section 13. Prices of cane blackstrap molasses.

The average contract prices, per gallon, of cane blackstrap molasses, f. o. b. storage plants at New York City, by months, January, 1914, to June, 1920, inclusive, are shown in the following table. The prices are the monthly average net receipts in cents per gallon for blackstrap in bulk, and were furnished by an important company handling this product. It is understood that feed manufacturers generally secure the bulk of their cane blackstrap molasses under contracts covering their requirements for several months, or even for a year, in advance. It should be pointed out that these figures are the contract prices of one concern only, and that contract prices for other companies would presumably show some differences.

It should also be noted that prices of "free" molasses (i. e., molasses not sold under contract) at times greatly exceeded those of contract molasses, e. g., in the early months of 1920, when there was an acute shortage of this product. (See Chap. VII, sec. 7.)

TABLE 28.—*Average net prices per gallon for contract cane blackstrap molasses, in bulk, f. o. b. storage plants, New York, by months, January, 1914, to June, 1920, inclusive.*

[Cents per gallon.]

	1914	1915	1916	1917	1918	1919	1920
January	8.04	7.13	10.91	16.80	23.75	15.37	8.86
February	8.03	7.18	9.82	16.95	25.29	17.72	10.69
March	7.85	7.10	13.34	16.88	22.13	17.32	9.71
April	7.37	6.80	13.48	18.27	20.56	16.43	11.07
May	7.80	7.28	11.09	17.31	20.47	7.47	10.48
June	7.69	6.75	13.02	17.71	20.55	7.29	10.38
July	7.82	6.93	12.30	17.57	19.97	7.78	.....
August	7.80	7.13	14.34	17.94	19.53	7.84	.....
September	7.40	6.64	13.08	19.64	18.11	7.82	.....
October	7.62	7.74	12.20	18.21	18.02	8.25	.....
November	7.54	7.00	16.10	18.54	18.09	9.00	.....
December	7.48	7.89	16.74	16.37	16.87	8.78	.....
Year[1]	7.70	7.13	13.03	17.68	20.28	10.92	[2] 10.20

[1] Simple averages of monthly averages. [2] Average, January–June.

During 1914 and 1915 the contract prices of blackstrap molasses ranged from 6.64 cents per gallon to 8.04 cents. The prices in 1916 were much higher in every month, with an average for the year of more than 13 cents per gallon. Still further advances brought the year average to 17.68 cents in 1917 and to 20.28 cents in 1918.

The United States Food Administration (Mar. 16, 1918) after an investigation of the cost of manufacturing blackstrap molasses, determined that any sale of imported blackstrap molasses or blackstrap molasses manufactured in the United States from imported cane sugar at a price of more than 18 cents per gallon, in tank cars, f. o. b. seaboard points, would return the owner an unjust and unreasonable profit.[42] By regulation (issued June 15, 1918, and repealed Jan. 26, 1919) it was provided that a licensee should not sell blackstrap molasses when manufactured from imported raw cane sugar

[42] U. S. F. A. Press Release No. 763, Mar. 16, 1918.

for more than 18 cents per gallon in bulk and 23 cents per gallon in barrels, f. o. b. cars, at primary markets or port of entry, or point of production if carrying the same freight rate as from primary markets.[43]

The maximum monthly average for the whole period covered by the table was 25.29 cents for February, 1918, from which point the price declined to 15.37 cents in January, 1919.

The most striking feature of the table is the break in prices from an average of 16.43 cents to 7.47 cents per gallon from April to May, 1919. A break of 6 cents per gallon in the spot price of bulk blackstrap occurred about March 1, 1919, and was attributed to accumulation of heavy stocks.[44] This break is not reflected in the contract prices shown in Table 28 until May.

Relatively low prices continued through the remainder of the year, and the average for the year (10.92 cents per gallon) was only slightly above half the average price for 1918. During the greater part of the first half of 1920 prices were considerably higher than at the end of 1919, and prices of free molasses were in many cases much higher than those shown in the table.

Section 14. Prices of digester tankage.

Prices for digester tankage were obtained from one of the large renderers in Chicago for the period January, 1917, to May, 1920, and also from a large packer in Indianapolis for the period June, 1917, to June, 1920. There was a similar movement in the prices of the two concerns. The simple average price, f. o. b. Chicago, for January, 1917, was $55.67 per ton, from which figure it rose steadily to $100 per ton in October, November, and December, 1918. During the year 1919 the price fluctuated around $100 per ton, the lowest price being $96.21 in June and the highest $102.50 in September. The price in January, 1920, was $101.25, February $106.25, and March, April, and May $110 per ton.

Section 15. Prices of alfalfa meal.

Alfalfa meal is graded under the rules of the American Feed Manufacturers' Association as Choice, No. 1, No. 2, and No. 3. The greater part of the output is of the No. 1 grade.[45]

Colorado is the leading State in the production of alfalfa meal, but there are mills in some of the other States of the West and Southwest. The principal markets in which mills make offerings are Kansas City, St. Louis, and Chicago.

Appendix Table 6 gives monthly average prices of No. 1 alfalfa meal in carload lots, f. o. b. Colorado and Kansas mills, and the average of quoted prices for Kansas City rate points, for the period January, 1913, to June, 1920, inclusive.[46]

The Colorado prices are weighted averages of several transactions per month furnished by one of the largest millers in the country.

[43] U. S. F. A. Special Regulation VI, B, rule 3.

[44] Journal of Commerce, Feb. 28, 1919, p. 14.

[45] The No. 1 grade is described as follows in the official definitions of the American Feed Manufacturers' Association:

"No. 1 alfalfa meal shall be milled from whole alfalfa hay of fair green color, sound and sweet, with pronounced alfalfa fragrance, and be free from foreign grasses, and shall contain not less than 12 per cent protein and 1 per cent of fat, and shall not contain to exceed 11 per cent of moisture; and be packed in 100-pound, net weight sacks."

[46] The Colorado mill figures do not cover the first six months of 1913.

For a few of the months in which prices were missing figures were supplied from the records of other millers. In three instances prices were interpolated. The Kansas mill prices are simple averages of the weekly prices as furnished by one of the largest millers in that State. The prices for Kansas City rate points are averages of the low and high quotations on or about the 1st, 10th, and 20th of each month as recorded in the Kansas City Daily Drovers Telegram.

The Colorado mill prices during the period of three and a half years from July, 1913, to December, 1916, ranged from a low of $12.90 (February, 1915) to a high of $20.58 (December, 1916). The price level was higher in the last half of 1913 than from 1914 to 1916, inclusive, the averages for these periods being, respectively, $16.05, $14.34, $14.18, and $15.04. The average price for 1917 was $25.87, or $10 higher than the average for 1916. There was a wide fluctuation in prices in 1917, the range being nearly $15 from the low price of $20 to the high price of $34.72. The 1918 average was about $4.50 above that of 1917 and the average price for the year 1919 was nearly identical with that of the preceding year. In the first half of 1920 there was an increase of about $4 in the price level over the 1919 average. The maximum price for the Colorado mills for the entire period of seven years was $37.40 for May, 1920, or nearly three times as high as the minimum price ($12.90) for February, 1915.

The prices for the Kansas mill were higher than the Colorado mill prices in all but a very few months. The differences in the yearly averages between the Colorado and Kansas prices ranged from about $1 to $2.75, except in 1919, when the difference was over $4, and in the first half of 1920, when it was less than $1.

The range in the monthly averages for the Kansas mill during the years 1913 to 1916 was $9.25, or from $14.25 to $23.50, both the low and high prices occurring in the year 1916. The general level of prices as shown in the yearly averages did not change greatly during this period, though the average was somewhat lower in 1915 than in the other years. The maximum monthly average for the Kansas mill was reached in April, 1919, instead of May, 1920, as was the case with the Colorado prices. The highest monthly average for the Kansas mill was $40, which was about two and three-quarters times the minimum ($14.25) of July, 1916.

The published quotations for Kansas City rate points differ considerably in some months from the Kansas mill figures, the former generally being higher. The difference in yearly averages for the two price records, however, is not marked except for the year 1918, namely, $3.64.

Section 16. Prices of ready-mixed feeds.

The study of the prices of ready-mixed or proprietary feeds is restricted within rather narrow limits. In the first place no two manufacturers produce ready-mixed feeds which are exactly alike, even when both are catering to the same body of consumers and both are making feeds to fill the same requirements. The only ready-mixed feeds which can possibly be exceptions are the very simple mixtures which contain as few as two or three ingredients. Even

these are likely to be mixed in different proportions and the ingredients themselves are likely to be of different qualities and costs.

When the more complex mixtures are considered, a very great diversity is found in the number and proportion of ingredients. Most manufacturers consider the formulas of their feeds as trade secrets, and in consequence they endeavor to guard them from detection and duplication by other manufacturers.

Moreover, since many manufacturers frequently change the proportions of ingredients in their feeds, a given brand name does not necessarily represent a mixture of exactly the same composition over a long period. (See Chap. IV, sec. 12.) Naturally, also, the quality of different supplies of the same ingredient may differ from time to time.

These facts must be borne in mind in comparing the prices of different brands of ready-mixed feeds, and it must be realized that even in the same group of feeds the prices of two brands can not be compared as though they represented exactly the same commodity. Even more serious is the limitation arising from the fact that the same brand may represent a different commodity at different times, though it may be assumed that most manufacturers try to preserve a given standard of quality in their feeds. They must also have in mind constantly the requirements of their guaranty of the chemical analysis of their feeds.

With these limitations in mind a study may be made of the prices of some of the leading brands of ready-mixed feeds, but naturally the results can not be as satisfactory as when the prices of commodities answering a more definite description or conforming to more exact specifications are the subject of study.

In the following sections the prices of a number of brands of ready-mixed feeds are discussed by groups, as follows: Dairy feeds, stock feeds, horse and mule feeds, hog feeds, calf meals, and poultry feeds. Tables of monthly average prices of a number of brands in each group will be found in the appendix.

The various brands for which price statistics are given are not identified by brand name or name of manufacturer. While a number of manufacturers were perfectly willing that such identification should be made, a considerable number objected to this identification, holding that since the composition of different mixed feeds differs greatly and since many manufacturers make frequent changes in their formulas, incorrect deductions would probably be made from price tables which revealed the identity of the brands. It was therefore decided not to identify any of the brands. In the tables of prices of mixed feeds the different brands are designated by numbers and the table headings of all the tables but the first [47] show the state or city in which the particular brand is manufactured.

A Presidential proclamation, dated January 10, 1918, required manufacturers of commercial mixed feeds to be licensed.[47a] The Food Administration, by regulation issued January 28, 1918, applying to manufacturers of mixed feeds and others licensed under this

[47] The first table (Appendix Table 7) gives only prices on the Boston freight rate basis, and the place of manufacture is not indicated. In a few of the other tables also the word "Boston" at the top of the column of prices indicates not the place of manufacture, but that the prices are on the Boston freight rate basis.

[47a] "Amendments and additions to rules and regulations governing the importation, manufacture, storage and distribution of food commodities and feeds for domestic trade by persons subject to license," pp. 25–27.

proclamation, provided that no more than a reasonable profit should be taken in the sale of any feedingstuffs.[48]

The Food Administration, by another regulation issued September 26, 1918, and repealed January 10, 1919, limited the margins of profit of manufacturers of mixed feeds, both on individual sales and on gross sales.[48a] This doubtless had the effect of limiting prices of mixed feeds during the period the regulation was in force.[49]

Section 17. Prices of dairy feeds.

There are many widely advertised dairy feeds on the market. The Commission secured price statistics for several of these, including both the dry feeds, so called, and the sweet or molasses feeds. The feeds for which these prices were obtained cover a wide range in quality as measured by protein content, varying all the way from the high-protein mixtures, selling under guaranties ranging from 24 to 26 per cent protein, down to those for which the guaranteed protein content runs as low as 14 to 15 per cent.

The dry feeds for which prices were secured belong mostly in the group which have a guaranteed protein content of 20 per cent or more. The molasses feeds for which prices are given vary in protein content from 14 per cent to 24 per cent.

The dry feeds are generally rather similar in the list of ingredients used. This, of course, is not equivalent to saying that they are similar in composition, for the same ingredients may be used in very different proportions in different feeds. The most common ingredients in the dry dairy feeds are cottonseed meal, linseed meal, corn gluten feed, wheat bran, and brewers' or distillers' dried grains. Numerous other ingredients are used, but they are not characteristic of the group as a whole. The sweet feeds represented in the price tables contain a smaller or larger number of the ingredients named above, with the addition of molasses or molasses and alfalfa. Some of these feeds also contain one or more of the so-called low-grade ingredients, such as clipped oat by-product, oat feed, and screenings. Many dairy feeds also contain a small quantity of salt, generally one-half of 1 per cent.

Two tables of monthly average prices of dairy feeds are given in the appendix. Appendix Table 7 gives the prices of three brands on the Boston freight rate basis for the years 1913 to 1919, with figures for two brands for the first six months of 1920. All three of

[48] U. S. F. A. Special License Regulations XXV—B—5, 6, 7. (Rule 7.)

[48a] *Margins and profits for mixed feed manufacturers.*—The United States Food Administration considers that in the manufacture and sale of ground or crushed grains or ground hay, and of all commercial mixed feeds, the advance on any individual sale should not exceed the cost of materials, manufacturing, and overhead, plus 12½ per cent. The Food Administration will therefore consider unreasonable and as a violation of the foregoing rule any sale of such feeds in excess of this advance.

Furthermore, the Food Administration will consider an annual net earning of more than 6 per cent upon the total gross sales of any such feedingstuffs if the dealer's gross sales amount to $100,000 or more per annum, to be prima facie evidence of a violation of the rule which prohibits the taking of unreasonable profits.

The maximum margin on individual sales is purposely made wide because of the speculative character of the products which enter into such manufacture and the rapidly fluctuating prices which may prevail. As pointed out, the general average on all sales must not exceed 6 per cent advance over the cost of materials, manufacture, and overhead, nor does this 6 per cent limitation modify or abrogate the general principle contained in the Food Administration regulations that a licensee shall not earn more than a reasonable net profit on his capital invested. The manufacture of mixed feeds is a business which varies in many respects according to the type of feed, the expense of manufacture, and the rapidity of turnover. There are therefore some manufacturers to whom a 6 per cent annual net profit may give an unreasonable return on their investment. In such case they are obliged to sell at a lower average return. (Special Regulations Applying to Manufacturers of Commercial Mixed Feeds, XXV–G–1, under rule B 7; U. S. Food Administration Press Release No. 1373, Jan. 12, 1919.)

[49] See also Chap. VI, sec. 3.

the brands are dry feeds. Brands one and two have a very high protein content, the guaranty for both feeds being in excess of 24 per cent. The third brand has a guaranteed minimum protein content of 20 per cent.

The general movement of prices per ton of these three brands may be seen in the year averages, which are shown in the following statement:

Brand.	1913	1914	1915	1916	1917	1918	1919	1920 [1]
No. 1	$30.43	$32.67	$33.03	$34.69	$52.06	$64.26	$72.85	$79.42
No. 2	30.87	32.40	32.24	34.52	51.94	62.40	69.92	75.66
No. 3	[2] 29.36	30.99	31.30	33.20	[3] 49.74	[3] 59.40	68.98	.....

[1] Average, January–June.
[2] Average, March–December.
[3] Average, 11 months.

These figures show that there was not much change in prices of these three brands from 1913 to 1916, inclusive, though there was a slight upward trend. Marked increases were made in the prices of all three of the brands in the years 1917, 1918, and 1919. The increases in yearly averages from 1913 to 1919 were approximately as follows: Brand No. 1, 139 per cent; brand No. 2, 126 per cent; brand No. 3, 135 per cent. There was a still further advance in the prices of brands Nos. 1 and 2 in the first half of 1920. Figures for brand No. 3 are lacking for this period. The increase in the average for the first half of 1920 over the average for the year 1913 was 161 per cent for brand No. 1 and 145 per cent for brand No. 2.

It will be noted that the prices of the 20 per cent protein brand ran only slightly lower than the prices of the two brands which carry over 24 per cent protein.

Appendix Table 8 gives the prices of eight brands of dairy feeds on the f. o. b. factory basis for the years 1915 to 1919, inclusive, with prices for all but two of the brands for the first half of 1920. Figures for three of the brands are lacking for 1915. All these brands except No. 2 are molasses feeds.

The following statement of yearly averages taken from Appendix Table 8 is given to show the general trend of prices per ton for these eight brands of dairy feed:

Brand.	1915	1916	1917	1918	1919	1920 [1]
No. 1	$27.18	$31.30	$46.79	$58.67	$68.25	$73.31
No. 2	.....	[2] 30.42	41.14	55.85	62.06	70.04
No. 3	.....	34.45	51.85	[2] 63.24	68.51	76.41
No. 4	25.25	29.28	44.85	55.88	[2] 60.88	.....
No. 5	27.10	[2] 27.42	.....	55.13	59.46	66.81
No. 6	23.15	25.24	39.10	44.69	48.76	56.11
No. 7	.....	30.36	43.91	54.19	54.50	.....
No. 8	[2] 23.10	26.03	[2] 37.69	43.13	48.73	59.85

[1] Average January–June.
[2] Prices for some months lacking. See Appendix Table 8.

Marked increases in prices are shown in the years 1917 and 1918 and for some of the brands in 1919. There were also additional advances during the first half of 1920 for the six brands for which figures are given.

The following statement shows the amount and per cent of advance in prices per ton of the several brands as shown in yearly averages between 1915 and 1919 and between the yearly average for 1915 and the average for the first half of 1920.[50]

Brand.	Average price.			Increase.			
	1915	1919	First half 1920.	1919 over 1915.		First half 1920 over 1915.	
				Amount.	Per cent.	Amount.	Per cent.
No. 1	$27.48	$68.35	$73.31	$40.87	148.7	$45.83	166.8
No. 3	[1] 34.45	68.51	76.41	[2] 34.06	[2] 98.9	[2] 41.96	[2] 121.8
No. 4	25.25	60.88	.....	35.63	141.1	.....	.....
No. 5	27.10	59.46	66.81	32.36	119.4	39.71	146.5
No. 6	23.15	48.76	56.14	25.61	110.6	32.99	142.5
No. 7	[1] 30.36	54.50	.....	[2] 24.14	[2] 79.5	.....	.....
No. 8	[1] 26.03	48.73	59.85	[2] 22.70	[2] 87.2	[2] 33.82	[2] 129.9

[1] Average, year 1916. [2] Increase over 1916.

It will be noted that the prices on four brands for the year 1919 were approximately from 110 per cent to 150 per cent above the averages for the year 1915, while for three other brands the 1919 figures were about 80 per cent to 100 per cent above the 1916 averages. The averages on five brands for the first half of 1920 ranged from 120 per cent to more than 165 per cent above the 1915 or 1916 averages.

Section 18. Prices of stock feeds.

Appendix Table 9 gives monthly average prices of ready-mixed stock feeds for six brands f. o. b. factory at various points. The figures cover the period January, 1913, to June, 1920, except those for brands No. 1 and No. 2, for which the figures begin with July, 1914, and January, 1915, respectively. Brands No. 4 and No. 6 are dry feeds; the others all contain molasses, and brands Nos. 2, 3, and 5 also contain alfalfa meal. Two of the brands contain oat feed. The number of ingredients in these feeds differs widely from a simple mixture of alfalfa meal and molasses to a feed containing 10 or more ingredients.

The following statement of yearly averages shows the general trend of prices per ton of these six stock feeds:

Brand.	1913	1914	1915	1916	1917	1918	1919	1920 [1]
No. 1	.....	.....	$27.83	$31.00	$46.83	$52.00	$48.17	$52.22
No. 2	.....	.....	25.25	29.65	43.89	51.25	51.54	57.92
No. 3	$19.67	$19.26	18.92	22.89	32.82	38.57	37.00	[2] 42.43
No. 4	23.22	25.31	25.89	26.95	46.23	48.31	52.16	60.29
No. 5	25.58	26.27	26.20	28.17	40.92	53.90	50.48	57.44
No. 6	26.54	29.25	30.57	32.19	53.06	[3] 57.75	60.32	67.75

[1] Average, January–June. [2] Price for February missing. [3] 11 months only.

[50] In making comparisons of the figures for earlier years with those for the first 6 months of 1920, the fact must be kept in mind that prices of all feeds declined greatly in the last six months of 1920, and that averages for the year 1920 would be much lower than averages for the first half of the year.

As in the case of dairy feeds there were only moderate increases in prices from 1913 to 1916, but marked advances in 1917 and 1918. However, three of the six brands show a lower level of prices for 1919 than for 1918 and another a stationary price. All the brands show an advance in the price for the first half of 1920 over the average for the year 1919, but the increases were not uniform.

The following statement shows the range between the minimum and maximum yearly averages, and the per cent of increase of the maximum over the minimum for each brand; also the amount and per cent of increase of the average for the first half of 1920 over the minimum yearly average.

Brand.	Minimum yearly average.		Maximum yearly average.		Increase.		Average price first half 1920.	Increase over minimum yearly average.	
	Year.	Average price.	Year.	Average price.	Amount.	Per cent.		Amount.	Per cent.
No. 1	1915	$27.83	1918	$52.00	$24.17	86.8	$52.22	$24.39	87.6
No. 2	1915	25.25	1919	51.54	26.29	104.1	57.92	32.67	129.4
No. 3	1915	18.92	1918	38.57	19.65	103.9	42.43	23.51	124.3
No. 4	1913	23.22	1919	52.16	28.94	124.6	60.29	37.07	159.6
No. 5	1913	25.58	1918	53.90	28.32	110.7	57.44	31.86	124.6
No. 6	1913	26.54	1919	60.32	33.78	127.3	67.75	41.21	155.3

The maximum yearly averages of 1918 or 1919 for brands Nos. 2 to 6, inclusive, ranged from 104 to 127 per cent above the minimum year averages of 1913 or 1915, and the averages for the first half of 1920 for these brands ranged from 124 per cent to 160 per cent above the minimum yearly averages. The relative advance in price of brand No. 1, as measured by the difference between the minimum and maximum yearly averages, was much less than for the other brands (only 87 per cent).

Section 19. Prices of horse and mule feeds.

Appendix Table 10 gives monthly average prices of six horse and mule feeds, f. o. b. factory at various points, for the period January, 1913, to June, 1920, inclusive, except for brands Nos. 5 and 6, which begin with January, 1914. All these brands are sweet feeds except No. 5. The first four brands are comparatively simple mixtures, the chief ingredients being corn, oats, alfalfa, and molasses. Brands No. 5 and No. 6 contain oat feed.

The yearly averages as shown in this table are summarized for convenience in the following statement. This shows a slight advance in prices from 1913 or 1914 to 1916, and very marked increases in 1917 and 1918. Only two of the brands show a higher price level in 1919 than in 1918. The five brands for which prices are given for the first half of 1920 show substantial advances over the 1919 price level:

Brand.	1913	1914	1915	1916	1917	1918	1919	1920[1]
No. 1	$24.35	$26.03	$26.90	$29.88	$50.00	$55.18	$55.21	$61.81
No. 2	26.86	27.59	27.77	31.80	41.33	54.74	52.58	.....
No. 3	26.22	28.09	25.57	30.16	43.59	58.62	52.85	64.65
No. 4	25.54	27.67	28.29	31.81	51.69	57.43	55.47	60.86
No. 5	.....	28.29	28.47	29.10	.....	47.65	55.18	63.25
No. 6	.....	23.96	26.45	32.12	44.07	52.78	50.22	59.24

[1] Average, January-June.

The following statement shows the range between the minimum yearly average (1913 or 1914) and the maximum yearly average (1918 or 1919) for each brand and the per cent by which the maximum average exceeded the minimum; also the amount and per cent of increase of the average for the first half of 1920 over the minimum yearly average.

Brand.	Minimum yearly average.		Maximum yearly average.		Increase.		Average price first half 1920.	Increase over minimum yearly average.	
	Year.	Average price.	Year.	Average price.	Amount.	Per cent.		Amount.	Per cent.
No. 1	1913	$24.35	1919	$55.21	$30.86	126.7	$61.81	$37.46	153.8
No. 2	1913	26.86	1918	54.74	27.88	103.8			
No. 3	1913	26.22	1918	58.62	32.40	123.6	64.65	38.43	146.6
No. 4	1913	25.54	1918	57.43	31.89	124.9	60.86	35.32	138.3
No. 5	1914	28.29	1919	55.48	27.19	96.1	63.25	34.96	123.6
No. 6	1914	23.96	1918	52.78	28.82	120.3	59.94	35.98	150.2

The increase in prices as registered in the difference between minimum and maximum yearly averages, ranged from 96 per cent to nearly 127 per cent, and averages for the first half of 1920 were from about 124 per cent to 154 per cent above the minimum yearly averages.

Section 20. Prices of hog feeds.

Appendix Table 11 gives monthly average prices of four brands of hog feeds for the years 1917 to 1919, inclusive, and for the first half of 1920. Prices for brands 1 and 2 were also given for the year 1916.

The number of ingredients in the different brands varies from 6 to 11. Brands 1 and 2 contain both molasses and alfalfa meal, while 3 and 4 are dry feeds, but No. 4 contains alfalfa meal. All contain digester tankage, meat meal, or blood meal. Corn feed meal is also an ingredient common to the four brands. The guaranteed protein content of the four brands ranges from 12 per cent to 18 per cent.

The following statement gives a summary of the yearly averages for the four brands:

Brand.	1916	1917	1918	1919	1920 [1]
No. 1	$31.33	$50.06	$60.74	$68.15	$73.53
No. 2	30.69	47.29	58.65	65.43	73.64
No. 3		55.22	62.12	67.79	72.35
No. 4		[2] 55.02	[3] 55.27	64.89	72.78

[1] Average, January-June.
[2] Average, February-November.
[3] Average, January-October.

Brands No. 1 and No. 2 increased rapidly in price in each of the years 1917, 1918, and 1919, and in the first half of 1920. The greatest absolute increase in both brands was in 1917. The total increase in yearly averages from 1916 to 1919 for brand No. 1 was from $31.33 to $68.15, or 117 per cent. The difference between the yearly average for 1916 and the average for the first half of 1920 was $42.20, an increase of 135 per cent.

Brand No. 2 shows an increase in yearly averages from 1916 to 1919 from $30.69 to $65.43, or 113 per cent, while the difference between

the average for the year 1916 and the first half of 1920 was $42.95, or 140 per cent.

Similar comparisons can not be made for brands Nos. 3 and 4, but these two brands advanced from an average price of about $55 for 1917 to between $72 and $73 for the first half of 1920.

Section 21. Prices of calf meal.

Calf meal is produced by a comparatively small number of manufacturers. The Commission secured price statistics for three brands, which are given in Appendix Table 12. The figures for two brands begin with January, 1916, while those for the third could be furnished only as far back as March, 1917. The prices for all three brands are brought down to June, 1920.

These brands of calf meal differ in number of ingredients from half a dozen to 15 or more, and the guaranteed protein content varies from 20 per cent to 27 per cent.

Calf meal is very high in price as compared with feed mixtures for other animals, as will be seen by a comparison of the figures in Appendix Table 12 with those of other mixed feeds already given.

While there were considerable differences in the movement of prices of the different brands, as shown in the monthly averages, the general trend was similar. Brand No. 3 was nearly uniformly somewhat lower in price than the other two brands. Brand No. 2 was slightly higher in price than brand No. 1 in 1916 and 1917, while the reverse was true for the later years.

The yearly averages for each of the three brands are given in the following statement:

Brand.	1916	1917	1918	1919	1920 [1]
No. 1	$50.97	$71.47	$88.47	$94.03	$105.55
No. 2	52.50	72.49	85.24	93.73	102.36
No. 3		[2] 70.53	84.94	88.50	99.39

[1] Average, January-June.
[2] Average, March-December.

Brands Nos. 1 and 2 show rapid increases in each of the years 1917, 1918, and 1919, with a further marked increase in the first six months of 1920. Brand No. 3 shows a marked increase in 1918 over 1917, only a slight advance in 1919, and another marked increase in the first half of 1920.

The 1919 yearly average for brand No. 1 was 84 per cent above the average for 1916, and the corresponding increase for brand No. 2 was 79 per cent. The increase in the average for the first half of 1920 over the 1916 average was 107 per cent for brand No. 1 and 95 per cent for brand No. 2.

Section 22. Prices of poultry feeds.

Appendix Tables 13 to 16 give prices of leading brands of poultry scratch feeds and poultry mash feeds. The scratch feeds are mixtures of cracked corn and various whole grains, and ordinarily also contain a small percentage of sunflower seeds. There is generally not much difference in the kind of ingredients used by different manufacturers, though there may be considerable differences in the proportions

of the various ingredients used in different brands. The following list of ingredients may be considered fairly typical of this class of feeds: Cracked corn and whole grains of wheat, barley, oats, Kafir corn or milo maize, buckwheat, and sunflower seeds. Some of these ingredients may be omitted and others occasionally added.

The so-called mashes are mixtures of various ground feeds and are used chiefly for egg production and developing and fattening young fowl. The mash feeds for which prices are given in Appendix Tables 15 and 16 differ in number of ingredients from 8 to more than 20.

Appendix Table 13 gives the average monthly prices of four scratch feeds for the years 1913 to 1919, with figures for the first half of 1920. Brand No. 1 is on the Boston freight rate basis and the other brands f. o. b. factory at Memphis, St. Louis, and Chicago, respectively.

The following statement shows the yearly averages for these four brands of scratch feed:

Brand.	1913	1914	1915	1916	1917	1918	1919	1920[1]
No. 1	$34.52	$37.44	$39.87	$42.25	$71.86	$78.22	$74.14	$81.14
No. 2	[2]31.30	31.94	30.31	33.09	62.78	69.82	[3]66.72	71.76
No. 3	31.48	33.88	35.40	38.17	66.23	73.60	74.32	78.27
No. 4	28.98	31.64	33.57	35.99	64.49	70.79	69.71	77.75

[1] Average, January-June.
[2] Average, August-December.
[3] Average, January-November.

This statement shows that the trend of prices was upward but the increase was comparatively slight from 1913 to 1916. The striking feature of the statistics is the very great increase in prices in 1917 over 1916. The yearly averages for 1917 range from 70 per cent to nearly 90 per cent above the averages for the preceding year. The trend was still upward in 1918, but the advances in that year were slight as compared with those of 1917. Three of the four brands showed a lower average price in 1919 than in 1918, and the increase in the average price of the other brand was slight. There were substantial increases in the prices of all the brands in the first half of 1920 over the average for the year 1919.

The following statement shows the advance in prices, as measured by yearly averages, from 1913 to 1918:

Brand.	Average price for year.		Increase.	
	1913	1918	Amount.	Per cent.
No. 1	$34.52	$78.22	$43.70	126.6
No. 2	[1]30.31	69.82	39.51	130.4
No. 3	31.48	[2]74.32	42.84	136.1
No. 4	28.98	70.79	41.81	144.3

[1] Year 1915.
[2] Year 1919.

These figures show increases in the maximum yearly average over the minimum yearly average ranging from 127 per cent to 144 per cent. The per cent of increase of the average for the first half of 1920

over the minimum yearly average for each brand was as follows: No. 1, 135 per cent; No. 2, 137 per cent; No. 3, 149 per cent; No. 4, 168 per cent.

Appendix Table 14 gives monthly average prices for 5 other scratch feeds, but covers only the years 1915 to 1919, with figures for the first half of 1920 for all but one brand.

The following statement shows the yearly averages for the several brands:

Brand.	1915	1916	1917	1918	1919	1920.
No. 1	[2] $35.86	$38.23	$65.80	$72.44	$72.74	$77.34
No. 2	31.56	35.79	63.67	[3] 68.53	68.39	78.48
No. 3	33.60	36.44	[4] 61.32	72.27	72.67	75.12
No. 4	35.28	36.79	64.18	70.84	70.46	76.31
No. 5	31.63	32.92	56.83	67.14	66.16	.....

[1] Average, January–June.
[2] Average, June–December.
[3] Average eleven months (April missing).
[4] Average seven months (April–August missing).

The prices of all these brands of scratch feeds also show a very great increase in 1917 over 1916. The per cent of increase, as shown in the yearly averages, was nearly the same for the several brands, ranging only from 72 per cent to 78 per cent. There was also a considerable advance in 1918 over 1917 for all brands, but this advance did not continue in 1919.

The following statement shows the minimum and maximum yearly averages for the several brands with the amount and per cent of increase for each; also the difference between the yearly average for 1915 and the average for the first half of 1920 for four of the five brands:

Brand.	Yearly average.		Increase.		Average first half 1920.	Increase over 1915.	
	1915.	1918.	Amount.	Per cent.		Amount.	Per cent.
No. 1	[1] $35.86	[2] $72.74	$36.88	102.8	$77.34	$41.48	115.7
No. 2	31.56	68.53	36.97	117.1	78.48	46.92	148.7
No. 3	33.60	[2] 72.67	39.07	116.3	76.12	42.52	126.5
No. 4	35.28	70.84	35.56	100.8	76.31	41.03	116.3
No. 5	31.63	67.14	35.51	112.3	.....	.....	.....

[1] Average, June–December.
[2] Average for 1919, maximum yearly average.

These figures show increases varying from 101 per cent to 117 per cent between the yearly average for 1915 (minimum) and the average for 1919 or 1918 (maximum yearly average). The increases in the averages for the first six months of 1920 over the average for the year 1915 range from 116 per cent to 149 per cent.

Appendix Table 15 gives monthly average prices of two brands of poultry mash for the period January, 1913, to June, 1920, inclusive.

There was a slight upward movement of the price level from 1913 to 1916 for these brands, as for most other brands of mixed feeds the prices of which have been under discussion. The prices of these brands did not advance as greatly in 1917 as did the prices of scratch feeds for which figures have already been given. Brand No. 1 shows an increase in the yearly average from 1916 to 1917 of only 46 per cent

and brand No. 2, 49 per cent. Substantial increases in the prices of both brands were made in 1918, and a slight increase in 1919 for brand No. 1 and a considerable increase for brand No. 2. The yearly average price of brand No. 1 increased from $37.14 in 1913 to $73.26 in 1919, or 97 per cent, and the increase for the first half of 1920 over the 1913 average was about 120 per cent. Brand No. 2 advanced from $34.48 in 1913 to $74.88 in 1919, or 117 per cent, while the increase in the average for the first half of 1920 over the average for 1913 was 135 per cent.

Appendix Table 16 gives the prices of three brands of poultry mash, but covers only the years 1917 to 1919 and the first half of 1920.

There were some fluctuations in prices, but all brands advanced greatly in price, reaching a high level at the end of the summer of 1919, receding some in the later months of that year, and then advancing to maximum prices in May and June, 1920. Brand No. 1 increased in price from $43.67 in January, 1917, to $89.75 in June, 1920. Brand No. 2 advanced from $43.17 in January, 1917, to $84.67 in May, 1920.

The following increases are shown between the yearly averages for 1917 and the six-months' average for 1920:

Brand.	Average, 1917.	Average, January–June, 1920.	Increase.	
			Amount.	Per cent.
No. 1	$55.82	$82.86	$27.04	48.4
No. 2	58.10	79.36	21.26	36.6
No. 3	61.70	85.28	23.58	38.2

Section 23. Price decline last six months of 1920.

The main body of information collected during the investigation covered the period prior to July 1, 1920. In the consideration of prices of feedingstuffs, however, the treatment would be far from complete if allusion were not made to the marked decline in prices of all feeds which occurred during the last six months of 1920. Prices of some feeds, both straight and ready-mixed, on December 31 were less than one-half of what they were at the end of June. This decline went on almost uninterruptedly from July to December, from week to week, with only now and then a slight rally.

Decline in prices of straight feeds.—Figures have been gathered showing the weekly prices of some of the principal feeds. The straight feeds selected are bran, middlings, cottonseed meal, linseed meal, corn gluten feed, alfalfa meal, and hominy feed. The decline in the prices of these feeds between June 26, 1920, and December 31, 1920, was as follows:

	Price, per ton, June 26.	Price, per ton Dec. 31.	Decline per ton.	Per cent.
Spring wheat bran, Minneapolis	$50.50	$26.50	$24.00	47.5
Spring wheat middlings, Minneapolis	55.50	24.00	31.50	56.8
Linseed meal, Minneapolis	62.50	38.50	24.00	38.4
Cottonseed meal, Memphis	62.50	27.00	35.50	56.8
Corn gluten feed, Chicago	68.75	48.00	20.75	30.2
Alfalfa meal, Chicago	46.00	28.00	18.00	39.1
Hominy feed, Chicago	70.00	32.50	37.50	53.6

The table following shows the weekly prices of these feeds during the last six months of 1920, taken from the Market Reporter, Department of Agriculture:

TABLE 29.—*Prices of seven important straight feeds per ton in carload lots, by weeks, June 26 to Dec. 31, 1920, inclusive.*[1]

	Spring wheat bran, Minneapolis.	Spring wheat middlings, Minneapolis.	Cottonseed meal (36 per cent), Memphis.	Linseed meal, Minneapolis.	Corn gluten feed, Chicago.	Alfalfa meal, Chicago.	Hominy feed, Chicago.
June 26	$50.50	$55.50	$62.50	$62.50	$68.75	[2]$46.00	[2]$70.00
July 3	50.00	55.00	61.50	63.50	68.75	[2]45.50	[2]70.00
July 10	49.50	54.50	60.00	63.50	63.75	[2]45.25	[2]70.00
July 17	48.50	54.00	60.00	63.50	64.25	[2]40.00	[2]63.00
July 24	45.00	52.00	59.00	63.00	64.25	41.00	63.00
July 31	43.00	52.00	56.00	62.00	64.25	37.50	62.50
Aug. 7	39.50	50.00	56.00	62.00	64.25	38.50	62.00
Aug. 14	40.50	51.00	56.00	60.50	64.25	39.00	
Aug. 21	43.00	53.00	55.00	62.00	64.25	40.00	62.00
Aug. 28	42.50	53.00	53.00	62.00	63.75	41.00	62.00
Sept. 4	39.00	48.00	52.50	63.00	63.75	39.50	58.50
Sept. 11	38.50	46.50	52.00	63.00	58.75	38.00	60.00
Sept. 18	38.00	46.00	51.00	63.00	58.75	37.00	55.00
Sept. 25	37.00	44.00	49.50	63.00	53.75	36.50	45.00
Oct. 2	34.00	38.00	45.00	62.80	53.75	35.00	40.00
Oct. 9	28.50	29.00	42.00	61.00	48.75	32.00	40.00
Oct. 16	29.50	29.00	37.50		43.75	32.50	37.00
Oct. 23	31.00	30.50	36.00	59.00	43.75	32.00	34.50
Oct. 30	30.00	28.50	37.00	54.00	43.75	30.00	34.00
Nov. 6	32.00	30.00	38.00	52.00	43.75	32.00	36.00
Nov. 13	31.00	29.00	35.50	50.00	43.75	31.00	37.00
Nov. 20	31.50	29.00	32.00	49.00	48.00	31.00	34.00
Nov. 27	30.00	26.50	31.00	48.00	48.00	31.00	33.00
Dec. 4	26.50	23.50	29.00	40.50	48.00	30.00	37.00
Dec. 11	26.00	23.50	29.00	41.00	48.00	29.50	35.50
Dec. 18	25.00	23.00	27.00	40.00	48.00	28.60	35.00
Dec. 25	25.50	23.50	27.00	40.00	48.00	28.00	33.50
Dec. 31	26.50	24.00	27.00	38.50	48.00	28.00	32.50

[1] From the Weekly Market Reporter, of the Department of Agriculture.
[2] Figures furnished by the Department of Agriculture.

DECLINE IN PRICES OF READY-MIXED FEEDS.—The several classes of ready-mixed feeds also fell off in price during the last six months of 1920. The declines in prices of the different brands varied widely, but on the whole the drop was practically as great as that for the straight feeds just discussed.

Dairy feeds with protein content of 20 per cent or over sold at about $75 on June 20, 1920. On December 31, 1920, prices of these feeds had fallen to about $45, or 40 per cent. Two high protein content dairy feeds had declined only about 27 per cent during this period.

The decline in the lower protein content dairy feeds varied greatly for the different feeds. Prices of one such feed fell from $63.75 on June 20, 1920, to $29 on December 31, 1920, or 54.5 per cent; while another with the same protein content sold at $64 on June 20 and declined only to $51 on December 31, or 20 per cent. Other feeds in this group declined as much as 46 per cent and as little as 36 per cent.

The drop in prices of ready-mixed stock feeds was fairly uniform among the different brands. The greatest decline was 52.5 per cent, from $54.75 on June 20 to $26 on December 31, and the least from $54 to $37 for the same period, or 31.5 per cent. Several other brands of ready-mixed stock feed declined about 47 per cent.

Horse and mule feeds also fell off greatly in price in the last half of 1920. Only 3 brands out of a total of 18 showed a decline of less than 40 per cent, and 12 declined at least 45 per cent. One brand which sold at $88 June 20 fell to $41.50 at the end of December, while another which also sold at $88 June 20 fell only to $56. These two brands represent the extremes in the per cent of decline, viz, 53 per cent and 36 per cent. The prices of other brands of horse and mule feeds ranged from $59.50 to $78.50 on June 20, and from $33 to $41 on December 31.

Several brands of hog feeds for which prices were secured showed about 40 per cent decline in the last six months of 1920. The prices on these brands ranged from $72 to $80.75 per ton June 20, and from $43.50 to $48 December 31. One brand which brought $82 at the earlier date fell only to $60 at the later date, a decline of only 27 per cent as compared with a maximum decline of 45 per cent.

Three brands of calf meal, which ranged in price from $103 to $108 June 20, decreased from 18 per cent to 34 per cent by December 31.

Fourteen brands of poultry scratch feeds declined from 38.5 per cent to 52 per cent. The decline in the prices of eight brands was more than 45 per cent. Prices June 20 ranged from $74 to $90.50 and on December 31 from $39 to $52.

Poultry mash feeds showed relatively small declines from June 20 to December 31, 1920. The prices of five brands fell from 27 per cent to 37 per cent. Prices on these brands June 20 ranged from $81 to $91, and on December 31 from $55.50 to $66.

Chapter VI.

COSTS, PROFITS, INVESTMENT, AND RETURN ON INVESTMENT OF FEED MANUFACTURERS, 1913–1919.

Section 1. Introductory.

Scope and companies covered.—A number of commercial feed manufacturers were visited for the purpose of securing data from their books regarding cost, profit, and investment. Due to the incomplete records of many companies visited, it was found that with the exception of 14 concerns the data were not sufficiently complete to show the results of the business. It was the original intention of the Commission to secure, for comparative purposes, data from all companies studied for the years 1913 to 1919, inclusive. This was impossible, however, as several of the companies visited began operations after 1913 and the records of other companies were not complete as far back as that date. As a result the Commission compiled three sets of figures, one set covering a period of seven years, 1913–1919, combining the results of three companies; a second set covering a period of five years, 1915–1919, which combines the results of nine companies, including the three whose results are shown for seven years; and a third set covering a period of three years, 1917–1919, inclusive, which combines the results of 14 companies, including the nine companies in the second set.

In presenting these tables the Commission does not attempt to draw any conclusions applicable to the feed industry in its entirety, or even to mixed feeds as a whole. The companies included, however, are thoroughly representative of the mixed feed industry. The results shown by the tables, therefore, may probably be considered as representative of the situation in this important branch of the industry. The companies whose results are presented are as follows:

Alfocorn Milling Co.	St. Louis, Mo.
Arcady Farms Milling Co.	Chicago, Ill.
The Buckeye Cotton Oil Co.	Cincinnati, Ohio.
Chapin & Co.	Chicago, Ill.
Clover Leaf Milling Co.	Buffalo, N. Y.
The Corno Mills Co.	St. Louis, Mo.
Edgar-Morgan Co.	Memphis, Tenn.
Golden Grain Milling Co.	East St. Louis, Ill.
Hales & Edwards Co. (now Hales & Hunter Co.)	Chicago, Ill.
The Larrowe Milling Co.	Detroit Mich.
M. C. Peters Mill Co.	Omaha, Nebr.
Superior Feed Co.	Memphis, Tenn.
Tarkio Molasses Feed Co.	Kansas City, Mo.
The Ubiko Milling Co.	Cincinnati, Ohio.

Section 2. Definitions and adjustments.

In order more readily to understand and interpret the figures appearing in the following tables it is desirable briefly to discuss the adjustments necessary to render comparable the results obtained and to define the meanings of various terms mentioned in the headings herein.

Net sales.—The term net sales as used in this chapter means the total sales after deducting all returns, allowances, and freight.

Cost of sales—Inventories.—No revision was made by the Commission of the inventory figures as carried on the companies'

books. All companies, except three, valued their inventories at average cost. Of the three companies that valued their inventories at the market, two were small, while the third was one of the larger companies. As the valuation of the inventories of the three companies does not greatly affect the results of the combined companies, no attempt was made to revalue these inventories at cost.

DEPRECIATION.—The practice of commercial feed manufacturers with respect to depreciation varies considerably. Some treat depreciation as an element of cost and make a yearly charge thereto; others make no periodical charge for depreciation, but at the end of a prosperous year charge to profit and loss such a lump sum as is considered an adequate provision for that year; while still others make yearly charges to profit and loss, of lump sums, usually what they can afford. In order to place all companies on a comparable basis with respect to depreciation the Commission has substituted computations of its own for those shown by the books of the various companies. It was found that several of the best-managed companies allowed as an average charge about 2½ per cent on buildings and 7½ per cent on machinery and equipment, which figures were adopted by the Commission, and yearly provision for depreciation was computed on this basis for each company and charged to manufacturing costs.

INTERCOMPANY PROFITS.—One instance was encountered in which the cost of sales was increased through the inclusion of intercompany profit. In this case the Commission in preparing the profit and loss accounts eliminated all such profit.

ELIMINATION OF RESERVES.—In all cases where it was found that there had been included in the cost of sales any provision for a general or nonspecific reserve, such as a contingency reserve or profit-sharing fund reserve, etc., the Commission adjusted the cost of sales by the elimination of such charges, as they were considered as appropriations of earnings rather than charges against the profits of the companies.

GENERAL AND ADMINISTRATIVE EXPENSES.—From general and administrative expenses the Commission has eliminated any charge for Federal income and excess-profits tax, as the provision for or payment of such taxes was not considered a proper operating charge.

SELLING EXPENSE.—In all cases bad debts were eliminated as an item of selling expense and were charged to financial expenses.

NET OPERATING PROFIT.—Net operating profit represents profit derived from the manufacture and sale of commercial feeds before making any deduction or addition, unless otherwise stated, for interest paid or received, cash discount allowed or received, and before adding or deducting the income and expense derived or incurred from purely financial transactions, or from transactions not connected with the actual operations of the feed business. The item "interest received and cash discounts," included in the statements, represents largely interest received on the receivables, the cash discounts being shown by only two companies, and in both instances being small.

INVESTMENT.—Investment as here employed represents the actual cash or its equivalent invested in the business either by the stockholders or those who loan capital to the business. The following table shows the total investment irrespective of the ownership of the capital involved, which is represented by stockholders' investment, (the capital stock and surplus) plus borrowed capital, the borrowed

capital representing the average monthly balance of interest-bearing indebtedness. There has been included in the investment the amount of any general reserves, namely, reserves that can not be allocated to a specific asset, such as a contingency reserve. There have been eliminated from the value of the companies' book assets all amounts representing increases in valuation of the assets by reappraisal and any amounts representing good will, patented processes, or the like, unless an actual cash consideration was paid for the same. There have also been eliminated investments considered by the Commission as "outside investments" which represent the company's holdings of Liberty bonds, stocks and bonds of other companies, and buildings and other assets not used for purposes of the feed business.

In those cases where the company has engaged in other outside operations, or where the feed mill is a department of a large corporation, the investment has been segregated in the balance sheet and allocated, in proper proportions, to the feed operations and to the other operations which have been considered outside investments.

RATE OF RETURN ON INVESTMENT.—The rate of return on investment represents the percentage which the amount of the net operating profit bears to the investment. The amount of net operating profit applying against the investment is found before deducting interest. As the borrowings have been included in the investment, interest has not been deducted from the profit. This rate of return reflects the result of operations in the mixed-feed business as it has actually been conducted.

Section 3. Unit costs of producing and selling ready-mixed feeds.

The following table shows the unit costs per ton of producing and selling ready-mixed feeds as well as the average sales price, the net operating profit, and the number of tons produced and sold. It was found that the cost records kept by all companies visited covered the entire production of the mill regardless of the kind or grade of feed manufactured. This made it impossible for the Commission to allocate the costs to the various classes of feed manufactured. The unit figures presented below, therefore, are those of the composite output of all classes and grades of feed mixed.

TABLE 30.—*Unit costs per ton of producing and selling ready-mixed feeds, for groups of representative manufacturers, by years, 1913–1919, inclusive.*

Years and number of companies.	Materials.	Sacks.	Labor.	Millover-head.	Total manufacturing cost.	Inventory adjustment.	Manufacturing cost of sales.
3 companies:							
1913	$23.59	$1.55	$0.55	$0.57	$26.26	.....	$26.26
1914	24.72	1.24	.52	.64	26.12	.....	26.12
1915	24.12	1.21	.57	.57	26.47	$0.03	26.44
1916	25.32	1.84	.69	.76	28.61	.02	28.59
1917	34.46	2.18	.90	.75	37.29	.01	37.28
1918	45.04	3.89	1.36	.92	51.81	.13	51.68
1919	50.44	2.68	1.40	1.04	55.56	.04	55.52
9 companies:							
1915	20.43	1.34	.63	.63	23.03	.01	23.02
1916	22.24	1.83	.76	.82	25.65	[1].01	25.66
1917	29.34	2.37	1.01	.96	33.68	.14	33.54
1918	40.10	3.89	1.44	1.17	46.60	.11	46.49
1919	42.76	3.47	1.51	1.14	48.88	[1].01	48.89
14 companies:							
1917	32.45	2.53	.96	.87	36.81	.09	36.72
1918	43.14	4.35	1.36	1.09	49.94	.07	49.87
1919	45.93	3.68	1.52	1.12	52.25	.....	52.25

TABLE 30.—*Unit costs per ton of producing and selling ready-mixed feeds, for groups of representative manufacturers, by years, 1913–1919, inclusive*—Continued.

Years and number of companies.	General and administrative expenses.	Selling expense.	Commercial cost of sales.	Net sales.	Net operating profit.	Tons produced.	Tons sold.
3 companies:							
1913	$0.79	$0.92	$27.97	$29.00	$1.03	165,536	165,524
1914	.79	1.06	27.97	29.30	1.33	169,688	160,638
1915	.81	.98	28.23	29.65	1.42	152,591	153,546
1916	.72	1.03	30.34	31.13	.79	181,330	183,327
1917	.92	1.22	39.42	43.67	4.25	186,904	185,833
1918	1.01	1.41	54.10	56.01	1.91	164,657	162,763
1919	1.02	2.08	58.62	62.40	3.78	173,650	176,699
9 companies:							
1915	.85	1.18	25.05	26.56	1.51	356,534	357,641
1916	.92	1.17	27.75	28.32	.57	368,845	369,826
1917	1.00	1.16	35.70	38.29	2.59	369,045	368,725
1918	1.21	1.44	49.14	51.11	1.97	370,032	368,060
1919	1.16	2.04	52.09	54.89	2.80	439,741	443,211
14 companies:							
1917	.99	1.23	38.94	41.34	2.40	545,764	544,971
1918	1.15	1.34	52.36	54.09	1.73	596,307	591,069
1919	1.19	1.80	55.24	57.55	2.31	733,757	736,553

[1] Increase.

A study of Table 30 indicates that the years 1913, 1914, and 1915 were normal ones for the companies whose results are combined in the 3-company group. The average cost of materials, which is the chief item, increased slightly, while the average cost of sacks showed a considerable decrease for such a small item. There were very small increases in the other elements of cost and expense as well as in the commercial cost of sales, which advanced only $0.26 per ton. The average sales price per ton increased slightly more than did the commercial cost of sales, which resulted in an increase in the net operating profit per ton from $1.03 for 1913 to $1.42 for 1915. From all appearances these profits are actual trade profits and may be considered as representative results during a normal competitive period.

In 1916 the manufacturers encountered new conditions which they were apparently unable to overcome during the year, and consequently the favorable results obtained during the previous years were not maintained in 1916. Toward the end of the year feedingstuff prices began to increase and reflected moderate advances in the 1916 cost figures over those of 1915. The average cost of materials advanced $1.20 per ton for the 3-company group and $1.81 per ton for the 9-company group, the other elements of cost and expense having increased $0.90 and $0.87 for the groups respectively, the largest individual increase being in the cost of sacks ($0.63 and $0.49). These advances resulted in increases in the total manufacturing cost of over $2 a ton for both the three and nine company groups, as compared with 1915, and accounted for practically all of the increase in the commercial cost of sales, which advanced, from 1915 to 1916, $2.11 per ton for the 3-company group and $2.70 for the 9-company group. The average sales price per ton, however, advanced only $1.48 for the 3-company group and $1.76 for the 9-company group, with the result that the selling price was not sufficient to meet the increased

costs and realize as large profits as those obtained in previous years. The net operating profit per ton for the 3-company group decreased $0.63, or from $1.42 for 1915 to $0.79 for 1916, while for the 9-company group the decrease was slightly greater ($0.94), or from $1.51 for 1915 to $0.57 for 1916.

The increase in prices of raw materials which began in 1916 continued even more rapidly throughout 1917, causing marked increases in the manufacturing costs per ton. The average cost of materials for the 3-company group increased from $25.32 for 1916 to $33.46 for 1917, or $8.14, while the increase for the 9-company group was from $22.24 to $29.34, an increase of $7.10 per ton, or about $1 per ton less. The increases in the two groups from 1916 to 1917 represented 31 per cent of the 1916 cost. The other elements of cost and expense did not increase ($0.93 and $1) proportionally as much as did the cost of materials. The increase in the cost of materials represented about 90 per cent of the increase in the commercial cost of sales, which advanced $9.08 (from $30.34 to $39.42) for the 3-company group and $7.95, or from $27.75 for 1916 to $35.70 for 1917, for the 9-company group. The average sales price advanced $12.54 for the 3-company group and $9.97 for the 9-company group. It will be noted that the increase in the average sales price for 1917 was considerably larger than the increase in the commercial cost of sales, which probably indicates that the manufacturers not only made ample provision for the increases in costs and expenses but also realized additional profit by taking into consideration to some extent the replacement value of raw materials when making their selling prices for this year. Thus the large increases in the net operating profit of $3.46 and $2.02 per ton for the two groups, respectively, over the preceding year, include a certain amount of profit derived from the increase in value of the raw materials during the period of their conversion into mixed feeds. The amount of this profit can not be computed or even estimated with any degree of accuracy.

The prices of feedingstuffs in general continued to advance during 1918. These increases were not as great as in 1917. The average cost of raw materials showed a considerably greater advance in this year than in any other year during the period covered. For the 3-company group the average cost of materials increased $12.18 over 1917, and for the 9 and 14 company groups $10.76 and $10.69, respectively. These advances represented relative increases of from 33 per cent to 37 per cent over the preceding year, nearly 100 per cent over the cost in 1913 for the three companies and over that of 1915 for the nine companies. The costs of sacks and labor also showed the largest annual increase of the period during 1918. The cost of sacks per ton increased $1.71 for the 3-company group, $1.52 for the 9-company group, and $1.82 for the 14-company group. Labor and mill overhead also advanced considerably.

The increase in the cost of materials in 1918 represented about 80 per cent of the increase in the commercial cost of sales. This item advanced $14.68 over 1917 for the 3-company group, $13.44 for the 9-company group, and $13.42 for the 14-company group. The average sales price, however, in 1918 advanced consid-

erably less than the commercial cost of sales, i. e., $12.34 for the 3-company group, $12.82 for the 9-company group, and $12.75 for the 14-company group. This situation was approximately the reverse of 1917, when the advance in sales prices was considerably greater than the advance in the commercial cost of sales. The smaller advance in selling prices than in commercial cost of sales in 1918 was probably due in some measure to the regulations of the Food Administration. As already pointed out (Chap. V, sec. 16), a regulation issued January 28, 1918, provided that licensed manufacturers of mixed feeds should not take more than a reasonable profit in the sale of any feedingstuffs. A regulation issued September 26, 1918, specified maximum margins of profit for mixed-feed manufacturers both on individual sales and on gross sales.[1]

The Food Administration regulations did not go into effect until late in the year. It is probable, therefore, that their effect was considerably less than would have been the case had they applied to the industry during the entire year. The extremely heavy increase in costs in 1918, especially mill costs, together with the effect of the Food Administration regulations, resulted in a heavy decline in the net operating profit per ton in 1918. The profit per ton in 1918 was only $1.91 for the 3 companies, $1.97 for the 9 companies, and $1.73 for the 14 companies, as compared with $4.25, $2.59, and $2.40 per ton for the same groups in 1917.

Prices of feedingstuffs continued to advance throughout 1919, and costs also increased in this year as compared with 1918. Both increases in costs and prices, however, were on the whole much less than in the two preceding years. In 1919 the cost of materials increased only $4.80 per ton for the three-company group over 1918 and about $2.80 for the other two groups. These increases, however, were partially offset by considerable declines in the cost of sacks, which showed decreases of $1.21, 42 cents, and 67 cents for the three groups, respectively. With the exception of selling expense, which increased about 60 cents a ton over 1918, the remaining costs and expenses showed only small increases.

The commercial cost of sales, which in 1919 advanced $4.52 for the 3-company group and about $2.90 for each of the others, represented but a fraction of the increase which occurred in 1918. Average sales prices, however, showed much greater increases than the commercial cost of sales. For the 3-company group they advanced $6.39, for the 9-company group $3.78, and the 14-company group $3.46. The relatively greater increases in sales prices than in the commercial cost of sales resulted in very profitable prices per ton in 1919. The net operating profits of $3.78, $2.80, and $2.31 for the 3, 9, and 14 company groups, respectively, in this year compared favorably with high profits of $4.25, $2.59, and $2.40 for the same groups in 1917.

A short survey of the entire period 1913–1919 indicates that from 1913 to 1915 there was practically no change in either the cost of materials or the commercial cost of sales per ton and but a slight advance in the average sales price, reflecting a nominal increase in

[1] See p. 131, note 48. The price of corn is reported to be one of the chief barometers by which the prices of mixed feeds are gauged. If this is true, the decrease in the price of corn during 1918 may have caused the manufacturers to fix lower sales prices for mixed feeds than would have been the case had the price of corn been higher.

net operating profit. In 1916 moderate increases occurred in all costs and expenses as well as in the average sales price. However, the increase in the commercial cost of sales was relatively greater than the increase in the average sales price, which resulted in a decrease in the net operating profit per ton. In 1917, however, the increase in the average sales price was considerably greater than the advance in the commercial cost of sales, with the result that a much larger net operating profit per ton was shown than in preceding years. In 1918 costs and expenses increased even more than in 1917, but presumably due to the Food Administration regulations the manufacturers were unable to realize a correspondingly higher sales price, and as a consequence profits decreased from the 1917 figures. In 1919 the increases in the cost of materials, commercial cost of sales, and average sale prices were much smaller than in 1917 or 1918, but in the absence of Government regulation the advance in the average sales price was considerably greater than the increase in the commercial cost of sales, and the manufacturers were able to realize net operating profits as large or nearly as large as in 1917.

An analysis of the large profits of 1917 and 1919 for the nine-company group brings out an interesting comparison. Table 32 shows that the increase of 1917 over 1915 in the average cost of materials was 44 per cent, for the commercial cost of sales 43 per cent, and for the average sales price 44 per cent, while the net operating profit for 1917 represented a 72 per cent increase over that of 1915. In this instance the net operating profit showed a considerably larger relative increase than did the average costs or the average sales price. For 1919, however, the reverse was true. The cost of materials for 1919 increased 109 per cent of the 1915 figure, the commercial cost of sales 108 per cent, and the average sales price 107 per cent, while the net operating profit increased but 85 per cent of its 1915 figure.

With few exceptions all costs and expenses increased 100 per cent or more from 1915 to 1919. The cost of materials represented about 83 per cent (actual range 81 per cent to 86 per cent) of the commercial cost of sales.[2]

The commercial cost of sales in turn averaged about 95 per cent (actual range 90 per cent to 98 per cent) of the average sales price and, relatively, the cost of materials represented close to 80 per cent of the average sales price.

The average sales price increased $28.33 per ton from 1915 to 1919. This increase was composed of the following increases: $22.33 in the cost of materials, $4.71 in the other elements of cost and expense combined, and $1.29 in the net operating profit. In this case the increase in the cost of materials represented 79 per cent of the increase in the average sales price and clearly indicates the preponderance of the cost of materials in the high prices of 1919.

Section 4. Investment, profits, and rate of return on investment.

The following table presents the investment, operating profit, and the rate of return on investment for the three groups of companies whose costs are shown in Table 30:

[2] In making this comparison the inventory adjustment has not been considered, as it is very small in each year and its effect on the figures as a whole is slight.

TABLE 31.—*Investment and profit of groups of ready-mixed feed manufacturers, by years, 1913–1919, inclusive.*

	1913	1914	1915	1916	1917	1918	1919
3 companies:							
Investment	$1,142,782	$1,271,915	$1,332,666	$1,465,078	$1,684,978	$2,602,115	$2,410,509
Net sales	$4,800,511	$4,883,424	$4,552,181	$5,707,237	$8,114,887	$9,116,429	$11,025,967
Net operating profit	$170,331	$221,652	$217,937	$145,250	$789,557	$311,116	$669,295
Per cent of net operating profit on net sales	3.55	4.54	4.79	2.54	9.73	3.41	6.07
Investment turnover	4.20	3.84	3.42	3.90	4.82	3.50	4.57
Per cent of profit on investment	14.90	17.43	16.35	9.91	46.86	11.96	27.76
9 companies:							
Investment			$2,353,066	$2,747,447	$3,454,063	$5,446,077	$5,569,445
Net sales			$9,497,388	$10,474,254	$14,119,410	$18,812,301	$24,329,444
Net operating profit			$538,541	$209,150	$957,710	$726,059	$1,242,407
Per cent of net operating profit on net sales			5.67	2.00	6.78	3.86	5.11
Investment turnover			4.04	3.81	4.09	3.45	4.37
Per cent of profit on investment			22.89	7.61	27.73	13.33	22.31
14 companies:							
Investment					$5,008,166	$8,318,810	$8,444,752
Net sales					$22,530,880	$32,132,995	$42,389,819
Net operating profit					$1,308,817	$1,024,363	$1,699,036
Per cent of net operating profit on net sales					5.81	3.19	4.01
Investment turnover					4.50	3.86	5.02
Per cent of profit on investment					26.13	12.31	20.12

An analysis of the individual statements of the various companies whose results are combined in this table indicates in general that the increases in plant and equipment were chiefly taken care of by the reinvestment of earnings. A greater problem was the financing of the materials used in the production of feeds. The purchasing policy of mixed-feed manufacturers evidently has been to accumulate large inventories and enter into long-time contracts for materials at such times as the manufacturer considers the market favorable. The manufacturer in order to finance such purchases has found it necessary to secure large amounts of money on short-time loans.

It will be noted from Table 31 that the investment shown therein was greatly increased during the years 1917, 1918, and 1919. While this increase was due to some extent to an increase in the fixed assets of the company, the larger part of the increase was due to the increase in value of the inventories and an increase in the borrowing necessary to finance them. The decrease in the investment for the three-company group in 1919 was due to a decrease in the amount of borrowings.

Table 31 shows that the amount of net sales also increased greatly in 1917, 1918, and 1919, which was due almost entirely to the increased prices of mixed feeds per ton, as Table 30 shows that with the exception of the 14-company group for 1919 the number of tons sold did not vary appreciably.

The per cent of net operating profit on net sales varied considerably. The lowest rate occurred in 1916 and the highest in 1917. The average rates of profit on sales for the period covered by the

results for the three groups of companies were 5.24 per cent for the 3-company group, 4.78 per cent for the 9-company group, and 4.16 per cent for the 14-company group.

The rate of turnover of the investment was about four times during each year in all groups, with slight variations from year to year.

The rate of return on the investment or the per cent of the net operating profit to the investment fluctuated closely in line with the amount of net operating profit per ton. The table shows that in all years except 1916 the net operating profit was at least sufficient to net a fairly high rate of return on the investment. In 1917 the rate of return was considerably larger than in the other years. The average rate of return for the entire period covered was 20.21 per cent for the seven years of the 3-company group, 18.77 per cent for the five years of the 9-company group, and 18.52 per cent for the three years of the 14-company group, which indicates that as a whole the average profit was such as to yield a high rate of return on the investment. It must be remembered, moreover, that these figures represent the profits on an investment which includes borrowed capital and that the rates of return would be much greater if the earnings on capital stock and surplus only were given.

The high rate of return realized by the nine-company group for 1915 was due to large profits realized by several companies which had comparatively small investments.

Section 5. Comparative results of Quaker Oats Co. with other companies.

Cost and profit figures were obtained from the Quaker Oats Co., but they were not included in the groups in Tables 30 and 31 because (1) No comparable investment data for this company could be obtained, and (2) the operations of the Quaker Oats Co. were so large that if its figures were combined with those of the other companies a disproportionate weight would be given to the operating results of this company in the total.

On account of the possibility of identification it was also thought undesirable to present the cost figures of the Quaker Oats Co. anonymously and separately.

In order to permit some comparison of the operations of this company with those of the other mixed-feed companies, especially with reference to costs, selling price, and net operating profit during the period under examination, Table 32 has been prepared. This table presents the relative increases in costs, expenses, prices, and net operating profit per ton over 1915 for the Quaker Oats Co. and for nine companies combined:

TABLE 32.—*Relative increases in the unit cost per ton of producing and selling ready-mixed feeds for nine companies and for the Quaker Oats Co., by years, 1915–1919, inclusive.*

	1915		1916		1917		1918		1919	
	9-company group.	Quaker Oats Co.	9-company group.	Quaker Oats Co.	9-company group.	Quaker Oats Co.	9-company group.	Quaker Oats Co.	9-company group.	Quaker Oats Co.
Materials	100	100	109	105	144	153	196	178	209	197
Sacks	100	100	137	127	177	182	290	327	259	271
Labor	100	100	121	112	160	170	229	226	240	307
Mill overhead	100	100	130	100	152	130	186	148	181	191
Total manufacturing costs	100	100	111	106	146	155	202	187	212	202
Manufacturing cost of sales	100	100	111	106	146	155	202	187	212	202
General and administrative expenses	100	100	108	114	118	139	142	126	136	172
Selling expense	100	100	99	124	98	122	122	142	173	216
Commercial cost of sales	100	100	111	107	143	153	196	184	208	202
Net sales	100	100	107	104	144	162	192	184	207	197
Net operating profit	100	100	38	78	172	243	130	187	185	150

The net operating profit of the Quaker Oats Co. for 1915 was somewhat higher than that for the nine-company group, which accounts largely for the variation of the relative per cent increases in profit as shown for each year as between the two. However, the trend of the two sets of figures was substantially identical except in 1919. In that year the average sales price for the Quaker Oats Co. increased considerably less than the commercial cost of sales, resulting in a decrease in the net operating profit from that of 1918, while for the nine-company group the net operating profits were larger in 1919 than in 1917.

Chapter VII.

COMPETITIVE CONDITIONS IN THE ANIMAL-FEEDS INDUSTRY.

Section 1. Competition between factory and home-mixed feeds.

Farmers independent of mixed feeds.—From a study of the data secured in the investigation it would appear that the conditions of the feedingstuffs industry are such as to give to the farmers and feeders of the country a position of considerable economic independence with respect to the ready-mixed feeds. Their position as actual and potential producers of feeds and the fact that the market generally carries both the ready-mixed rations and a variety of the straight ingredients from which they may mix their own rations, afford them substantial protection against the possibility of any extended exploitation on the part of the proprietary feed mixers, should such exploitation be attempted either in the form of excessive prices or of offering rations of low feeding value. Generally speaking the farmers and feeders who use the ready-mixed rations do so not of economic necessity but because they prefer to buy such feeds rather than to mix their rations at home. Likewise with respect to the methods by which farmers and feeders may purchase their feeds it appears that while the great majority of them patronize the local retail dealers, they may, and to some extent do, secure their feeds independently of such dealers by making their purchases individually or collectively directly from producers or wholesalers.

The greater part of the feeds that are consumed by live stock does not enter into commerce, but is fed on or near the farms where it is produced. Only a very small percentage of farmers or feeders of the country purchase all their feeds.

The farmers and other users of feeds who must purchase all or a part of their requirements on the market buy them either in the form of a ready-mixed ration or in the form of straight unmixed feeds. Generally when the straight feeds are purchased they are mixed at home in such proportions as will serve the purpose for which they are to be used.

Reasons for this independence.—Both the ready-mixed rations and the unmixed or straight feeds are generally available in the markets at the same time. For two reasons this situation is of economic importance to the feeders who buy commercial feeds. First, with feeds offered in the two forms, the farmer is generally free to choose between a ration of his own mixing and one mixed by the manufacturers. Whether or not the great bulk of the ready-mixed rations represents the maximum of feeding values as compared with home mixtures, and whether or not their cost is less or greater than a home mixture of identical feeding value, purchasers of feeds are, generally speaking, not compelled to buy the ready-mixed feeds. Secondly, this economic position of the farmer tends to establish a competitive

relation between the prices of the ready-mixed rations and those of the straight feeds.

It has been shown that feeds are purchased either mixed or as straight unmixed products. A study of the situation shows that generally there are no distinct or arbitrary influences or circumstances which compel the feeder to adopt one or the other of these methods of feeding. It was noted that while some feeders preferred the ready-mixed products, others in the same community purchased the unmixed or straight feeds and did their own mixing, both groups using the feeds for identical purposes. Moreover, it was found that there were a large number of feeders who at different times purchased their feeds in both forms according to local conditions. Frequently a shortage of labor on the farms influenced the selection of the ready-mixed feeds. Feeders interviewed who use both the ready-mixed and the straight feeds report no consistent difference in the results secured from the two methods.

Other feeders, it was found, who generally preferred to do their own mixing, are at certain times of the year compelled to purchase the ready-mixed products, not being able to procure the particular concentrates which they believe to be necessary ingredients in a ration. However, such conditions do not appear to have been very general or seriously to have prevented home mixing.

Whatever the factors are that influence the feeder to buy the ready-mixed feeds, it is evident that as a general rule he selects his feed in this form because he chooses to do so and not because the straight unmixed feeds are not available. While at times it is difficult to secure certain straight feeds, there are generally available a sufficient number of others of equal feeding value. Among the 25 or more of the most commonly used concentrates it is usually possible for feeders to secure a sufficient variety to constitute a suitable mixture.

Feed-nutrition experts in some of the agricultural colleges have from time to time suggested to farmers a number of formulas for home mixing which in their opinion would give the maximum feeding results at the minimum cost. Lists of the most commonly used concentrates have also been published showing current market quotations and the proportions and cost of the digestible nutrients of each.

Most of the by-products and grain feeds are produced in different sections of the country and are distributed by many different interests. It is not possible that these could be entirely diverted to the manufacturers of mixed feeds or in other ways withheld from feeders, thereby rendering the latter dependent on the ready-mixed rations. Since there are so many different feedingstuffs on the market of similar chemical analysis and feeding value, feeders may substitute one for another and thereby protect themselves against a scarcity of any of these feedingstuffs.

Not only are farmers and other users of feedingstuffs by doing their own mixing enabled to operate independently, in large measure, of the proprietary feed mixers, but generally they have access to a great deal of information and advice furnished by State authorities on the question of home mixing. In practically every State both the feed-control officials and the feed-nutrition experts in the agricultural colleges disseminate a vast amount of information on the proper mix-

ing and balancing of home rations. Frequently feeding formulas are suggested to cover the needs of different classes of feeders.

In many cases the State officials and scientific authorities recommend the use of home mixtures. Such advice is generally based on the theory that most farmers grow, or should grow, a sufficient quantity of roughages and need only to purchase the necessary concentrates to make a balanced ration. Thus, by home production of the roughages and by purchasing concentrates of high protein content, the feeders, it is claimed, should be able to mix a well-balanced ration at a cost below the manufacturers' rations. The following is typical of such advice:

> Even if the "balanced" mixed feeds offered by the dealer are composed of pure, sound feeds it is usually not profitable to buy them. Carbohydrates can be raised more cheaply on the corn-belt farms than any other place in the United States. What the corn-belt feeder lacks is protein, and when he buys any considerable amount of carbohydrates as he does when buying a balanced mixed feed, he buys a nutrient of which he already has an abundant supply in his farm feeds. Also he pays the freight both ways, the elevator man's profit, the commission men's profit, the manufacturer's profit, and the dealer's profit.
>
> So, under ordinary conditions, corn-belt feeders should buy only nitrogenous feeds, should insist on having a standard product, and should ask for the guaranteed analysis of the feed.
>
> Oftentimes there are different grades of the same feeds on the market. Thus one may purchase cottonseed meal containing 20 to 45 per cent of protein, or tankage containing 30 to 60 per cent of protein. Almost invariably it is more economical to purchase the best grades rather than the poorer ones, as it will not be profitable to pay freight on a lot of cottonseed hulls or peat.
>
> In most cases it will pay the farmers to buy the standard feeding stuffs and mix his own rations, as he usually can mix them as cheaply as the manufacturer, besides having the assurance of knowing exactly for what he is paying. (Sleeter Bull, Principles of Feeding Farm Animals, p. 226.)

In addition to the efforts of practically all of the agricultural colleges and experimental stations which are directed toward the education of feeders in the matter of home mixing, some of the cooperative farm organizations advocate and aid home mixing. Several of the cooperative organizations in the East have mixed feed manufactured for them, which they sell to their members.

Reasons for using ready-mixed feeds.—Among the factors most frequently mentioned as influencing the selection of the ready-mixed feeds are: First, avoidance of the labor and trouble of calculating and mixing the home rations; second, a saving of the labor involved in purchasing and handling small lots of several kinds of feeds as compared with a larger quantity of one feed; third, that generally a well-known brand of ready-mixed feed constitutes a better and more scientifically balanced ration than the average feeder has learned to mix at home; and fourth, that the feeds compounded by the manufacturers are better and more thoroughly mixed. Thus, many feeders turn to the use of the various ready-mixed products because they find them more convenient to handle and because they believe such mixtures produce satisfactory results.

It is noted that in many of the communities visited by the Commission's agents, the smaller feeders were more generally inclined to use the ready-mixed rations than to attempt home mixing, believing that such rations could be handled more economically. Such feeders rarely ever made a definite comparison of the costs involved in the two methods. It was also noted that many feeders continued to buy the ready-mixed feeds in communities where the State agricultural

authorities had apparently demonstrated that such feeds could not be fed as economically as home mixtures of equal feeding value.

There is an indication from information secured that there is another class of farmers who are using the ready-mixed rations without regard to comparative costs, because they do not know how to mix a well-balanced ration at home, nor have they availed themselves of the information with regard to home-mixing methods and formulas furnished by the State agricultural colleges and other sources.

Many large feeders were encountered who use the ready-mixed feeds. Various reasons were assigned by them for this, the one most frequently heard being that these feeders could not trust their employees to mix a ration properly. These mixed feeds had also proved satisfactory.

Reasons for home mixing.—While some farmers, for reasons stated above, prefer to use the ready-mixed feeds, other farmers in the same communities who do their own mixing generally give two reasons for so doing. First, they contend that they can purchase the concentrates and compound a satisfactory ration of the same chemical analysis; and second, generally they express a lack of confidence in the proprietary mixed feeds, of which the percentage of ingredients is not known. This lack of confidence is based on the suspicion frequently expressed that many of the ready-mixed rations contain ingredients of very low feeding value. This constitutes one of the most prevalent objections to the use of the ready-mixed products. It also appears that much of this attitude could be overcome were such mixtures sold with open formulas so that the feeders could know the exact proportions of each of the ingredients.

Section 2. Feeders' methods of purchasing feeds.

Introductory.—Commercial feeds both in the form of the ready-mixed rations and straight unmixed products are usually purchased in three ways. A comparatively small number of feeders individually purchase part or all of their supply direct from the manufacturers or wholesalers. Another small proportion secure their feeds through some form of collective buying, while the great majority buy from the local retail feed dealers.

Direct purchases.—In many of the farming communities there are a few feeders who purchase their feeds in carload lots directly from the manufacturers, millers, or other wholesale distributers. Representatives of this class of purchasers stated that by so doing they were able to secure their feeds more economically than from the local dealers. There are certain disadvantages, however, which tend to restrict this sort of buying to the comparatively few feeders who practice it. Most of the feeders in the average farming community lack the storage facilities required to handle carload quantities, or do not require carload lots, and therefore find it most convenient to secure their feeds from the local dealer in such quantities and varieties as they may need. Direct purchases entail a certain amount of time and trouble in the matter of transportation. Shipments are frequently delayed for one reason or another, thus inconveniencing the feeder and interfering with his feeding operations. Another factor militating against direct purchasing is that many farmers can not and others prefer not to pay cash for their feeds, as is required when

making direct purchases from manufacturers. Then, too, manufacturers as a rule do not solicit such business, as it may bring them into disfavor with the retail dealer.

Cooperative buying.—While at present only a small part of the commercial feeds used by feeders is purchased by them through cooperative buying agencies, there are indications that such collective buying is increasing. This sort of purchasing is much more prevalent in some farming communities than in others. In certain communities practically the entire distribution of feeds is handled by cooperative agencies. In most places, however, the dealers receive the patronage of nearly all who purchase commercial feeds.

The services performed by the regular feed dealers are in certain localities largely or partly taken over by cooperative buying organizations, which perform more or less the same services given by the dealers, as when the cooperatives operate feed stores with warehouse facilities and carry a variety of feeds for their members. In other localities cooperative buying is done in such a way as largely to dispense with such facilities, the participating members being required to secure their feed allotments directly from the cars upon arrival of shipments.

Cooperative buying seems to have developed largely around the idea that feeders should be able to secure their supply of feeds more economically through cooperative purchases than through the local dealers, the assumption being that some of the dealers were charging more than a reasonable margin for their services. In other cases cooperative buying has been stimulated because the local dealer failed to render the service required by the community, usually by not furnishing the kinds of feeds demanded. In still other instances cooperative organizations of farmers engaged in general lines of buying and selling, purchase feed for their members, regardless of the efficiency of the local dealers.

The retail dealers.—The local retail feed dealer who handles the great bulk of the commercial feeds usually performs the following services: He provides storage facilities and carries a variety both of the ready-mixed rations and straight feeds; he buys in large quantities and distributes in small lots and usually keeps informed as to changing market conditions, so as to take the utmost advantage of the market; he is sometimes provided with mixing machinery to mix such rations as his customers may desire; he extends credit to his customers and frequently gives advice to feeders regarding properly balanced rations. His functions are much like those of retail dealers who handle other staple lines of farm commodities, such as fertilizer or farm machinery. It is not uncommon to find that commercial feeds are handled locally by merchants engaged in other lines of retailing, such as fuel, farm machinery, and lumber.

Inasmuch as comparatively few feeders are in a position to secure their supply of feeds in carload lots directly from the manufacturers, or care to do so, such services as are usually performed by the local feed dealers are essential to the interests of the feeders and if not performed by the dealers must be rendered by some other agencies. In any case, certain well-defined services are required to meet the needs of the average farming community.

In those cases where the retail feed dealer does not conduct his business in competition with cooperative buying organizations, he is

confronted constantly with the possibility that such collective buying may develop in his field. Likewise the retail dealer also faces the actual or possible competition of individual feeders making their purchases directly from wholesalers. Regardless of the competition that may exist among themselves, the dealers are generally impelled to render the kind of services required by the feeders, and at not too great cost, in order to maintain their position against the actual and potential competition afforded by the two classes of direct purchasing mentioned above.

The extent to which the feeders may, by direct buying, protect themselves against local feed dealers who exact excessive profits, or whose services are inefficient, depends somewhat on whether the channels of the feed trade are open to such direct buying.

Such was not the case in New York State at one time, as is shown by the report of a joint legislative committee, known as the Wicks committee, which in 1916 investigated this and other agricultural conditions in that State. The report of the committee shows that at the time of that investigation the New York Retail Feed Dealers' Association, an organization of local feed dealers, was engaged in a boycotting campaign to obstruct, and did effectively obstruct, the channels of feed distribution in such a way as largely to prevent the retail distribution of feeds except through the regularly established local dealers.

The evidence secured by the joint committee was turned over to the attorney general of the State of New York, whereupon the New York Retail Feed Dealers' Association voluntarily dissolved. (See Sec. 6.)

One of the subjects of constant inquiry in the present investigation was the determination of whether or not there exist at the present time any collusion or concerted activities on the part of the retail and wholesale feed distributers tending to obstruct or prevent feeders from securing their feeds (either the compounded rations or the straight ingredients) directly from the wholesalers. While no evidence was found indicating that practices along this line are now being followed, nevertheless it was noted that there exists among manufacturers and wholesale distributers of commercial feeds a strong tendency to discourage direct sales to feeders and to distribute their feeds through the retail dealers. Although practically all feed manufacturers interviewed stated that they would sell direct to feeders who were financially responsible, it is understood that certain of them will not under any circumstances sell directly to feeders in communities where such manufacturers are represented by local dealers. In many of the cases where manufacturers are called on to make direct sales in communities where they are represented by dealers, they protect such dealers by allowing them a commission, usually of from 25 cents to $1 per ton, on such direct sales.

Section 3. Competition in the animal-feeds industry.

The Commission's investigation of competitive conditions in the manufacture of animal feeds included interviews with manufacturers, jobbers, dealers, and consumers; the examination of the files of associations and individual companies; and the examination of all available secondary sources of information on the subject.

The following sections deal with competitive conditions in the animal-feeds industry as exhibited in the activities of some of its associations which are or were directly conected with the industry; as existing in connection with certain products which are controlled by only a few companies and which are, therefore, practically monopolized and potentially subject to the influences which attend such conditions; with certain customs which are considered undesirable even by the trade itself; and with the subject of unfair practices.

Section 4. The American Feed Manufacturers' Association.

ORGANIZATION, MEMBERSHIP, AND PURPOSES.—The most important association in the commercial feed industry is the American Feed Manufacturers' Association, with headquarters at Chicago. This association, which includes all related lines of business in its active and associate membership, was organized on March 26, 1909, primarily for the purpose of obtaining more uniform State laws regarding animal feeds. Its principal activities, however, have been in support of, or in opposition to, legislation affecting the interests of its members.

Article II of its constitution issued September 12, 1917, sets forth its purposes as follows:

> To assist in the enactment and enforcement of uniform laws and regulations which in their operation shall deal justly with the rights of feedingstuffs manufacturers, dealers and consumers.
>
> By concert of action with each other and with administrative officers of State and Federal laws, either individually or in their organized capacity, [to] endeavor to correct any abuses, dishonest practices, or any evils in any way pertaining to the feedingstuffs industry.
>
> To foster and promote such relations and intimacies between its members as shall tend to firmer business relations in which all can stand together in efforts to improve and perfect a standard of business integrity which shall include honesty of representation, carefulness of obligations, and promptness of execution.

In the spring of 1920 the membership of the association was composed of 197 companies, which included most of the large feed manufacturers.

ATTITUDE TOWARD PRICE AGREEMENTS.—The association has not, apparently, engaged in any considerable price discussion or price arrangements, although certain members have made tentative efforts in this direction. At or immediately following meetings of the executive committee there have been "discussions." It is said that at these meetings frequent charges of selling at too low prices were made and met by countercharges of the same nature, or by admissions or denials, as the case might be. No minutes have been kept of these discussions. They may have tended to advance prices, but there is no method of determining how much effect, if any, they had.

PROPOSED PRICE-FIXING PLAN.—In the early part of 1919, however, an effort was made by members of the association to organize a bureau of grain and feed statistics, a body which seems to have had price fixing as an object, although the organization agreement stipulated that "no part of the machinery of this organization will be permitted to be used to fix prices for the sale of material," and "under no circumstances whatsoever shall information be collected or distributed respecting any price which any member intends or expects to ask." According to one informant who was present at some of the meetings, however, "the idea was to improve prices in a

way that they figured they could legitimately do." Apparently the organization was never completed.

By-product manufacturers and their opponents.—In the American Feed Manufacturers' Association there are two factions, the bickerings of which have at times, indicated more or less lack of harmony among the membership. One faction is composed of manufacturers whose principal business is the production of food for human consumption and who carry on an animal-feed business merely in order to dispose of the by-products of the principal business.

The other faction is composed of manufacturers who oppose the use of these by-products on the ground that they do not have enough feeding value.[1] Such manufacturers hold that they use no such "roughages" and that the mixtures they produce are superior to the feeds produced by the by-product manufacturers. They have, therefore, carried on an active propaganda against the products of the other class of manufacturers, and some have openly favored laws the enactment of which would require manufacturers to state on their feed bags the percentages of so-called low-grade ingredients used in a mixed feed. Hence, for purely competitive reasons, considerable rivalry and disagreement have arisen at times between the two classes of manufacturers in the association.

The St. Louis open-formula resolution.—One of the results of this situation was what is known as the St. Louis resolution, unanimously adopted at the convention of the American Feed Manufacturers' Association, June 5–6, 1919. The resolution reads as follows:

> The American Feed Manufacturers' Association agrees that any form of efficient governmental factory inspection will be welcomed by all honest manufacturers.
>
> The association agrees that no honest feed manufacturer opposes the filing of formulas with State or National feed control officials, when required by law.
>
> The association agrees that if, in the judgment of Congress, the percentage of an ingredient or ingredients in mixed feeds should be stated on the tag or label, then such provision or provisions should require the statement, by percentage, of each and every ingredient in the mixture to the extent of the full 100 per cent, whether or not the feed contains ingredients of so-called low feeding value. Reasonable provision in this event must be made for variation in analyses of constituent ingredients, which variations necessitate slight changes in percentages to maintain the guaranteed chemical analysis.

Despite the lack of harmony between the two factions in the association, they unanimously agreed on the above resolution. It was framed by a committee composed of six members, three of whom represented the by-product manufacturers and three who represented their opponents.

Almost immediately after the resolution had been passed much opposition to it arose among the members, the claim being made that if such a law were passed by Congress it could not be enforced because the percentage of the different ingredients in mixed feeds could not be determined accurately by feed-control officials. (See Chap. IV, sec. 12.) It was also opposed by some manufacturers who did not wish to make public their formulas.

In speaking of the matter to a representative of the Commission, one manufacturer said:

> It was agreed by all that it was as desirable to the feeder to know the percentage of the high-grade materials as to know the percentage of the so-called low-grade materials. The committee realized that it was impossible to enforce a law which required the

[1] See Chap. IV.

percentages of all or a part of the ingredients to be stated. The committee likewise was in doubt as to whether or not such a law would be constitutional. * * * The committee were opposed to such a law, but if we had to have it, because Congress thought so—if we had to state the percentage of any ingredient, then it was fair to all manufacturers, and of more practical value to the feeder, that all materials should be stated and that all manufacturers should be treated alike.

This resolution was not adopted with the idea, nor was it intended to convey the idea, that we were favorable to stating the percentages of all ingredients. We were not; and the association has always stood opposed to stating the percentages of all ingredients, or the percentage of any ingredient. But it was clear in our minds that there was a movement on which, in the final show-down, might result in a law being recommended by the committees in charge at Washington requiring the percentage of some of the ingredients; and the resolution was intended to forcibly put on record the thought that if we had to have a percentage or percentages of anything, then the percentages of all was the right thing to do.

Apparently, then, the resolution was not passed in the belief that such a law would result, or that it could be made effective, nor was there even a general desire to have such a law. Yet the association made capital of it by giving the passage of the resolution much publicity.

Section 5. Other feed manufacturers' associations.

Sweet Feed Manufacturers' Association.—The controversy over low-grade feeds, discussed in Chapter IV, has resulted in the organization of certain independent associations by members of the American Feed Manufacturers' Association who felt that the public interest as well as their own interests would be served by discouraging the use of oat feed and other low-grade by-products. The first of these associations was the Sweet Feed Manufacturers' Association, organized on May 9, 1917. Its activities were limited mainly to an advertising campaign intended to establish the "pilot wheel" as an emblem of mixed feeds of the best quality.

The Pilot Wheel Manufacturers' Association.—In August, 1918, the name of the Sweet Feed Manufacturers' Association was changed to the Pilot Wheel Manufacturers' Association. Stress was laid upon standardizing sweet feeds on a high level and upon the elimination of low-grade by-product feeds. The feeds manufactured by members had to be passed by the association before the feed could bear the pilot wheel emblem. Apparently the standards were too severe, as out of 38 members only 15 secured the right to use the emblem on their horse and mule feeds. Fourteen members resigned and eventually, in the early part of 1919, the association ceased to function.

United Feed Manufacturers of the United States.—Soon after the passing of the Pilot Wheel Manufacturers' Association, a new organization was effected under the title of the United Feed Manufacturers of the United States, this body holding, like its predecessors, that the American Feed Manufacturers' Association leaned too much to the interest of the by-product manufacturers. They maintained that they were competitively at a disadvantage under this domination. The membership included only nine manufacturers, most if not all of whom were also members of the American Feed Manufacturers' Association. Inasmuch as practically all of them have continued as members of the older organization, apparently they have decided that they can better accomplish their purposes by remaining in the older association than on the outside. The United Feed Manufacturers' Association is, therefore, practically inactive.

Section 6. Eastern Federation of Feed Merchants.

This organization followed the New York State Retail Feed Dealers' Association, which on February 8, 1917, was dissolved as the result of an investigation by the New York State Legislature, known as the Wicks investigation, in which it was disclosed that the New York State Retail Feed Dealers' Association, in opposing direct sales by feed manufacturers, had resorted to unfair trade practices, especially boycotting.

The Eastern Federation of Feed Merchants was organized June 22–23, 1917, at Binghamton, N. Y. Its purposes as stated by Section II of the constitution are:

* * * A closer acquaintance and a free interchange of thought; the discussions of various questions of interest in the manufacture and distribution of feeding stuffs, flour and grain in all its various phases; to remedy such misunderstandings among members as may be injurious to their business; to foster and promote greater efficiency and economy among members; to oppose in every legal manner unjust governmental interference with legitimate business; to provide a convenient means whereby members may present their aims and desires and to cooperate with other similar organizations which may be striving to accomplish similar purposes.

The membership of the Eastern Federation of Feed Merchants is largely composed of retailers, wholesalers, traveling men or salesmen connected with such concerns, and of local or county associations of feed merchants. The present organization began with about 75 members, largely recruited from the membership of the old New York State association, but the number of members has increased until it was about 800 in 1920. Besides retail and wholesale companies and their representatives its membership includes the Sussex and Orange Counties (N. J.) Retail Feed Dealers' Association, with a membership of 50; the South Jersey Retail Feed Dealers' Association, with 15 members; and the Mutual Millers and Retail Feed Dealers Association (Pennsylvania), with about 90 members. The Eastern Federation of Feed Merchants is an associate member of the American Feed Manufacturers' Association.

The association is quite active in its opposition to legislation which it believes to be detrimental to the interests of its members, but it seems to confine itself to legitimate methods of opposition.

Like other associations of retailers, the Eastern Federation of Feed Merchants is strongly opposed to direct selling to consumers by manufacturers and wholesalers, and it takes pains to prevent such a practice when it comes within its observation. Its officials maintain, and the results of this investigation seem to bear them out, that they do not in any way interfere with or make threats against offenders. They do present to the manufacturer the "educational argument" that it is not to the best interests of the individual town, the consumer, or the manufacturing concern itself to eliminate the retailer by selling direct to the consumer.

In addition to the Eastern Federation of Feed Merchants there are numerous other smaller associations of retail feed dealers the activities of which, however, are mainly local.

Section 7. Quasi control of by-products.

As already noted, some by-products used in mixed feeds are in large part produced or purchased by a few concerns. A quasi

control is thus exercised over corn gluten feed, a by-product of the manufacture of cornstarch and glucose, by the comparatively few concerns which produce it; over dried beet pulp, by one concern which has contracts for purchasing a large part of the pulp; and over cane blackstrap molasses, produced by practically all cane sugar mills but imported from Cuba and Porto Rico by a few companies. In no case, apparently, is the control of a nature to exclude competitors from the field if they feel that circumstances would justify their making an energetic effort to compete.

CORN GLUTEN FEED.—The production of corn gluten feed in the United States is practically confined to 10 companies. The percentages of total output produced by each of these companies are shown in the following table. The companies are not identified, except No. 10, which is the Corn Products Refining Co.

TABLE 33.—*Percentage production of corn gluten feed by the 10 principal producing companies, 1913–1919, inclusive.*

Company.	Per cent of total.						
	1913	1914	1915	1916	1917	1918	1919
1	2	2	2	2	1	1	1
2	1	1	1	1	1	1	1
3	1	2	2	1	1	1	1
4	2	2	2	2	2	2	2
5	6	8	8	10	9	9	2
6	4	4	4	5	4	4	4
7	3	3	(1)	6	8	7	7
8	6	7	7	7	8	7	9
9	9	10	10	10	10	8	10
Total	34	39	37	44	44	40	37
10	66	61	63	56	56	60	63
Total	100	100	100	100	100	100	100

[1] Less than one-half of 1 per cent.

The table shows the dominant position of the Corn Products Refining Co., its production considerably exceeding the total for the other nine companies in every year. Only two other concerns have produced as much as 10 per cent in any year. On the other hand, the percentage of the Corn Products Refining Co. during the period under consideration did not fall below 56 per cent and in 1919 was 63 per cent. The tonnage of this company increased from 183,000 tons in 1914 to 297,000 tons in 1918 and 280,000 tons in 1919.[2]

Uniformity of prices.—Practically all of the concerns included in Table 33 are members of the American Manufacturers' Association of Products from Corn. There seems to be no connection, however, between this fact and the uniformity of the price of corn gluten feed. An examination of the files of the association and studies of the situation made in the offices of individual manufacturers by repre-

[2] In 1913 a proceeding under the antitrust acts was instituted by the Government against the Corn Products Refining Co., and a decision was rendered in favor of the Government by the District Court of the United States, Southern District of New York. The decree entered on Nov. 13, 1916, provided for a dissolution of the combination. The Corn Products Refining Co. appealed to the United States Supreme Court, but before the matter was reached for argument the appellants abandoned their appeal. Both parties agreed to an amended final decree incorporating some of the provisions of the original one, which was entered on Mar. 31, 1919. The final plan provided for the disposal by Jan. 1, 1921, by the Corn Products Refining Co. of certain of its plants, some of which manufacture corn gluten feed.

sentatives of the Commission revealed nothing indicative of price fixing and other objectionable activities on the part of the association or smaller groups of manufacturers.

The various manufacturers of corn gluten feed frankly explain the situation as being the result of the dominant position which the Corn Products Refining Co. occupies in the industry, saying that they find it necessary to keep their prices in line with those of this leading concern, so much so that immediately upon receiving news of a change in the prices of the Corn Products Refining Co., each of the smaller concerns institutes a similar change in its prices. No evidence was found indicating that this company communicates its price changes to other manufacturers; on the contrary, the smaller concerns say that they receive intelligence of the changes only through brokers and jobbers to whom, of course, the Corn Products Refining Co. communicates the changes instituted.

Speaking of the situation, E. W. Meyers, manager of the feed and oil department of the Clinton Corn Syrup Refining Co., Clinton, Iowa, said to a representative of the Commission that the price made by the Corn Products Refining Co. determined the prices charged by his own concern, and that "the Corn Products Co. holds the umbrella."

So closely does the Piel Bros. Starch Co., Indianapolis, Ind., follow the prices of the Corn Products Refining Co. that when it was requested to furnish prices of corn gluten feed for a period of years it pointed out that if the Commission had secured such data from the Corn Products Refining Co. the compilations would answer for the Piel Bros. Starch Co. The prices of the two concerns were practically the same. The Piel company does not make its price on corn gluten feed as a result of cost studies, but simply follows the prices of the Corn Products Refining Co.

Apparently the substantially identical prices of different manufacturers of corn gluten feed are due not to any well-defined understanding among the producers, but are the result of the dominating position which the Corn Products Refining Co. occupies in the industry. The manufacturers feel that their safest plan is to follow the lead of the dominating concern.

The prices of corn gluten feed throughout the country, regardless of the location of the manufacturer, are based on the Chicago price—that is, the price paid by a purchaser in Milwaukee, for example, for corn gluten feed purchased from the Clinton Corn Syrup Refining Co. is not a given price plus the freight from Clinton, Iowa, to Milwaukee, but the price the Clinton Corn Syrup Refining Co. or the Corn Products Refining Co. charges a Chicago purchaser plus the freight from Chicago to Milwaukee.

A. H. Kersting, vice president and general manager of the Clinton Corn Syrup Refining Co., explained the situation by saying that this price policy is of long standing and is followed in order to protect the buyer; that—

> To avoid discrimination between buyers or users of our products, it is absolutely essential that we have a common basing point. In other words, a price f. o. b. Chicago, upon which the delivered price to any point in the country is based. In other words, our price at Montgomery, Ala., or any point you might state—New York City, San Francisco—is based upon the Chicago price, plus the freight and such other charges as are assessed to all buyers alike. * * * Now, were we to follow a different plan,

what would be the result? It would simply mean that a user of our products in a city like Clinton, where a plant happens to be established, would be getting its goods from us cheaper than a man in the same line would have to pay at Dubuque, Iowa, or San Francisco, or New York. * * * We have always felt that it was absolutely essential for us to protect all buyers in all parts of the country, according to their geographical location. In other words, that they would not be called upon, by virtue of a disadvantageous location, to pay a higher price for their goods than people who might be more advantageously located. * * * We are obliged to do business in every part of the country in order to dispose of our product. Did we do anything else, we might place ourselves in a position where a competitor would enter at times territory which might be called a natural territory—tributary to Clinton, reducing prices to a point where we could not live—and we would have no means of retaliating. In order best to conserve the consumer, the industry has to hold itself in a position to serve all buyers in every part of the country, differing only in differences of price by differentials in freight rates. Did we do anything else, you can plainly see that we would be discriminating against certain classes of buyers. As a matter of fact, we would be cutting other manufacturers' prices, and the amounts involved would be so infinitesimal that it would not cut any ice—it is so ridiculously small.

If, by virtue of our location, we are able to get into certain points at a lower rate of freight and at a lower cost than our competitors, why should we relinquish that advantage?

The use of the Chicago price of the Corn Products Refining Co. as a base price by other concerns is illustrated in the case of the Champion Milling & Grain Co., Lyons, Iowa, a few miles from Clinton, Iowa, where the Clinton Corn Syrup Refining Co., a producer of corn gluten feed, is located. The Champion Milling & Grain Co. reports that whenever it buys from the Clinton concern, despite its proximity to Clinton, Iowa, it has to buy on an f. o. b. Chicago basis—that is, it has to pay the Chicago price plus the freight from Chicago to Clinton.

Another example is that of the Chas. A. Krause Milling Co., Milwaukee, Wis., which says that it pays $1.03 a ton more than Chicago concerns for its corn gluten feed, regardless of the source from which it is purchased. C. G. Rooks, vice president of this company, reports as follows on the situation:

> We can understand this when purchasing from the Corn Products Refining Co., who have to ship from Argo [near Chicago] and therefore have to pay a freight of $1.03. But we don't understand why we should have to pay more than Chicago when purchasing corn gluten feed from Clinton or Cedar Rapids, inasmuch as the freight rate from either place to Milwaukee is the same as the rate from either place to Chicago.

DRIED BEET PULP.—In 1902 the Larrowe Milling Co., Detroit, Mich., contracted for the output of dried beet pulp from two companies which were operating crude drying machines and began to develop a market for the dried pulp. Later it secured the patent rights to a German steam drier and began the manufacture and sale of the machines in America. [3] Since that time the use of dried beet pulp as an animal feed has greatly increased, and at present there are 30 beet-sugar companies in the United States and 1 in Canada operating a total of 50 factories that have driers. The Larrowe Milling Co. has contracts with 24 of these factories for their output of dried pulp. Some of these contracts expire in the campaign[4] of 1920–21, others in the period 1922–1924.

[3] There are at least 10 other concerns in the United States manufacturing beet pulp driers.
[4] The beet-sugar manufacturing season.

The quantity of dried beet pulp sold and used by the Larrowe Milling Co. by campaign years from 1913–14 through December 31, 1919, is given in the table below:

TABLE 34.—*Quantity of dried-beet pulp handled by the Larrowe Milling Co., by seasons, 1913–14 to 1918–19, inclusive, and for part of the season 1919–20.*

Campaign year.	Sold direct.	Used.	Total.	Campaign year.	Sold direct.	Used.	Total.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
1913–14	78,480	8,207	86,687	1917–18	43,158	17,844	61,002
1914–15	63,273	16,529	79,802	1918–19	82,338	30,525	112,863
1915–16	94,272	21,609	115,881	1919–Dec. 31	28,318	6,813	35,131
1916–17	87,827	17,869	105,696				

Figures for the total output of dried beet pulp in the United States and Canada are not available, but undoubtedly the tonnages handled by the Larrowe Milling Co. constitute a very large per cent of the total.

The only other concerns contracting with factories for any appreciable quantities of dried beet pulp are Max Hottlet, broker, of Milwaukee, Wis., and the Ubiko Milling Co., of Cincinnati, Ohio. The former has contracts with the Green Bay Sugar Co., Green Bay, Mich.; Chippewa Sugar Co., Chippewa Falls, Wis.; United States Sugar Co., Madison, Wis.; and the Wisconsin Sugar Co., Menominee Falls, Wis., and the latter with two concerns—Mount Clemens Sugar Co., Mount Clemens, Mich., and the Rock County Sugar Co., Janesville, Wis.

The extent to which the Larrowe Milling Co. controls the dried beet pulp output is illustrated by a statement made by a mixed-feed manufacturer to a representative of the Commission, as follows:

> We have tried to buy it [dried beet pulp] at times but always found it a close proposition. One or two interests seem to have a monopoly on the dried beet pulp in this country—Larrowe Milling Co. and Max Hottlet, broker, in Milwaukee. * * * During the last two years we have sent letters to every producer of sugar beet pulp in the country, asking if they could furnish dried beet pulp. Some replied saying to go to Larrowe; others said they were sold out; others that they would give us an opportunity when the time was ripe.

The reason why the Larrowe Milling Co. has been able to secure the hold upon the dried beet pulp production that it has is due to the active part it took in making this product commercially valuable. Some companies were not willing to risk building driers, and in such cases the Larrowe Company contracted to build them with its own capital, taking its pay therefor in dried beet pulp. Because of its pioneer work in reclaiming a waste product the Larrowe Milling Co. was favored by the sugar companies, and the dominant position now enjoyed by it has resulted.

Although the Larrowe Milling Co. does occupy a dominant position in respect to domestic dried beet pulp, nevertheless it is not without some competition, as is shown by the fact that in 1919 the Larrowe Milling Co. lost contracts for the dried pulp of two sugar companies on account of higher competitive bids. Imports of dried beet pulp from Europe have steadily increased since 1917 and this source may be used by competitors of the Larrowe Milling Co. (See Ch. III, sec. 6.)

The fact that the Larrowe Milling Co. does have considerable control of the dried beet pulp supply has not provoked much complaint. The policy of the company seems to be to sell to regular dealers first, only one jobber being among its regular customers. The company says that it checks up the disposition of the dried pulp made by the retailers to whom it sells, and if it finds that they are selling to jobbers, brokers, or mixed-feed manufacturers, the company warns them that they must discontinue such sales or no pulp will be sold to them.

Here and there, while the field work on this investigation was going on, some complained that the price of dried beet pulp has been too high, due to a monopoly of the product. Others believed that it was merely a situation where a product had naturally fallen into the hands of people who were specialists and did not believe that the Larrowe concern had in any way misused its advantage.

The Larrowe Milling Co. maintains that it endeavors to be fair both to the sugar companies and to the consumer and holds that its price is lower than that of jobbers who sell dried beet pulp. In the cases examined this statement was borne out by figures submitted.

A letter under date of January 3, 1920, from the Larrowe Milling Co. to a customer indicates the policy which the company declares that it maintains in selling dried beet pulp. It reads in part as follows:

> Our policy, however, has always been to maintain a uniform price and not to be tempted by any increased bids. We have always felt that if dried pulp was worth more than we were asking, we should charge the increased price to everybody, and if it was not worth what we were asking, we should reduce the price to everybody, and it is not fair to sell to one person at $55, and ask another one $56, and another one $60.
>
> * * * * * * *
>
> We very much appreciate your having taken the trouble to secure bids for us at prices higher than we are now asking, but upon mature consideration we have decided that we will not depart from our usual policy, as we feel that if your customers are entitled to get any beet pulp at all, they are entitled to get it at the same price as anybody else, or at least with no greater addition to the price than a fair brokerage or commission to yourselves.
>
> * * * * * * *
>
> Now, if you feel that you can trust us with the name of your customer who is to get this pulp, and if we find it is not a party who has already bought direct from us and has had his full allotment, we would be willing to sell you two or three cars, but will sell it to you at the regular price, with the understanding that you will not add more than $1 a ton to the price. If, on the other hand, the party had already had pulp either from us or from some other source and has had more than he is entitled to get, we believe you will agree we would be justified in asking him to be satisfied and let some one else get what they are entitled to.

The basis for deciding the quantity of dried beet pulp to which their various customers were entitled was the quantity such customers had purchased in the past. A letter from the Larrowe Milling Co. to the Commission dated March 1, 1921, states:

> If a dealer who had only purchased two cars in a section during past years inquired of us for three or four cars at one time, we naturally suspected that he did not want this for his usual normal retail business, but was trying to buy some beet pulp to sell to outside points, and in such cases we felt it only proper to decline to make the offer.

According to this letter the Larrowe Milling Co. is no longer—

> making any allotment of beet pulp to various customers, but are selling any reputable dealer that inquires. The supply at the present time is ample for all demands and there is no necessity for restriction.

CANE BLACKSTRAP MOLASSES.—The use of sweet feeds has increased very rapidly in the last 10 or 15 years. This gain in popularity on the part of these feeds has been attended by a corresponding increase in the supply of cane blackstrap molasses, which is an essential material used in their manufacture. Ten to fifteen years ago the available supply of blackstrap amounted to about 500,000 tons annually, but has since increased to over 1,100,000 tons. This has been in the past used more largely in distilling alcohol than in the manufacture of animal feeds. However, in years when other materials for distillation can be bought for less than feed manufacturers are willing to pay for blackstrap, its use in sweet feeds increases.

The importation of Cuban blackstrap has so far been in the hands of the alcohol manufacturers. Prior to 1915 the Cuba Distilling Co., a subsidiary of the United States Industrial Alcohol Co., practically dominated the business of importing Cuban blackstrap molasses. The United States Industrial Alcohol Co. was in its turn a subsidiary of the Distilling Co. of America. In 1915, however, the United States Industrial Alcohol Co.'s stock owned by the Distilling Co. of America was sold to Rockefeller interests.

In March, 1919, the Distillers Securities Corporation, which controlled the Distilling Co. of America, changed its name to the U. S. Food Products Corporation, and announced its intention to begin the manufacture of various foods and feed products. In carrying out this purpose it acquired in the following August the entire capital stock of the Sugar Products Co., importers of molasses, and several other English and Canadian importing companies. It at once began a campaign for a share in the Cuban import business. This campaign has apparently been attended with more or less bitterness because of the resistance offered by the Cuba Distilling Co. It appears, however, that the subsidiaries of the U. S. Food Products Corporation have succeeded in making contracts and acquiring facilities for transportation and storage in Cuba that will enable them to secure a part of the blackstrap available for exportation.

Whether this increase in competition for the supplies of blackstrap obtained from Cuba will result in rendering larger supplies available for manufacturers of feeds in the United States, or in lower prices for such supplies, can not be foreseen.

As a result of the increased demand for alcohol and the higher price of feed grains on account of the war, the price of blackstrap paid by the jobbers who sold to manufacturers of feed, more than doubled from 1915 to 1918. In 1915 they had paid but little over 6 cents a gallon, but in 1918 the price averaged over 15 cents. The following year, with the falling off in war demand, the average price was about 7 or 8 cents per gallon.

This situation was entirely changed, however, in the early months of 1920. An extraordinary export demand for alcohol developed. The exports for January, 1920, are said to have been double those for any prior January. At the same time the demand for sweet feeds greatly increased. Coincident with the development of this increased demand occurred a railroad strike and other transportation difficulties in Cuba. These conditions in connection with the heavy demand for sugar transportation because of the very high

prices of sugar practically halted for a time the transportation of molasses. Closely following the difficulties in land transportation came the loss of three molasses tank ships.

The situation outlined in the preceding paragraph for a time made it practically impossible for the molasses jobbers to fill orders on contracts made with the sweet-feed manufacturers. As a result many of these manufacturers were seriously inconvenienced and some made charges of unfair treatment on the part of the jobbers with whom they had contracts. The prevailing conviction on the part of the feed manufacturers, however, appears to be that the jobbers throughout the period filled requests for shipments on contracts as fast as it was possible for them to obtain supplies. The acute situation in molasses above referred to had practically disappeared by July, 1920.

Section 8. Trade practices.

In the mixed-feed industry there have grown up certain practices which are regarded by some manufacturers as undesirable and which have an important bearing upon competition. Chief among these are the long-time contract and the guaranty against decline.

LONG-TIME CONTRACTS.—Apparently the long-time contract is a result of competition, the seller, in an effort to take a customer from a competitor or to prevent a competitor from taking a customer from him, offering the goods to be delivered at a given price at some time in the future, often 90 to 120 days, payment being made at the time of delivery. Thus a customer is not only secured, but secured for some time.

Among the manufacturers, generally, the long-time contract is not looked upon with favor. At the St. Louis convention of the American Feed Manufacturers' Association, June 5–6, 1919, a resolution was adopted to the effect:

> That it is the opinion of the American Feed Manufacturers' Association that the practice of making contracts for mixed feeds for delivery for a period longer than 60 days from date of contract should be discontinued, and that any member of the Association securing information that any other member of the Association is making such contracts be requested to report such information to the executive committee and that said executive committee endeavor to prevail upon such manufacturers making such contracts to discontinue such practices.

Many members, however, did not conform to the resolution and under date of December 17, 1919, the executive committee advised the secretary to notify all members that the committee would—

> offer no criticism of any manufacturer who feels compelled to book sales of mixed feed for shipment not to exceed 90 days from date of sale.

This form of contract, however, is capable of reacting upon the seller, as is illustrated by the experience of the Corno Mills, St. Louis, Mo. In the past their customers had for a number of years taken only from 30 per cent to 40 per cent of their contracted tonnage. In 1917, however, by the end of the first four months of the year, due to the rapidly advancing market, the purchasers had called for more than 68 per cent of the total tonnage contracted for. The Corno Mills then issued a statement to its customers, pointing out the facts and notifying them that the company could not supply the full ton-

nage demanded by the contracts. One of the paragraphs of the announcement read as follows:

Facts have shown that custom and usage compel the seller to sell a large amount of tonnage in order to receive a reasonable quantity of specifications to operate his mill. We have abided by the law of custom and usage and the spirit of our contract and will continue to do so. Just what percentage of the tonnage contracted for we will be able to deliver, we are, of course, not yet in a position to say, but it will probably be in the neighborhood of 50 per cent of the total amount of tonnage contracted for, which, by comparison with the figures stated above, you will see is greatly in excess of any amount we have heretofore been called upon to deliver.

GUARANTY AGAINST PRICE DECLINE.—Guaranteeing prices against decline is practiced in one form or another by many feed manufacturers. Some guarantee their prices to date of shipment, others for a definite period of time, such as for six months. Other manufacturers adopt the policy of repricing orders in lieu of openly guaranteeing against decline. The price policies of some manufacturers are very elastic, and even where orders have been booked and shipments made the prices have been cut upon the request or the demand of the purchasers.

It is alleged by some that the practice, in so far as the feed business is concerned, originated with the big cereal mills which in early days flooded the country with salesmen who would guarantee customers against decline; that they introduced the practice, as they could better afford to take the risk, since they were selling comparatively unimportant by-products of their mills.

Despite the possibility of the market going against him, the seller, especially a large manufacturer who has a by-product which goes into mixed feeds, assumes this risk for several reasons. The buyer may be obliged to hold the product for some time before he entirely disposes of it. He desires to make a contract, therefore, which insures him against loss, in the event of the market going down in the meantime. Secondly, the demand for feeds is more or less seasonal, and in order to spread his business over the year and create a more nearly constant demand, the seller seeks to encourage buying out of season through the inducement of a price guaranty against decline. Furthermore, the manufacturers claim that the custom tends to insure continuous factory operation and enables the manufacturer to take advantage of the buyer's storage facilities where his own are limited, thus in a manner offsetting expense of the guaranty when prices decline.

There are, on the other hand, objections to this practice, and, as is the case with long-time contracts, many of the feed manufacturers object to the guaranty against decline. The American Feed Manufacturers' Association at its St. Louis convention June 6, 1919, passed a resolution opposing the guaranty against decline, as follows:

That it is the opinion of the American Feed Manufacturers' Association that the practice of selling mixed feeds on long-time contracts embodying a provision guaranteeing price, thereby protecting purchaser against market decline, is incompatible with present-day merchandising standards; that members of this Association are urged to discontinue such practices; that any member of the Association securing information to the effect that any other member of the Association is making such contracts, be requested to report such information to the executive committee of the Association and that said executive committee endeavor to prevail upon such manufacturers making such contracts to discontinue such practices.

The majority of manufacturers visited by representatives of the Commission did not hesitate to condemn the practice of guaranteeing against decline, although most of them resort to it.

The views of a number of feed manufacturers on the subject are given in the following paragraphs. The statements do not purport to be exact quotations but give the substance of the views expressed as found in the reports of the field agents of the Commission.

Speaking of guaranty against decline, H. L. McGeorge, secretary and sales manager of the Royal Feed & Milling Co., Memphis, Tenn., said in substance:

> We condemn the price guaranty absolutely—have nothing in its favor to say—never do it except to hold a good customer. Guaranteeing is principally done by manufacturers of cereals—oatmeal—who manufacture feeds as a side line to absorb their oat hulls. It is possible to recoup the loss by raising the price. We usually add a dollar a ton to sales on which we make a price guaranty. Reducing the quality by using cheaper ingredients has been tried but competition has regulated this.

E. H. Waldrop, president of the Waldrop-Estes Grain Co., Atlanta, Ga., disapproves of the practice:

> It is a very poor practice for both parties. It tempts the dealer to buy larger quantities than he otherwise would and aside from the speculative features, he stores the bought feeds, and they stand too long in storage and deteriorate in quality.

Will A. Hall, sales manager of the International Sugar Feed Co., No. 2, Memphis, Tenn., expressed a similar view:

> We guarantee prices to meet competition, but we would not do this were it not to meet competition. It is objectionable because it is unfair competition—it involves rebates and the controlling of markets. It controls markets through one agency of distribution. For example, suppose I had a customer in a town to whom I gave rebates, price reductions, until his competitors could not sell at a profit on their products he would control that market. We guarantee our prices against decline in the market because our competitors do. The practice is prevalent with the big factors, the big operators, all of the big ones. It is done in the hope to gain the customer's order and good will. The manufacturer is the loser by it. He can not recoup such losses. Recouping can't be done by raising the general level of prices.

H. G. Atwood, president of the American Milling Co., Peoria, Ill., spoke unfavorably of the practice:

> I am absolutely opposed to guaranteeing against decline, because in selling a large tonnage guaranteed against decline, in order that the manufacturer may protect himself he will necessarily have to buy his raw materials to cover his sales. There is no way of having his purchases of raw materials guaranteed; while in selling a large tonnage of manufactured feed, if prices should advance, he is required to fill all his sales; if prices are reduced to a considerable extent, his orders will either be canceled or it will be necessary to reprice them to the basis of the market. For instance, if a manufacturer guarantees against his own decline and the market goes down, the dealer will buy other brands of feed and refuse to take his original contracts. This will mean a heavy loss to the manufacturer, and if he is at all unscrupulous, he will naturally reduce the quality of the feed.

J. A. O'Halloran, general manager of the Champion Milling & Grain Co., Lyons, Iowa, opposed the guaranty against decline:

> I do not think guaranty against decline a good practice, because when you make a price, you undertake to cover. Prices ought to be based as nearly as possible on raw materials. The market may decline so far that all profit is eaten up. Besides, you would be selling the stuff at a loss, because in the event that you cover at high prices for raw materials, that naturally would be the result. When you guarantee against decline, you are not making a definite price. You are taking all the risk and the buyer is taking none.

John B. Edgar, president and general manager of Edgar-Morgan Co., Memphis, Tenn., expressed the hope that the custom of guaran-

teeing against decline would be abolished, also speaking of the custom as follows:

Guaranteeing prices means that you must give yourself a larger margin of profit in order to insure your own profits; you must charge more on all prices to insure the risk you take in guaranteeing, which means that the consumer has to pay more for goods. On an advancing market manufacturers will deliver a cheaper grade of goods because the buyer won't kick, knowing that he can sell, because the goods are in demand. To guarantee prices exaggerates, intensifies this evil.

W. F. Lippert, vice president in charge of sales of the Chas. A. Krause Milling Co., does not guarantee against decline and is opposed to the practice for the following reasons:

We do not guarantee against decline. Perhaps we lose a lot of business by it, but we are willing to lose it. Guaranteeing against decline works only one way and this is a bad rule. It works always in favor of the buyer, because if we buy the raw materials at the time of sale and the market goes down, we don't get any benefit in the decline of the raw material and we lose. If we defer buying the raw material at the time of sale and the price of the raw materials goes up, we don't get any benefit of an advanced price in our finished product and therefore we again lose. The only way a manufacturer can possibly come out even when guaranteeing against decline is not to reduce his own price regardless of changes in the market; or else be a very fortunate gambler; or work on an extraordinary margin in order to cover the increased risk. We do not regard guaranteeing against decline as fair competition.

On the other hand, R. W. Chapin, of Chapin & Co., Chicago, Ill., defends the practice:

When I guarantee against decline, that is my best answer to price cutters. It is my only weapon against price cutting.

Another thing, the only way to get people to buy in the summer time is to give them some assurance; otherwise we would have to shut down our plant and everyone would want feed in September and October and we should be able to run only a few months a year. Before we started to guarantee our prices, we had to get them so low in the spring that we lost large sums of money and some one had to pay for these losses later. Any device that will keep our plants going, even if we only break even, is useful to the community. I can give my employees employment and stabilize prices.

The contract guaranteeing against decline and made on a long-time basis is also offered with the understanding that the purchaser may at any time cancel any portion of the purchase which he deems advisable, an inducement which obviously has an important bearing upon competition and attracts trade to the concern that can make the offer. Having thus the privilege of canceling as much of the contract or order as he wishes, the purchaser is quite likely to overstate his requirements and cancel the overplus before the expiration of the contract. The seller, knowing this, permits him to contract for any quantity he likes, in order to secure the business.

On the whole, apparently the practice of guaranteeing against decline is one which the majority of manufacturers would be glad to abolish, but the competition of certain concerns, which are conveniently situated, results in others also resorting to it.

Overages.—A number of feed manufacturers engage in the practice of charging "overages." A feed dealer who has the exclusive sale of a manufacturer's feeds in a given territory may agree that other dealers in his territory be allowed to handle the same feeds provided he receives a fee or commission on each ton sold to such dealers. In such cases the manufacturer bills the feed to the new dealers at an advance over the price charged the regular dealer and remits to the latter the amount of this overage. This extra charge, or overage, is frequently as high as $1 per ton and at times as much as $2 per ton.

The purpose of the practice, it is alleged, is to protect the regular dealer, who is presumed to have built up a demand for the feed. It also serves to secure another outlet for the manufacturer's product.

The new dealers rarely are aware of the fact that they pay this overage, which is remitted to their competitors. Manufacturers following the practice take care to see that dealers who are charged overages do not receive the regular price lists, but receive instead quotations which include the overage. The question may be raised as to whether or not this is a price discrimination. The Commission has taken steps to determine whether it is in violation of section 2 of the Clayton Act or section 5 of the Federal Trade Commission Act.

PREMIUMS GIVEN WITH MIXED FEEDS.—At least one mixed-feed manufacturer puts a coupon in each bag of his feeds. These coupons are exchanged by this company for various articles, such as milk testers, scales, chinaware, cooking utensils, etc.

Section 9. Other practices.

Misbranding, giving short weight, refilling branded bags with inferior feeds, and adulteration occasionally occur here and there, but not to such an extent that the cases which do arise can be said to pervade the industry or to be the result of combined efforts on the part of manufacturers, jobbers, or dealers.

More or less resort is also had to the use of "alternate brands." That is, a manufacturer may put feeds made from the same formula upon the market under two or three different brand names, the purpose being to win trade by appearing to give exclusive sales of a brand to a certain dealer. In cases where the identity of these brands is kept secret the practice may be undesirable if not pernicious, as a consumer finding that a given brand is not suitable for feeding to his stock may purchase exactly the same feed under a different name from the same or a different dealer and believe that he is getting a different feed. If the facts are clearly known to both dealer and consumer the practice is not serious, as the dealer knows that he is selling the same feed under a different name from that under which a competitor is selling it; and the consumer is not misled into buying it in the belief that he is purchasing a different feed. Unfortunately, the facts are not always made clear and the practice then becomes reprehensible.

Section 10. Summary.

As previously pointed out, there is competition between the ready-mixed and home-mixed feeds. If prices of the ready-mixed feeds become too high as compared with the prices of straight feeds, farmers will tend to do their own mixing to a greater extent than usual. This potential competition serves to keep the prices of ready-mixed and straight feeds in line with each other on the basis of their feed utility. The possibility of home mixing and the wide variety of commodities which may be substituted for any particular feed or ingredient thereof operate in no small degree to prevent unreasonable prices, and probably also prevent attempts on the part of producers of feedingstuffs to organize and combine to obtain price control.

Because of the great variety of the products which are thus used both for home mixing and in ready-mixed feeds artificial control of the feedingstuffs market is probably much more difficult to accomplish than in the case of some commodities. While there are fairly good

substitutes for many commodities, there is perhaps no branch of commerce in which the substitution of various commodities, either in whole or in part, for others, can afford equally satisfactory results. In the case of feedingstuffs it may often be true that the substitute proves equal or superior to a commodity ordinarily employed.

Monopolistic control of the feedstuffs market from the standpoint of prices therefore would require a huge organization with wide ramifications, because not alone one feedstuff or class of feedstuffs must be controlled but also a great many others which might be substituted therefor. Any such organization would clearly be most difficult and probably impossible to effectuate. It also follows, in the absence of such complete control, that combinations of manufacturers in particular lines are perhaps less harmful than in other industries because the possibility of the substitution of other ingredients and feeds for those controlled by the association or combination sets a practical limit to the extent to which prices can be raised by a combination of any single group of feed manufacturers.

Three important by-products of other industries—corn gluten feed, dried beet pulp, and blackstrap molasses—which are of high value to the animal feed industry, are controlled by a few concerns.

In the case of corn gluten feed, while the prices are practically the same or on the same basis for all manufacturers, the situation apparently is not one of prearrangement between the producers, but the result of one concern, the Corn Products Refining Co., dominating the market through producing more than 50 per cent of the output.

Dried beet pulp is largely in the hands of one concern, the Larrowe Milling Co., but it does not produce the commodity, and while it has contracts for the great bulk of the output of the beet sugar factories other concerns are in the market and secure contracts in competition with the dominant company.

In the case of blackstrap molasses, a few large companies import the bulk of the quantity that comes into the United States, but among these concerns there seems to be active competition.

CHAPTER VIII.

THE REGULATION OF THE FEED INDUSTRY.

Section 1. State and Federal laws.

The first law regulating the sale of feedingstuffs was enacted by Connecticut in 1895. Shortly thereafter other States began enacting such laws until it now appears that all except New Mexico have passed statutes which regulate to a greater or less extent the manner in which feedingstuffs shall be sold or offered for sale within their respective States. In some of the States feed laws have only recently been enacted. Forty-one States have laws pertaining specifically to animal feeds. The other six, namely, Arizona, Colorado, Delaware, Idaho, Montana, and Nevada, while not having such specific statutes, may regulate the sale of feedingstuffs under provision of their pure-food laws, which laws are patterned after the Federal Food and Drugs Act of 1906. Only a relatively small quantity of commercial feeds are distributed in these latter States. It can be said, therefore, that in the States where commercial feedingstuffs are used to any great extent specific statutes to regulate their sale have been enacted.

PURPOSE OF FEED LAWS.—While in most of the 41 States the feedingstuff laws vary in many of their provisions, the purposes for which such laws were adopted are generally the same. These purposes are:

(1) To protect the purchaser against adulterated and inferior feedingstuffs.

(2) To give him information with respect to the composition of such feedingstuffs as are offered for sale.

(3) To protect the honest manufacturer and distributor of meritorious feeds against dishonest competition.

FEED LAWS GENERALLY UNIFORM IN ESSENTIAL PROVISIONS.—The important provisions which are found in most of the State feed laws by which it is sought to secure such protection are those requiring:

(1) That every feedingstuff offered or exposed for sale within the State, except certain exempted commodities, such as the whole grains and hays, shall have first been registered by name, brand, or trade-mark.

(2) That such registration shall show the guaranteed chemical composition of the commodity in percentages of protein, fat, and fiber, and the common names of the ingredients.[1]

(3) That the container of, or the tag accompanying each feed, with certain exceptions, shall show plainly the net weight, name, brand, or trade-mark of the commodity, and also the name and address of the manufacturer or person responsible for placing it on the market.

(4) That such container or tag shall also show the minimum per cent of crude protein, the minimum per cent of crude fat, and the maximum per cent of crude fiber, and in some cases the minimum per cent of carbohydrates or nitrogen-free extract of each feeding-

[1] Some States also require the guaranteed chemical analysis to include the total carbohydrates or the nitrogen-free extract.

stuff, and also the specific name of each ingredient used in its manufacture.

(5) Not only must the purchaser be furnished with the above information, but such feed laws, furthermore, prescribe a system for inspecting, sampling, and analyzing feeds sold or offered for sale, by which it may be determined whether or not such feeds conform to their guaranteed composition.

(6) It is also provided in most of these States that the results of such inspections and analyses shall from time to time be made public.

This latter provision is obviously an important one, inasmuch as the names of the brands or commodities and the manufacturers of the same are given in connection with the published results of each analysis, thereby enabling purchasers better to distinguish between superior and inferior feedingstuffs and between reliable and unreliable manufacturers. Such information in itself should react to the advantage of the honest manufacturer and to the disadvantage of those less reliable or honest.

(7) Penalty provisions in most of the State feed laws have been provided for the prosecution of those found guilty of any violation of these statutes.

Prohibition of certain ingredients.—While it may be assumed that the enforcement of the above provisions (requiring that the container or label of a certain feed shall show its percentage content of protein, fat, and fiber, and in some cases carbohydrates or nitrogen-free extract, and also the names of the different ingredients), should afford the purchasers considerable protection against adulterated or injurious feedingstuffs, the statutes of a number of the States provide additional protection in this respect by making it specifically a violation of the law to offer for sale feedingstuffs containing materials considered of little or no feeding value, or materials injurious to the health of animals.

In order to limit, and in some instances to prevent, the sale of certain materials several States have laws which prohibit the use in feeds of certain specified ingredients. Thus, several States prohibit the use of rice hulls in feeds. A number of other States prohibit the use of certain specified low-grade feeds unless the percentages of such low-grade ingredients in the feed are specified or the percentage of each ingredient in the feed is stated on tags or labels. Other variations in such provisions might be cited as, for example, those which limit the percentage of fiber in a feed containing certain specified low-grade ingredients to 9 per cent with a narrow tolerance.

The feedingstuffs laws in a majority of the States do not, however, specifically prohibit the use of any of these or other similar low-grade materials, it being contended that such materials have a place in the economy of feeding and that the purchaser is given sufficient protection when the presence of these ingredients is stated on the container or label of a given feed with the guaranteed percentages of protein, fat, fiber, and sometimes carbohydrates or nitrogen-free extract.

Variations of State feed laws.—In addition to the specific provisions of the law, the feed-control officials, or the agencies to which they are responsible, promulgate rules and regulations deemed necessary to carry into effect the full intent and purpose of feedingstuffs laws. These rules and regulations, as well as some of the

definite provisions of the law, vary in many particulars in the different States. Such variations relate principally to the requirements for tagging, labeling, and registering brands, methods of furnishing inspection samples, and in other ways that prescribe the manner in which the law shall be administered.

Manufacturers and others interested in feed distribution and regulation urge that more uniform provisions among the States would facilitate regulation and promote greater economy in the manufacture and sale of feedingstuffs. Manufacturers of feedingstuffs frequently ship their products into several States. In order to comply fully with all the various registration, labeling, and other regulations governing the sale of such products in these States, they are frequently compelled to prepare and label their shipments in a different manner for different States. This obviously involves extra expense.

Application of Federal Food and Drugs Act to feeds.—In addition to the feedingstuffs laws enacted in all of the principal commercial feed-consuming States, the Federal Food and Drugs Act applies to feeds for animals. With respect to animal feeds this act provides against misrepresentation of ingredients, of chemical constituents, of weight, and against the use of deleterious materials. Enforcement of the act is also provided for and is referred to below.

Section 2. Administration of feed laws.

The execution of feed laws is committed in the different States to various agencies previously created and administering other laws. In the majority of the States having feedingstuffs laws, their execution lies with the board or department of agriculture, or with some division of such board or department, such as the bureau of chemistry or the commissioner of dairies and foods. In many of the States these laws are administered by their agricultural experiment stations.

While the feed laws are administered by various agencies in different States, and there are certain other variations in methods of execution, it is noted that the States quite uniformly employ a staff of inspectors who in a manner prescribed by law or regulation collect samples of feeds sold or offered for sale. Such samples are forwarded to the State laboratories, where they are analyzed by chemists to determine their conformity to the guaranties under which they have been offered for sale.

Federal inspection of feeds.—The Federal Food and Drugs Act is administered by the United States Bureau of Chemistry. The bureau, through its field inspectors, collects samples of feeds in various sections of the United States and sends them to its laboratories, a number of which are located in the larger cities. These samples are then analyzed to determine whether or not they represent feeds that have been misbranded or adulterated. If these inspections or analyses show that feeds are being sold in interstate commerce in violation of the food and drugs act, complaints are brought against the parties responsible and the accused parties are given a hearing under the criminal section of the act. The facts are passed on by the branch laboratory, the head of inspection district, the Bureau of Chemistry expert on feeds, and the chief or assistant chief of the Bureau of Chemistry or both. Many of the complaints result in prosecution.

COOPERATION OF STATE AND FEDERAL INSPECTORS.—An important feature of the enforcement of the Federal Food and Drugs Act is the extent to which the state feed-control officials cooperate with those of the Federal Government in the detection of violations of this Federal law. This cooperation is frequently required by State law. In many instances inspections of certain feeds are simultaneously made by the two agencies and identical samples examined by the State and Federal chemists, and subsequent cases may be prosecuted under both the State and Federal laws. The value of this cooperation is illustrated in the following statement from a recent report made by the feed-control officials of Indiana on the enforcement of the feed laws of that State:

> The cooperation with the United States Department of Agriculture whereby all the inspectors become official inspectors of feeding stuffs in Indiana under the Federal Food and Drugs Act through the appointment of the State chemist as Federal Inspector and Collaborating Chemist, has proven very valuable in the enforcement of the State law since it enables this department to prosecute the original shippers of interstate shipments directly and removes the necessity for prosecuting local dealers in cases where their only fault is lack of information other than the interstate shippers' guarantee.

THE ASSOCIATION OF FEED CONTROL OFFICIALS.—Cooperation between State and Federal feed-control officials in regulating intrastate and interstate commerce in feedingstuffs and in promoting more uniformity of administrative and regulatory methods is facilitated through the Association of Feed Control Officials of the United States. This organization, composed of both State and Federal feed-control authorities, meets each year and discusses the various problems confronting the industry and recommends the adoption and observance of such procedure as will tend to benefit the whole industry and make regulation more uniform and effective. In these respects the public interest has undoubtedly been served through the activities of this association.

Section 3. Results of feed-law enforcement.

INTRODUCTORY.—It is the purpose of this section to discuss the general character of the feedingstuffs that have been marketed in the United States during the past few years, and to indicate so far as is possible from available data the extent to which such feeds have contained substances tending to reduce or injuriously affect their feeding value, and to show the tendency to misbrand feeds or in other ways to violate feed laws. The apparent need for, and the efficiency of, the regulatory laws that have been enacted are also discussed.

State feed laws, as explained above, usually require that the results of such analyses of feedingstuff samples as have been made, shall be published from time to time so as to show a comparison of the percentages of protein, fat, fiber, and sometimes carbohydrates or nitrogen free extract, determined by the analysis of each sample, with its guaranteed percentages, and to give also the names of the ingredient or ingredients identified, together with those certified as being present. Not all States[2] have published the results of their analyses of feeds, nor do all of the States issuing such information publish fully or in the same form the complete results of such analyses.

[2] A notable example is Illinois.

Most of the States, however, have issued in summary form the results of their analyses of feedingstuffs, such tests representing a wide range of inspections. Samples of practically all feedingstuffs sold within these States have been examined and, in some cases, especially where deficiencies have been suspected, several samples have been analyzed. The scope of this service is indicated by the fact that from 500 to 3,000 samples of feeds have been analyzed annually in each of the most important feed-consuming States during the past few years, one State having examined from 5,000 to 8,000 each year.

It is the results of these State analyses that furnish apparently the most comprehensive indication available of the general character and quality of the commercial feeds that have been placed upon the markets of the several States, and which show the nature and indicate the extent of such violations of feedingstuff laws as have occurred.

RESULTS OF REGULATION IN CERTAIN STATES.—Before giving a general review, however, of these past and present aspects of the commercial feed industry, a more detailed summary of the results of feed regulation is provided in the following statements from annual reports of some of the State feed-control officials, and which may be regarded as more or less typical of the general situation reported by most of the States.

Pennsylvania.—The first is from a 1919 Pennsylvania State report:

It may be stated that the character of the feedingstuffs sold in the State during the year, as represented by the samples examined, was good and showed an improvement over the condition prevailing last year, especially with respect to the correctness of the guarantees for protein, fat, and fiber. There were a large proportion of "overages" and a less number of samples representing shipments guaranteed with both minimum and maximum guarantees, which in previous years upon analysis failed to meet the higher guarantees, thus being incorrectly labeled and misleading. Of the total number received 974 samples were found to be labeled with the guaranteed analysis, and of this number 31 were found to be deficient in protein and 100 in fat. There is, however, considerable room for improvement in the case of the mixed feeds, which included 718 samples out of the total number analyzed. Of this number of mixed feeds there were 259, or 36 per cent, of the samples where variations from the compositions claimed were found upon microscopical examinations. These variations were not as a rule of a serious nature and consisted for the most part of the absence of one or more claimed ingredients, the presence of additional ingredients, the substitution of one by-product for another, the presence of small amounts of rice hulls in five samples and of peanut hulls in three other samples. In addition to these discrepancies in composition there were 139 samples which contained as ingredients either oat hulls, clipped oat by-product, oatmeal mill by-product, flax-plant refuse or cottonseed hulls, where the content of crude fiber was found upon analysis to materially exceed 10 per cent, the amount permitted in mixed feeds containing these ingredients. In a few cases excessive amounts of these low-grade feeding materials were used where the excess fiber was found to be from 5 to 12 per cent above the amount permitted. As a result of these variations from the certified analyses and compositions it became necessary during the year to order prosecutions in the case of 5½ per cent of the samples received where serious violations of the law were found.

South Carolina.—The results of the enforcement of the feed law in South Carolina are shown in a 1915 official report of that State, from which the following is taken:

The enforcement of the commercial feedstuffs law has at last become so effective that South Carolina, instead of being a notorious dumping ground for inferior mixed feeds and fake oats, as this territory was a few years ago, is now regarded generally through the country as being one of the best protected States in the Union. At

first the department was confronted with the difficulty of shippers of such products resident in other States hiding under the cloak of interstate commerce. Now the commissioner, under the Federal law, is the collaborating State official, clothed with Federal authority, and this also is true of all inspectors and chemists employed under the State law.

It is not very often necessary to institute proceedings under the United States law, but when it is necessary, in order to cure a situation and put a stop to abuses, it is done without hesitancy, as some manufacturers and shippers have found to their regret.

The character of feeds of all kinds now is much higher than ever before and honest competition has been fully established. This condition has been most cordially welcomed by high-class manufacturers and merchants alike.

* * * * * * *

During the year inspectors have visited 1,839 towns, made inspections of 10,431 stores, drew 1,072 samples of concentrated commercial feedstuffs, 13 samples of corn, 27 samples of grits, 175 samples of corn meal, 23 samples of oats, and 76 samples of flour.

Texas.—Some of the results of the Texas feed law were noted in a 1917 bulletin of that State, as follows:

(1) It has placed the feedingstuff trade on such a basis that mixtures of corn chops, wheat bran, wheat shorts, cotton seed meal, and other products with corn bran, screenings, sweepings, cottonseed hulls and such materials, are now sold for *what they really are* and not as pure corn chops, wheat bran, cottonseed meal, etc.

(2) It has equalized and promoted uniformity in the selling price of feedingstuffs.

(3) It has induced farmers and feeders to investigate the relative values of feedingstuffs, and has thus increased the sale of feedingstuffs of known value.

(4) It has prevented the sale of a number of worthless feedingstuffs.

(5) It has encouraged the manufacturers to maintain a high standard.

(6) It has prevented the shipment into the State of inferior feedingstuffs barred from other States that have feedingstuffs laws.

(7) It has prevented the sale of adulterated feeds as pure products.

Michigan.—A 1919 bulletin published by the Michigan Agricultural Experiment Station discusses the results of the analysis of feeds in that State as follows:

In the following tables are given the results of analyses of 1,530 feeds, 22 of which are not subject to license. Of the 1,508 licensed feeds 97 (6.4 per cent) were below guaranty in protein, 72 (4.8 per cent) were deficient in crude fat, and 126 (8.4 per cent) contained an excess of crude fiber. These figures show a very satisfactory reduction in the number of violations of the feedingstuffs law. There has been a steady decrease each year in the number of feeds that have failed to conform to guaranty as is shown by the following table:

	Year ending July 1—			
	1916	1917	1918	1919
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Deficient in protein	15	11	8.3	6.4
Deficient in crude fat	11.5	8	7.5	4.8
Excess of fiber	9.9	15.1	12.5	8.4

In making these computations the following allowances for variations from guaranty were made: Protein, 1 per cent; fat, 0.5 per cent; and fiber, 1 per cent.

Indiana.—The following statement, taken from a 1919 report of the Indiana feed-control officials,[3] will give some idea of the extent of the work done in enforcing the feed law of that State:

Since July 1, 1907, inspectors have secured 31,647 official samples in the State, 29,687 of which have been analyzed chemically and microscopically, 1,731 microscopically only, and 229 were discarded.

[3] Bulletin No. 228, Commercial Feedingstuffs, Purdue University, Indiana, p. 15.

The following table gives in brief form the results obtained for each year in the same State:

TABLE 35.—*Summary of results of the inspection of feedingstuffs by the Indiana Feed Control Officials, in specified years, 1907–1918.*

	1907[1]	1911	1912	1913	1914	1915	1916	1917	1918
Number of samples secured		2,303	2,433	2,903	3,105	3,775	3,877	3,058	3,252
Number of samples analyzed	1,452	2,035	2,349	2,696	2,943	3,469	3,535	2,893	3,039
Per cent up to guaranty	57.2	75.3	74.0	79.7	82.0	79.4	75.7	68.9	82.8
Per cent below guaranty in fat only	21.7	16.1	17.5	9.4	9.6	9.9	8.1	6.7	3.5
Per cent below guaranty in crude protein only	13.9	7.5	4.8	6.0	6.1	8.3	12.7	9.1	7.9
Per cent below guaranty in both crude fat and crude protein	5.9	2.9	2.4	3.4	2.3	2.4	3.3	2.3	2.2
Per cent misbranded as to presence of inferior ingredients[2]	9.9	3.2	2.7	4.0	3.8	3.8	2.5	12.6	3.4

[1] July 1, 1907, to July 1, 1908. [2] Includes samples examined microscopically.

GENERAL CHARACTER OF FEEDINGSTUFFS.—The results of the administration of the feedingstuff laws as reported by the different States indicate that the great bulk of the feeds that have been placed upon the markets of these States during the past few years have been found to be substantially equivalent to the guaranty under which they have been sold. A detailed study of the summaries of feed analyses issued by the several States shows that while a considerable proportion of the samples analyzed revealed some degree of deficiency, such deficiencies for the most part did not materially reduce the feeding value of the particular commodities involved. The great majority of the deficiencies involved samples found below the minimum guaranty in either protein or fat, or both, or above the maximum guaranty in fiber. On the other hand, it was also noted that a much larger proportion of feed samples analyzed averaged substantially higher than their guaranty in protein and fat, and likewise below in fiber.

A more definite indication of the general extent to which feedingstuff samples comply with their guaranties in this respect is the average of all protein deficiencies and overages computed for five States, namely, Indiana, Kentucky, Michigan, New York, and Pennsylvania for the year 1918. In these States, of the 6,858 samples analyzed including both straight and mixed feed, 1,179, or 17.2 per cent, showed an average protein deficiency of 1.4 per cent, while 5,679 of these samples, or 82.8 per cent, showed an average of 2.1 per cent above their minimum guaranty in protein. In these same States 11.6 per cent of the samples were found to be deficient to the extent of 1 per cent or over in protein, and 88.4 per cent were found to be 1 per cent or more above their minimum guaranty in protein.

A similar study was made of the extent to which the fiber content exceeded the guaranty in representative tests in four of these States, Indiana not having reported such results for the year under consideration. A review of the analyses of 1,825 feed samples showed that 663, or 36.3 per cent of the total number tested, exceeded their maximum fiber guaranty by an average of 1.9 per cent, and were thus deficient in this particular, and 1,162, or 63.7 per cent, showed an average of 2.5 per cent below their maximum guaranty in fiber.

STRAIGHT AND MIXED FEEDS COMPARED.—A similar test of the protein deficiencies and overages was separately made for straight feeds and for mixed feeds. Such calculations showed no consistent difference in the average percentages of deficiencies and overages between the two classes.

There appears to be no great difference between the straight and mixed feeds in the matter of the extent to which they have been misbranded or in other ways have varied from the guaranties under which they have been sold. A number of the States, however, reported finding excessive amounts of cottonseed hulls in the cottonseed meal sold in those States, resulting in this commodity showing an unusually high percentage of samples which were deficient.

It was noted also that of the total of 244 judgments obtained against feed manufacturers by the United States Bureau of Chemistry from June 1, 1914, to December 31, 1919, on account of adulteration and misbranding of feedingstuffs, 137 of such judgments involved adulteration or misbranding of cottonseed meal. Most of these cases were on account of this feedingstuff being misbranded, the actual percentage of protein being found below, or the fiber content above, the guaranty.

VARIATIONS AS TO GUARANTEED INGREDIENTS.—A further study of the published results of the various State analyses of feeds shows that there has been a persistent tendency among feed manufacturers to offer for sale compounds in which one or more ingredients, not designated on the label or tag, have been used in addition to, or as a substitute for, one or more of the ingredients certified as being present.

While these are technically cases of misbranding, it appears that in the majority of such instances the feeding value of the particular feed involved was not reduced thereby. The guaranteed percentages of protein, fat, and fiber were frequently maintained even though the analysis showed some variations in ingredients. The ingredient or ingredients not designated were frequently equal in nutritive value to those for which they were substituted, as when hominy feed was substituted for corn feed meal.

EFFECT OF FEED LAWS.—It appears from a study of the reports of the administration of the State feedingstuff laws, and from all other information found to be applicable, that when and wherever a feedingstuff law has been enacted and enforced in a State there has followed, presumably as a consequence, a substantial improvement in the quality of the feeds offered for sale in that State. Feed-control officials generally are in accord with this conclusion. Previously to or at the time of the enactment of a State law there was placed upon the markets of that State a much larger proportion of inferior, misbranded, or adulterated feedingstuffs than has since been detected. It may be said that in the States that are now enforcing such essential provisions of a feed law as were discussed above there are being found today comparatively few cases where feedingstuffs have been adulterated with substances considered deleterious or as having practically no nutritive value. In States where these laws are enforced such adulteration generally constitutes not over, and frequently less than, 1 per cent of all feed samples analyzed.

Section 4. Legislative activities of the American Feed Manufacturers' Association.

INTRODUCTORY.—As stated elsewhere, the American Feed Manufacturers' Association was organized primarily to foster State and Federal legislation believed to be proper and to oppose laws thought to be inimical to the interests of its members.

Representatives of this association are usually found at State capitals, and also at Washington, whenever legislation affecting the feed industry is being considered. If the proposed bill is not in accord with the manufacturers' wishes, strenuous efforts to defeat it are made and a substitute bill to which the manufacturers subscribe is frequently offered.

KIND OF LEGISLATION FAVORED BY THE ASSOCIATION.—A feed law, known as the Uniform Feed Law, is indorsed by the association. This law is similar to numerous laws already passed by a number of States. It includes provisions for registration of brands and requires the statement of the ingredients and a guaranteed chemical analysis.

It is reasonable to expect the manufacturers to support this or a similar law. It contains the provisions they profess to believe necessary for the protection of both purchasers and the industry. Furthermore, it is highly desirable from the manufacturers' standpoint that the laws of the States be as uniform as possible. At the present time manufacturers must sell in accordance with the many different provisions of State laws. It is claimed by them that this adds to the cost of feeds to the purchaser.

KIND OF LEGISLATION OPPOSED BY THE ASSOCIATION.—In general it may be stated that any law differing markedly from the Uniform Feed Law is usually opposed by the association. Proposals to require the statement of the percentage of ingredients, factory inspection, the tag of distinctive color for feeds containing certain ingredients, and the statement of ingredients in order of their preponderance are opposed by this association.[1]

It is undoubtedly a fact that the activities of the American Feed Manufacturers' Association have resulted in considerable benefit in so far as laws regulating the feed industry are concerned. It is also true that some proposed laws which would be detrimental to public interest have been defeated by their efforts.

The activities of the association and of influential individual members in opposing or influencing feed legislation have at times been of doubtful propriety, to say the least. Thus a feed manufacturer had representatives of his concern see a certain State feed-control official and "play up to his vanity somewhat and show him a good deal of attention, with a view to securing his cooperation in having the legislature at its next session change the existing law." This course was believed to be effective, as this feed-control official some years earlier while connected with another State had, according to this same manufacturer, "helped greatly in adjusting the difficulty in its legislature, and I believe it was purely on personal grounds." In another instance this same manufacturer, at the time hearings were being held on the so-called Gore amendment, instructed one of his assist-

[1] Certain members of the association do not oppose laws of this sort. In fact, a few have advocated them.

ants to have the company's customers at certain towns wire the Member of Congress in whose district these towns were located protesting against the amendment. The manufacturer wrote that he had been advised that this Congressman "needs votes badly and pressure from these towns will be very influential with him just at this time. If you have anybody in any of these towns who can put it up strong you had better have them do it Perhaps you had better work the telephone."

Somewhat similar activities have occurred in the various States, particularly in New York, where the association, as well as many individual manufacturers, have been particularly active on legislative matters.

APPENDIXES.

Appendix 1.

EXPLANATION OF CHEMICAL TERMS.

The following definitions and statements are extracted from Bulletin 251 of the Texas Agricultural Experiment Station, published September, 1919.

Protein, being the constituent of food which forms flesh, muscle, hair, ligament, and other portions of the animal body, is of great importance. It replaces the wear and tear of the animal tissue and furnishes material for additional flesh. Besides furnishing material for tissue, protein may be burned in the body to produce heat or it may serve as a source of fat in case of a deficiency in carbohydrates and fat accompanied by excess of protein. It is, however, a costly source of heat and fat.

Value of protein.—Protein is the most expensive portion of a feedingstuff, and feedingstuffs rich in protein usually sell for a higher price than feedingstuffs low in protein. With a given feedingstuff, the more protein it contains the better its quality, compared with other feedingstuffs of the same class. For example, cottonseed meal containing 48 per cent protein is of better quality than cottonseed meal containing 45 per cent protein. A low protein content accompanied by a high content of crude fiber indicates that the cottonseed meal contains an excessive amount of hulls.

The value of feedingstuffs of different kinds can not be compared on a protein basis alone. For example, a cottonseed meal containing 45 per cent of protein does not have five times the value of corn chops containing 9 per cent protein. There are other constituents of both feedingstuffs (fat and nitrogen-free extract), which are of value to the animal, and corn chops contain much more nitrogen-free extract than cottonseed meal. The digestibility of the constituents is also of importance.

Fat (or *ether extract*) is composed mainly of fats and oils in the case of concentrated commercial feedingstuffs, but with fodders and hays it is often composed to a considerable extent of waxes, coloring matter, and other substances. Fat is used in the animal body as a source of body fat and to furnish heat and energy. The animal requires heat to keep its body warm and energy to run the animal mechanism, or to do the outside work. The beating of the heart, chewing, movements of the intestines, and the involuntary muscular movements require energy which is furnished by the oxidation of fats, carbohydrates, or protein. One pound of fat is equal to 2.25 pounds of carbohydrates.

Value of fat.—Fat ranks next to protein in value as a feeding constituent. The more protein and fat a given feedingstuff contains the better its quality compared with other feedingstuffs of the same class. Cottonseed meal containing 55 per cent of protein and fat combined is of higher value than cottonseed meal containing 49 per cent of protein and fat combined. Cottonseed meal is indeed often sold on the basis of its protein and fat content, as determined by chemical analysis.

As with protein alone, however, two feeds of different kinds can not be compared on the basis of their content of protein and fat, since other factors enter into consideration.

Crude fiber is the proportion of the plant which resists the intense action of acids and alkalies. It consists mostly of the cell walls and woody fiber of the plant, and is the most indigestible part of the feedingstuff. By means of fermentation in the intestines, crude fiber is digested to some extent by animals which chew the cud. The operation, however, consumes so much energy that a large proportion of the value of the crude fiber is taken up by the process of digestion. Hays and fodders and other roughage generally contain much crude fiber, but concentrated feedingstuffs contain comparatively small quantities of it.

Value of crude fiber.—Crude fiber is the woody and less digestible portion of a feedingstuff. The more crude fiber a feedingstuff contains the poorer its quality compared with other feedingstuffs of the same class. Feeding materials of low commercial value and of low value to the animal, such as straw, cottonseed hulls, rice hulls,

oat hulls, corncobs, etc., contain large quantities of crude fiber, and their addition to a concentrated feedingstuff increases its content of crude fiber. Thus, if the crude fiber in cottonseed meal exceeds certain limits, it indicates that the meal is adulterated with cottonseed hulls. In a similar way, crude fiber in excess of a given maximum indicates corncobs or corn bran in corn chops; rice hulls in rice bran, and so on. The amount of crude fiber is a much more sensitive indication of the low quality or of adulteration than the protein and fat, since the adulterants generally contain large percentages of crude fiber.

To repeat, the more crude fiber a feedingstuff contains the poorer its quality compared with other feedingstuffs of the same class. This also holds good in comparing feedingstuffs of different kinds, but not entirely; we must also consider the protein and fat content of the two kinds of feedingstuffs. Thus, wheat bran contains considerably more crude fiber than corn chops, but has a higher value when protein is worth more than fat and nitrogen-free extract.

Ash is the residue left when the plant is burned. It represents mostly the mineral portion of the plant and the portion which comes from the soil, although a part of the ingredients withdrawn from the soil are volatilized during combustion. Nitrogen particularly is driven out completely. Ash is valuable to the animal, inasmuch as it furnishes material for bone, and some constituents of it, particularly the phosphoric acid and sulphur, are essential constituents of the animal cell.

Value of ash.—Ash is necessarily present in feedingstuffs. An excessive amount indicates contamination with dirt, sand, or other mineral matter. Too little ash in the ration may give rise to disorders, especially in young animals.

Nitrogen-free extract [N. F. E.] is composed of starch, sugar, dextrin, and other substances of a similar nature. These substances are mostly carbohydrates; that is, they contain carbon and hydrogen and oxygen in proportion to form water. Crude fiber is also composed largely of carbohydrates.

Value of nitrogen-free extract.—The nitrogen-free extract of most concentrated commercial feedingstuffs, such as corn chops, wheat bran, cottonseed meal, Kafir, etc., is composed largely of sugars and starches which are readily digested and have considerable value to the animal.

The nitrogen-free extract of wheat skins, corn bran, corn cobs, rice hulls, hays and straws, and similar feedingstuffs, is composed mostly of other substances than sugar and starch, and has a lower value to animals. The nitrogen-free extract of these two kinds of feedingstuffs, therefore, can not be compared directly.

In general, we may say that the more protein, fat, and nitrogen-free extract and the less crude fiber and ash a given feed contains, compared with other feedingstuffs of the same kind, the better the quality.

The same statement also holds in comparing feedingstuffs of different kinds, but not altogether, since in comparing feedingstuffs of different kinds we must also consider the digestibility and the productive value of the digested materials.

Carbohydrates is a collective term applied to crude fiber and nitrogen-free extract.

APPENDIX 2.

DEFINITIONS OF FEEDINGSTUFFS.

[Adopted by the Association of Feed Control Officials of the United States.]

Meal is the clean, sound, ground product of the entire grain, cereal, or seed which it purports to represent.

Chop is a ground or chopped feed composed of one or more different cereals or by-products thereof. If it bears a name descriptive of the kind of cereals, it must be made exclusively of the entire grains of those cereals.

Alfalfa meal is the entire alfalfa hay ground, and does not contain an admixture of ground alfalfa straw or other foreign materials.

ANIMAL PRODUCTS.

Blood meal is ground dried blood.

Cracklings are the residue after partially extracting the fats and oils from the animal tissues. If they bear a name descriptive of their kind, composition, or origin, they must correspond thereto.

Digester tankage is the residue from animal tissues, exclusive of hoof and horn, specially prepared for feeding purposes by tanking under live steam, drying under

high heat, and suitable grinding. If it contains more than 10 per cent of phosphoric acid (P_2O_5) it must be designated digester meat and bone tankage.

Meat scrap and meat meal are the ground residues from animal tissues exclusive of hoof and horn. If they contain more than 10 per cent of phosphoric acid (P_2O_5) they must be designated meat and bone scrap and meat and bone meal. If they bear a name descriptive of their kind, composition, or origin, they must correspond thereto.

Barley Products.

Barley hulls are the outer chaffy coverings of the barley grain.

Barley feed is the entire by-product resulting from the manufacture of pearl barley from clean barley.

Barley-mixed feed is the entire offal from the milling of barley flour from clean barley and is composed of barley hulls and barley middlings.

Brewers' and Distillers' Products.

Brewers' dried grains are the properly dried residue from cereals obtained in the manufacture of beer.

Distillers' dried grains are the dried residue from cereals obtained in the manufacture of alcohol and distilled liquors. The product shall bear the designation indicating the cereal predominating.

Distillers' corn solubles, a by-product from the manufacture of alcohol from corn, is a mash liquor concentrated after the removal of the alcohol and wet grains.

Distillers' corn and rye solubles, a by-product from the manufacture of alcohol from corn and rye, is a mash liquor concentrated after the removal of the alcohol and wet grains.

Distillers' rye solubles, a by-product from the manufacture of alcohol from rye, is a mash liquor concentrated after the removal of the alcohol and wet grains.

Malt sprouts are the sprouts of the barley grain. If the sprouts are derived from any other malted cereal, the source must be designated.

Buckwheat Products.

Buckwheat shorts or buckwheat middlings are that portion of the buckwheat grain immediately inside of the hull after separation from the flour.

Corn Products.

Corn bran is the outer coating of the corn kernel.

Corn feed meal is the by-product obtained in the manufacture of cracked corn, with or without aspiration products added to the siftings, and is also the by-product obtained in the manufacture of table meal from the whole grain by the non-degerminating process.

Corn germ meal is a product in the manufacture of starch, glucose, and other corn products, and is the germ layer from which part of the corn oil has been extracted.

Grits are the hard, flinty portions of Indian corn, without hulls and germs.

Corn gluten meal is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ, and the bran by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Corn gluten feed is that portion of commercial shelled corn that remains after the separation of the larger part of the starch and the germs by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Hominy feed, hominy meal, or hominy chop is the kiln-dried mixture of the mill-run bran coating, the mill-run germ, with or without a partial extraction of the oil and a part of the starchy portion of the white corn kernel obtained in the manufacture of hominy, hominy grits, and corn meal by the degerminating process.

Yellow hominy feed, yellow hominy meal, or yellow hominy chop is a kiln-dried mixture of the mill-run bran coating, the mill-run germ, with or without a partial extraction of the oil and a part of the starchy portion of the yellow corn kernel obtained in the manufacture of yellow hominy grits and yellow corn meal by the degerminating process.

Oil Cake.

Oil cake is the residual cake obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone

the term "oil cake" shall be understood to designate the product obtained from partially extracted, screened, and cleaned flaxseed. When used to cover any other product, the name of the seed from which it is obtained shall be prefixed to "oil-cake."

Ground oil cake is the product obtained by grinding oil cake. When used alone, the term "ground oil cake" shall be understood to designate the product obtained from partially extracted, screened, and cleaned flaxseed. When used to cover any other product, the name of the seed from which it is obtained shall be prefixed to "ground oil cake."

Cottonseed Products.

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil; provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein.

Choice cottonseed meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least 41 per cent of protein.

Prime cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least 38.6 per cent of protein.

Good cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and must contain at least 36 per cent of protein.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold pressed cottonseed is the product resulting from subjecting the whole undecorticated cottonseed to the cold pressure process for the extraction of oil, and includes the entire cottonseed less the oil extracted.

Ground cold pressed cottonseed is the ground product resulting from subjecting the whole undecorticated cottonseed to the cold pressure process for the extraction of oil, and includes the entire ground cottonseed less the oil extracted.

Linseed and Flax Products.

Linseed meal is the ground product obtained after extraction of part of the oil from ground flaxseed screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over 6 per cent of weed seeds and other foreign materials and provided further that no portion of the stated 6 per cent of weed seeds and other foreign materials shall be deliberately added.

Oil meal is the ground product obtained after the extraction of part of the oil by crushing, cooking, and hydraulic pressure, or by crushing, heating, and the use of solvents from seeds, which have been screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "oil meal" shall be understood to designate linseed meal as defined. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to the words "oil meal."

Old process oil meal is the ground product obtained after extraction of part of the oil by crushing, cooking, and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "old process oil meal" shall be understood to designate linseed meal as defined, made by the old process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "old process oil meal."

New process oil meal is the ground product obtained after extraction of part of the oil by crushing, heating, and the use of solvents from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "new process oil meal" shall be understood to designate linseed meal as defined, made by the new process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "new process oil meal."

Flax plant by-product is that portion of the flax plant remaining after the separation of the seed, the bast fiber and a portion of the shives, and consists of flax shives, flax pods, broken and immature flax seeds, and the cortical tissues of the stem.

Ground flaxseed or flaxseed meal is the product obtained by grinding flaxseed which has been screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over 4 per cent of weed seeds and other foreign materials, and provided further that

no portion of the stated 4 per cent of weed seeds and other foreign materials shall be deliberately added.

Unscreened flaxseed oil feed is the ground product obtained after extraction of part of the oil from unscreened flaxseed by crushing, cooking, and hydraulic pressure, or by crushing, heating, and the use of solvents. When sold without grinding the unground product shall be designated as "unscreened flaxseed oil feed cake."

Ingredients of unscreened flaxseed oil feed.—Ground cake from partially extracted flaxseed and foreign seeds (wheat, wild buckwheat, pigeon grass, wild mustard, etc.).

Screenings oil feed is the ground product obtained after extraction of part of the oil by crushing, cooking, and hydraulic pressure, or by crushing, heating, and the use of solvents, from the smaller imperfect grains, weed seeds, and other foreign materials, having feeding value, separated in cleaning the grain. The name of the grain from which the screenings are separated shall be prefixed to "screenings oil feed."

Oat Products.

Oat groats are the kernels of the oat berry.

Oat hulls are the outer chaffy coverings of the oat grain.

Oat middlings are the floury portions of the oat groat obtained in the milling of rolled oats.

Oat shorts are the covering of the oat grain lying immediately inside the hull, being a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats.

Clipped oat by-product is the resultant by-product obtained in the manufacture of clipped oats. It may contain light chaffy material broken from the ends of the hulls, empty hulls, light, immature oats and dust. It must not contain an excessive amount of oat hulls.

Peanut Products.

Peanut-oil cake is the residue after the extraction of part of the oil by pressure or solvents from peanut kernels.

Peanut-oil meal is the ground residue after the extraction of part of the oil from peanut kernels.

Unhulled peanut oil feed is the ground residue obtained after extraction of part of the oil from whole peanuts, and the ingredients shall be designated as peanut meal and hulls.

Rice Products.

Rice bran is the cuticle beneath the hull.

Rice hulls are the outer chaffy coverings of the rice grain.

Rice polish is the finely powdered material obtained in polishing the kernel.

Rye Products.

Rye middlings or rye feed consists of the products other than the flour obtained in the manufacture of the ordinary "100 per cent" rye flour from the rye grain which has been cleaned and scoured.

Rye 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."

Velvet Bean Products.

Velvet-bean meal is ground velvet beans containing only an unavoidable trace of hulls or pods.

Ground velvet bean and pod is the product derived by grinding velvet beans "in the pod." It contains no additional pods or other materials.

Wheat Products.

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, germ, and 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 ob-

tained from the "tail of the mill." This product must be obtained in the usual process of commercial milling.

Flour middlings shall consist 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 the germ and 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 feed) 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 millings.

Wheat bran and standard middlings consist of the two commodities as defined above, mixed in the porportions 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 other materials as are separated from the grain in the usual commercial process of scouring.

(*Note*) If to any of the wheat or rye by-product feeds there should be added screenings or scourings, as above 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 the same size and face of type 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."

Miscellaneous Products.

Dried beet pulp is the material obtained by drying the residue from sugar beets which have been cleaned and freed from crowns, leaves, and sand, and which have been extracted in the process of manufacturing sugar.

Coconut oil meal ("copra oil meal") is the ground residue from the extraction of part of the oil from the dried meat of the coconut.

Ivory nut meal is ground ivory nuts.

Palm kernel oil meal is the ground residue from the extraction of part of the oil by pressure or solvents from the kernel of the fruit of *Elaeis guineensis* or *Elaeis melanococca*.

Yeast or vinegar dried grains are the properly dried residue from the mixture of cereals, malt, and malt sprouts (sometimes cottonseed meal) obtained in the manufacture of yeast or vinegar, and consists of corn or corn and rye from which most of the starch has been extracted, together with malt added during the manufacturing process to change the starch to sugars, and malt sprouts (sometimes cottonseed meal) added during the manufacturing process to aid in filtering the residue from the wort and serve as a source of food supply for the yeast.

TENTATIVE DEFINITIONS.

41.12 per cent protein cottonseed meal, choice quality, must be finely ground, not necessarily bolted, perfectly sound, and sweet in odor; yellow, free from excess of lint, and by analysis must contain at least 41.12 per cent crude protein, equivalent to 8 per cent of ammonia.[1]

Cottonseed meal not fulfilling the above requirements as to color, odor, or texture, shall be branded "Off quality."

38.56 per cent protein cottonseed meal, prime quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and by analysis must contain at least 38.56 per cent crude protein, equivalent to 7½ per cent of ammonia.[1]

Cottonseed meal not fulfilling the above requirements as to color, odor, or texture, shall be branded "Off quality."

36 per cent protein cottonseed meal, good quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and by analysis must contain at least 36 per cent crude protein, equivalent to 7 per cent of ammonia.[1]

Cottonseed meal not fulfilling the above requirements as to color, odor, or texture, shall be branded "Off quality."

[1] Adopted tentatively, final action to be taken at the next annual meeting.

Fish meal shall be the dried, ground tissues of fish made from undecomposed fish, with or without the extraction of part of the oil.[2]

Fish residue meal shall be the clean undecomposed residue from the manufacture of glue or other fishery products and to be from nonoily fish.[2]

Maltose process corn gluten feed is the dried residue from degermed corn, after removal of starch in the manufacture of malt sirup.[2]

Ground barley is the entire product obtained by grinding clean, sound barley, containing not less than 90 per cent pure barley and not more than 10 per cent of other grains, weed seeds, and other foreign material and not more than 6 per cent fiber: *Provided*, That no portion of this stated 10 per cent of other grains, weed seeds, or foreign material shall be deliberately added.[2]

Mixed feed barley is the entire product obtained by grinding country run barley containing not less than 75 per cent pure barley and not more than 25 per cent of other grains, weed seeds, and other foreign material: *Provided*, That no portion of this stated 25 per cent of other grains, weed seeds or foreign material shall be deliberately added. The ingredients must be stated as barley, other grains, weed seeds, and other foreign material.[2]

Rice bran is the pericarp or bran layer of the rice grain, with only such quantity of hull fragments as is unavoidable in the regular milling of rice.[2]

Chopped alfalfa is the entire alfalfa hay, chopped, and not ground finely enough to become a meal. It must not contain an admixture of alfalfa straw or other foreign material.[2]

Ear corn chops is corn and cob, chopped, without the husk, with not a greater proportion of cob than occurs in the ear corn in its natural state.[2]

Head chops consists of the entire head of the grain sorghums, chopped, and should bear the name of the sorghum from which it is made. This includes, among others, kafir head chops, milo head chops, feterita head chops, and sorghum head chops.[2]

Head stems consists of the head of the grain sorghums, from which the grain has been removed, and should bear the name of the sorghum from which it is made.[2]

[2] Adopted tentatively, final action to be taken at the next annual meeting.

APPENDIX TABLES.

TABLE 1.—*Index numbers of wholesale prices of groups of 10 straight feeds, 12 commercial mixed feeds, farm products, and all commodities, by months, January, 1913, to June, 1920, inclusive.*[1]

Month.	1913				1914			
	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.
January	96	94	97	100	107	106	101	100
February	95	94	97	100	108	104	102	99
March	91	94	99	99	108	104	103	99
April	91	94	97	98	108	107	103	98
May	93	95	98	98	107	106	104	98
June	96	96	99	100	108	106	104	99
July	95	99	101	100	105	103	104	100
August	107	103	101	101	112	110	109	103
September	114	108	104	102	112	115	108	104
October	108	108	103	101	107	109	103	99
November	107	108	101	101	108	107	101	98
December	108	106	101	99	108	105	99	98
Year	100	100	100	100	108	107	103	100

Month.	1915				1916			
	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.
January	116	110	102	99	114	109	108	110
February	121	115	105	101	116	111	109	112
March	116	112	105	99	111	110	111	114
April	116	112	107	100	110	110	114	117
May	114	113	109	101	108	110	116	118
June	114	112	105	99	106	109	116	119
July	118	111	108	101	108	110	118	119
August	120	112	107	100	114	118	126	123
September	111	108	103	99	120	123	131	128
October	107	104	105	101	130	125	136	134
November	107	103	102	103	147	140	146	144
December	111	105	103	106	145	139	142	146
Year	113	109	105	101	120	118	122	124

Month.	1917				1918			
	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.
January	151	143	148	151	223	215	207	185
February	153	150	151	156	236	222	208	186
March	163	156	163	161	232	230	212	187
April	185	177	181	172	221	225	217	190
May	194	191	197	182	206	219	214	190
June	188	187	197	185	194	210	217	193
July	195	198	199	186	192	215	224	198
August	204	217	205	185	200	219	230	202
September	202	209	204	183	207	220	237	207
October	204	207	208	181	202	213	224	204
November	213	209	212	183	202	209	221	206
December	221	213	205	182	211	213	222	206
Year	188	187	189	176	210	218	220	196

[1] The index numbers are, respectively, averages of the relative prices of 10 straight feeds, 12 commercial mixed feeds, the farm products group, and all commodities (see pp. 105, 106, and 108). The figures for farm products and all commodities are those published by the Bureau of Labor Statistics of the Department of Labor. The index numbers for the two groups of feeds are unweighted; those of the Bureau of Labor are weighted, as explained on p. 106.

TABLE 1.—*Index numbers of wholesale prices of groups of 10 straight feeds, 12 commercial mixed feeds, farm products, and all commodities, by months, January, 1913, to June, 1920, inclusive*—Continued.

Month.	1919				1920			
	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.	10 straight feeds.	12 mixed feeds.	Farm products group.	All commodities.
January	221	215	222	203	236	229	246	248
February	210	204	218	197	254	229	237	249
March	219	204	228	201	262	235	239	253
April	230	213	235	203	267	244	246	265
May	235	218	240	207	285	264	244	272
June	233	221	231	207	280	265	243	269
July	250	231	246	218				
August	268	243	243	226				
September	247	230	226	220				
October	230	218	230	223				
November	238	220	240	230				
December	247	225	244	238				
Year	236	220	234	212	[2] 268	[2] 244	[2] 243	[2] 259

[2] Average, January–June.

TABLE 2.—*Average prices of mill feeds, sacked, f. o. b. Minneapolis, by months, January, 1913, to June, 1920, inclusive.*[1]

Month.	Bran.	Standard middlings.	Mixed feed.[2]	Flour middlings.	Red dog.	Rye middlings.[2]
1913.						
January	$19.59	$19.66	.....	$22.50	$24.19	.....
February	18.56	18.94	.....	22.38	24.00	.....
March	17.13	17.25	.....	21.81	23.38	.....
April	16.35	16.70	.....	20.75	22.80	.....
May	16.63	17.00	.....	19.63	23.44	.....
June	17.00	18.81	.....	21.31	24.25	.....
July	16.90	18.80	.....	21.65	24.20	.....
August	19.94	21.25	.....	23.25	25.69	.....
September	21.25	23.13	.....	25.38	27.00	.....
October	19.90	22.35	.....	24.90	26.20	.....
November	20.06	21.63	.....	24.25	25.00	.....
December	20.25	20.70	.....	23.00	24.50	.....
Year	18.63	19.68	.....	22.57	24.55	.....
1914.						
January	21.17	21.17	$22.67	24.17	25.42	$21.17
February	22.17	22.00	23.50	25.00	26.25	22.00
March	23.58	22.50	24.33	25.17	26.42	22.33
April	23.67	23.67	24.83	25.67	26.92	22.83
May	22.00	22.00	24.00	25.00	26.25	22.00
June	20.67	21.83	23.50	25.00	26.25	21.50
July	18.17	21.00	22.17	25.00	26.25	21.00
August	21.50	24.00	25.00	27.50	28.75	23.50
September	21.67	23.00	24.67	27.67	29.92	22.67
October	19.67	19.67	22.67	25.33	28.42	19.33
November	20.33	20.33	23.33	25.33	28.58	20.33
December	21.50	21.50	24.50	26.50	30.25	21.50
Year	21.34	21.89	23.76	25.61	27.51	21.68
1915.						
January	22.83	22.83	25.83	27.83	31.58	22.83
February	23.00	23.00	26.00	28.00	31.25	23.00
March	21.17	21.17	24.17	26.17	28.42	21.17
April	22.17	22.67	25.33	27.33	29.58	23.17
May	20.33	23.33	24.33	27.33	29.25	23.50
June	20.00	23.00	24.00	27.33	30.25	23.67
July	20.33	24.83	25.83	29.50	32.75	25.50
August	20.33	25.33	26.33	29.33	32.58	25.33
September	18.33	20.33	22.33	25.33	29.25	20.33
October	18.67	19.00	21.00	23.50	25.75	19.00
November	18.33	18.33	20.33	22.83	25.08	18.33
December	18.83	18.83	20.83	23.33	25.58	18.83
Year	20.36	21.89	23.86	26.48	29.28	22.05

[1] See text p. 113 for sources of these figures and method of computing averages.
[2] Figures for 1913 not available in source from which other figures were derived.

TABLE 2.—*Average prices of mill feeds, sacked, f. o. b. Minneapolis, by months, January, 1913, to June, 1920, inclusive*—Continued.

Month.	Bran.	Standard middlings.	Mixed feed.	Flour middlings.	Red dog.	Rye middlings.
1916.						
January	$19.33	$19.33	$21.33	$24.00	$26.25	$19.33
February	20.00	22.67	23.00	26.00	28.00	23.67
March	18.33	20.33	21.00	24.00	26.00	19.00
April	18.50	19.50	21.00	24.00	26.33	19.00
May	18.83	20.17	21.33	24.33	27.33	19.83
June	18.50	20.50	21.33	24.33	27.33	20.50
July	18.00	20.00	21.00	24.00	27.00	20.00
August	20.33	21.33	23.33	26.33	29.33	21.33
September	22.00	23.00	25.00	28.00	31.00	23.00
October	24.00	26.00	27.67	30.67	33.67	26.00
November	27.33	30.33	32.33	35.33	38.33	30.33
December	26.67	29.33	31.67	36.00	41.67	29.33
Year	20.98	22.71	24.17	27.25	30.19	22.61
1917.						
January	28.33	28.33	33.33	36.67	43.67	28.33
February	31.67	31.67	36.67	39.67	46.67	31.67
March	34.33	35.00	38.00	41.00	48.00	35.00
April	37.67	38.67	39.67	42.67	48.00	38.67
May	36.67	37.67	39.33	45.00	48.00	38.33
June	28.33	34.33	38.00	45.00	48.00	37.00
July	31.00	39.33	41.33	48.33	52.33	40.67
August	35.33	45.33	46.33	54.00	58.67	46.00
September	30.00	34.33	36.33	46.33	55.00	34.33
October	31.00	36.00	38.00	48.00	56.00	36.00
November	31.00	36.00	38.00	48.00	56.00	36.00
December	40.00	40.67	42.67	50.00	58.00	40.67
Year	32.94	36.44	38.97	45.39	51.53	36.89
1918.						
January	32.43	34.43	36.43	40.89	46.77	35.67
February	32.76	34.76	36.76	41.18	47.03	40.33
March	32.91	34.25	36.91	41.31	47.15	45.00
April	33.14	35.14	37.14	41.49	47.33	45.00
May	29.84	31.84	32.93	35.86	39.79	45.67
June	29.88	31.88	31.13	31.23	31.35	46.00
July	24.20	26.20	25.45	25.55	25.67	44.00
August	22.20	31.20	30.45	30.56	30.62	42.00
September	28.90	30.90	30.15	30.30	30.23	43.33
October	28.49	30.49	29.74	29.93	29.86	43.00
November	27.81	29.81	29.06	29.32	29.21	50.33
December[3]	34.87	38.37	40.50	40.63	43.08	48.33
Year	30.37	32.44	33.05	34.85	37.34	44.55
1919.						
January	50.00	50.00	55.00	55.00	60.00	48.00
February	40.33	40.33	45.33	45.33	53.33	40.33
March	38.00	38.33	43.00	43.00	50.67	38.33
April	38.00	40.33	45.00	45.00	52.00	39.67
May	39.00	45.00	47.00	50.00	55.67	40.00
June	34.67	42.67	47.67	50.67	56.67	38.00
July	37.00	46.00	49.00	52.33	58.67	43.33
August	41.00	53.00	55.00	59.00	65.00	53.00
September	39.33	52.33	54.33	58.33	64.33	52.33
October	36.33	45.33	51.00	55.67	63.00	45.33
November	39.00	44.00	50.00	55.00	63.00	44.00
December	41.33	44.00	48.33	53.33	60.33	44.00
Year	39.50	45.11	49.22	51.89	58.56	43.86

[3] As pointed out in the text, a very marked increase in prices took place Dec. 20, 1918, and additional advances were made before the end of the month. An average of the prices for the 1st, 10th, and 20th, therefore, does not correctly represent the price for this month. Accordingly, in computing the averages for December, 1918, the method was changed and the price on the 20th was given twice the weight of the prices on the 1st and 10th. This does not apply to the figures for rye middlings, the price of which did not increase with the advance in wheat feeds.

TABLE 2.—*Average prices of mill feeds, sacked, f. o. b. Minneapolis, by months, January, 1913, to June, 1920, inclusive*—Continued.

Month.	Bran.	Standard middlings.	Mixed feed.	Flour middlings.	Red dog.	Rye middlings.
1920.						
January	$43.00	$44.00	$48.00	$53.00	$58.67	$44.00
February	43.00	47.33	49.00	54.00	61.00	46.00
March	46.00	51.33	52.00	56.67	62.67	51.33
April	49.33	53.67	54.67	58.33	64.33	53.67
May	52.67	57.33	58.33	62.33	67.33	57.33
June[4]	52.00	57.00	58.50	63.00	68.00	56.50
January–June	47.67	51.78	53.42	57.89	63.67	51.47

[4] Average of prices for two dates only.

TABLE 3.—*Average prices per ton of white hominy feed, in bulk, f. o. b. mill, Indianapolis, and for New York City and Boston freight-rate points, by months, January, 1913, to June, 1920, inclusive.*[1]

Month.	1913			1914			1915			1916		
	Indianapolis.	New York.	Boston.	Indianapolis.	New York.	Boston.	Indianapolis.	New York.	Boston.	Indianapolis.	New York.	Boston.
January	$19.40	$22.85	$23.57	$23.80	$26.75	$27.52	$27.25	$27.35	$30.00	$25.00	$26.86	$29.06
February	18.70	21.50	22.57	23.85	26.62	27.57	27.15	29.50	30.99	24.50	28.30	29.08
March	18.00	19.75	20.85	24.50	27.00	27.53	25.00	30.28	28.64	24.25	27.44	27.44
April	19.45	21.66	21.98	24.00	27.25	27.57	25.00	28.92	29.16	24.00	27.00	27.18
May	20.30	22.50	22.85	25.00	27.00	27.57	26.90	30.25	30.43	24.50	27.00	27.23
June	20.95	24.42	23.57	25.80	27.66	29.90	26.10	30.20	30.23	24.25	27.25	26.85
July	20.95	23.75	24.27	25.50	27.50	28.40	26.15	29.10	29.49	24.50	27.87	27.58
August	24.80	28.50	27.18	28.35	29.66	31.07	28.25	30.50	31.18	27.00	30.87	31.88
September	27.80	29.30	29.90	27.30	31.91	31.43	27.00	31.50	31.75	29.00	33.00	34.00
October	22.90	26.87	27.73	24.00	29.12	27.57	24.00	28.14	28.41	32.50	32.80	34.41
November	23.10	26.25	27.15	23.05	26.47	27.18	24.75	26.37	26.60	35.00	33.70	41.33
December	23.60	26.75	27.40	23.60	26.62	27.57	25.00	26.60	28.26	35.85	39.15	41.40
Year	21.66	24.51	24.92	24.90	27.80	28.41	26.05	29.06	29.60	27.53	30.10	31.45

Month.	1917			1918			1919			1920		
	Indianapolis.	New York.	Boston.	Indianapolis.	New York.	Boston.	Indianapolis.	New York.	Boston.	Indianapolis.	New York.	Boston.
January	$37.00	$41.70	$41.22	$58.50	$53.50	$58.00	$56.25	$63.50	$61.56	$61.50	$61.00	$63.58
February	38.00	41.50	41.92	60.30	64.25	60.59	50.10	57.16	50.21	59.30	63.33	63.14
March	41.00	43.66	43.89	63.55	65.75	66.90	57.50	52.33	52.69	63.40	64.00	.....
April	48.85	48.25	52.90	53.45	63.67	57.20	62.35	63.00	58.15	65.00	65.00	.....
May	51.75	54.55	55.90	47.40	61.25	45.90	64.75	67.33	61.54	70.00	67.60	.....
June	50.00	55.66	51.47	51.40	53.50	48.43	65.85	70.00	62.93	68.30	73.33	.....
July	51.00	55.10	52.77	57.50	56.66	58.15	72.50	75.00	74.10	.....	.....	.....
August	54.85	62.50	[2]66.00	58.85	65.00	59.32	75.15	77.33	76.02	.....	.....	.....
September	56.00	58.00	56.57	56.00	59.50	58.47	60.00	70.30	66.45	.....	.....	.....
October	53.00	53.80	56.84	49.00	57.66	54.70	49.50	56.50	55.81	.....	.....	.....
November	58.65	57.00	53.60	48.50	55.33	52.47	55.45	56.50	58.97	.....	.....	.....
December	57.95	53.16	[2]60.00	57.65	60.50	[2]62.90	58.90	56.25	63.60	.....	.....	.....
Year	49.84	52.07	52.76	55.17	59.71	56.92	60.69	63.77	61.83	[3]64.58	[3]65.71	.....

[1] The figures in the first two columns were furnished by two leading manufacturers, operating plants in the middle west, the first giving prices f. o. b. factory, Indianapolis, and the second prices on the New York freight-rate basis. The figures in the third column were furnished by a leading jobber and are for Boston freight-rate points.

[2] Interpolated.

[3] Price for one date only.

[4] Average, January-June.

TABLE 4.—*Average prices per ton of rice bran and rice polish, f. o. b. mills, by months, January, 1913, to April, 1920, inclusive.*[1]

RICE BRAN.

Month.	1913	1914	1915	1916	1917	1918	1919	1920
January	$17.28	$14.90	$15.76	$14.98	$24.05	$39.74	$36.02	$30.80
February	16.18	14.62	17.65	16.36	24.12	41.60	36.03	32.60
March	19.03	15.31	21.21	16.42	28.65	40.85	35.55	30.50
April	15.79	15.30	21.05	16.79	38.26	39.45	37.64	34.09
May	17.34	15.53	18.89	17.01	33.68	39.45	33.07	.....
June	16.12	16.04	15.00	17.71	42.00	37.92	35.22	.....
July	16.03	17.00	18.45	15.00	.....	36.00	36.16	.....
August	15.60	17.06	14.71	15.18	34.69	36.00	43.97	.....
September	16.01	15.77	15.44	17.07	34.46	36.02	41.72	.....
October	15.90	15.33	14.28	22.30	34.97	36.02	33.71	.....
November	15.21	14.87	13.33	23.01	35.45	36.19	34.07	.....
December	15.95	14.48	14.66	23.82	38.39	36.00	33.29	.....
Year	16.21	15.30	14.80	17.17	[2] 31.67	36.36	38.81	[3] 30.89

RICE POLISH.

January	$23.25	$22.22	$24.83	$23.83	$30.26	$58.34	$51.60	$57.43
February	22.19	23.00	24.84	23.72	29.41	62.42	50.17	57.74
March	21.05	21.69	24.90	23.46	34.13	64.21	52.09	58.89
April	18.77	23.12	27.76	23.95	39.14	64.85	51.00	58.67
May	20.67	22.77	25.39	22.64	40.48	64.87	51.71	.....
June	18.68	25.40	30.23	24.92	50.60	56.73	54.58	.....
July	18.00	25.00	27.90	25.00	.....	.....	61.41	.....
August	22.00	24.71	24.53	23.08	50.00	50.01	68.59	.....
September	23.29	25.14	24.30	25.43	50.45	50.06	64.19	.....
October	23.52	25.45	24.29	27.66	50.94	50.50	61.50	.....
November	24.35	25.33	22.96	35.09	50.97	51.18	58.60	.....
December	25.62	25.65	23.83	29.17	57.39	51.30	59.62	.....
Year	21.77	24.16	24.44	26.27	[2] 40.25	[2] 56.41	59.50	[3] 57.96

[1] Weighted averages. See p. 119.
[2] Average, 11 months.
[3] Average, January–April.

TABLE 5.—*Average prices per ton of merchantable cottonseed hulls, f. o. b. mills, by months, February, 1913, to April, 1920, inclusive.*[1]

Month.	1913	1914	1915	1916	1917	1918	1919	1920
January	.....	$7.33	$6.02	$12.00	$15.96	$20.50	$11.50	$8.90
February	$8.10	6.35	6.72	11.58	16.50	21.50	10.23	10.67
March	7.81	6.94	6.79	11.67	16.50	21.50	7.88	11.88
April	8.81	8.00	7.25	13.50	16.50	21.50	7.88	12.63
May	8.94	8.04	7.06	14.67	16.50	21.50	7.88	.....
June	9.06	8.00	6.25	13.25	16.00	21.50	6.44	.....
July	9.42	8.00	5.75	12.00	15.54	21.50	5.96	.....
August	10.00	8.00	5.29	10.67	13.50	21.50	7.25	.....
September	10.00	6.29	4.25	9.58	12.50	20.00	6.67	.....
October	7.02	4.31	7.75	13.00	14.21	20.00	7.08	.....
November	7.13	4.08	8.96	15.50	17.63	18.00	9.21	.....
December	7.77	5.06	11.92	15.25	19.58	14.50	8.17	.....
Year	8.56	6.70	7.00	12.72	15.91	20.29	8.01	[2] 11.02

[1] Simple averages of the means of low and high quotations on the 1st, 5th, 10th, 15th, 20th and 25th of each month from records of the Memphis Merchants' Exchange.
[2] Average, January–April.

TABLE 6.—*Average prices of No. 1 alfalfa meal, carload lots, f. o. b. Colorado and Kansas mills, and average of quoted prices for Kansas City rate points, by months, January, 1913, to June, 1920, inclusive.*[1]

Month.	1913			1914			1915			1916		
	Mill prices.		Kansas City rate points.	Mill prices.		Kansas City rate points.	Mill prices.		Kansas City rate points.	Mill prices.		Kansas City rate points.
	Colorado.	Kansas.		Colorado.	Kansas.		Colorado.	Kansas.		Colorado.	Kansas.	
January	.....	$17.50	$18.58	$16.25	$20.00	[2]$19.50	$13.80	$15.50	$16.83	$13.20	$15.50	$17.00
February	.....	16.50	17.75	15.00	19.00	[3]18.33	12.90	16.00	17.00	13.41	16.00	17.00
March	.....	15.50	17.25	14.00	19.00	[3]17.75	14.40	16.50	16.58	14.11	15.50	16.00
April	.....	15.50	17.42	14.00	19.00	[3]17.75	15.75	16.50	17.00	13.00	15.50	15.83
May	.....	14.50	16.00	14.00	17.00	[3]17.00	15.20	16.00	20.67	13.70	15.00	17.00
June	.....	16.00	15.17	15.90	15.00	[3]17.00	14.89	15.50	18.83	13.25	14.50	17.25
July	$14.15	17.00	15.00	13.90	15.00	[3]15.50	[4]14.00	15.00	18.00	13.70	14.25	17.00
August	16.00	20.00	17.50	13.78	17.00	[3]16.00	13.80	15.50	16.67	13.40	17.00	17.17
September	16.23	21.00	18.83	14.00	16.50	[3]16.50	[4]14.00	16.00	16.92	15.47	17.50	17.92
October	16.90	20.50	19.67	13.90	15.50	18.33	14.25	16.50	17.17	16.90	18.50	18.75
November	19.00	20.00	20.17	13.50	16.00	17.00	13.00	16.00	17.00	19.79	23.50	22.83
December	14.00	19.50	19.50	[4]13.80	15.50	16.83	14.22	16.00	17.00	20.58	23.50	25.67
Year [6]	[7]16.05	17.79	17.74	14.34	17.04	17.29	14.18	15.92	17.47	15.04	17.19	18.28

Month.	1917			1918			1919			1920		
	Mill prices.		Kansas City rate points.	Mill prices.		Kansas City rate points.	Mill prices.		Kansas City rate points.	Mill prices.		Kansas City rate points.
	Colorado.	Kansas.		Colorado.	Kansas.		Colorado.	Kansas.		Colorado.	Kansas.	
January	$21.36	$24.00	$25.25	$33.13	$36.00	$37.50	$30.84	$34.50	$35.50	$33.56	$37.00	[4]40.50
February	20.98	23.50	24.75	34.35	35.50	37.50	28.69	35.00	34.08	34.74	33.00	[4]39.17
March	20.00	25.00	24.00	32.97	35.50	37.50	29.03	38.00	35.17	31.27	35.00	[4]35.67
April	28.41	28.00	28.17	27.50	30.00	34.00	35.75	40.00	41.33	35.51	35.50	[4]36.17
May	22.40	28.00	34.33	26.50	26.50	30.50	30.25	32.50	40.58	37.40	35.50	[5]44.67
June	23.92	26.00	35.33	23.50	25.00	29.33	29.13	31.00	37.58	35.65	36.00	[5]46.00
July	26.83	25.50	29.33	25.49	25.00	29.17	29.69	33.00	[4]33.33	.....	.....	.....
August	27.67	28.00	31.50	31.21	25.50	33.67	31.83	35.00	[4]35.50	.....	.....	.....
September	26.50	28.50	30.67	33.97	35.50	38.50	29.81	34.00	[4]35.17	.....	.....	.....
October	26.50	29.50	31.17	33.19	34.50	38.50	30.87	34.50	[4]34.50	.....	.....	.....
November	31.16	34.50	35.17	32.29	34.50	37.50	31.99	35.00	[4]34.50	.....	.....	.....
December	34.72	35.00	37.00	29.76	33.00	36.50	31.63	37.00	[4]35.67	.....	.....	.....
Year [6]	25.87	27.96	30.56	30.32	31.37	35.01	30.79	34.96	36.08	[7]34.69	[7]35.33	[7]40.33

[1] See text, p. 128, for sources and methods of computing average prices.
[2] Nominal prices paid to country mills.
[3] Interpolated.
[4] Bids to arrive.
[5] Nominal quotations, limited offerings.
[6] Simple averages of the monthly averages.
[7] Average, January–June.

TABLE 7.—*Average prices per ton of three dairy feeds, f. o. b. Boston rate points, by months, January, 1913, to June, 1920, inclusive.*

Month.	1913			1914			1915			1916		
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3	No. 1.	No. 2.	No. 3.
January	$30.50	$31.67	.....	$33.00	$33.00	$32.00	$34.00	$32.33	$32.50	$33.25	$33.17	$31.37
February	30.50	31.50	.....	33.00	32.92	31.67	34.17	33.00	32.50	33.50	33.50	31.70
March	29.83	30.25	[4]$27.50	33.00	32.92	31.33	33.33	32.00	31.00	33.00	33.00	31.70
April	28.17	29.00	28.50	33.00	33.08	32.00	33.00	32.33	31.00	32.83	33.17	31.70
May	28.33	29.00	29.50	31.00	31.83	32.00	32.67	32.50	31.67	32.17	32.83	30.70
June	28.00	29.00	28.50	31.42	31.50	31.20	33.00	32.25	31.50	32.33	31.83	30.50
July	28.83	29.00	28.20	31.17	31.50	30.80	32.67	32.25	31.60	32.67	32.17	31.80
August	30.83	30.83	28.20	33.00	33.00	30.00	33.00	32.50	31.20	33.17	33.17	32.13
September	33.00	32.67	29.13	33.67	[2]33.75	30.00	33.00	32.00	31.00	34.00	34.03	33.03
October	32.00	32.50	31.00	32.83	[2]32.00	30.00	32.00	[1]32.00	30.33	35.83	34.83	35.00
November	32.50	32.33	31.80	33.17	31.25	30.33	32.50	31.75	30.00	40.50	40.67	38.70
December	32.67	32.67	31.30	33.75	32.00	30.50	33.00	32.00	31.20	43.00	41.83	39.80
Year	30.43	30.87	[4]29.36	32.67	32.40	30.99	33.03	32.24	31.30	34.69	34.52	33.20

Month.	1917			1918			1919			1920		
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.
January	$43.08	[1]$42.25	$40.80	$60.00	$59.17	$56.00	$69.33	$67.00	$64.17	$79.50	$76.67	.....
February	44.67	44.00	43.50	60.00	59.50	56.33	68.50	65.00	64.83	80.00	75.33	.....
March	45.00	[2]45.00	44.40	62.00	61.67	60.00	67.33	64.33	63.83	79.33	74.50	.....
April	48.67	[1]51.00	[2]46.50	66.00	61.17	60.00	67.50	65.67	63.50	78.50	74.33	.....
May	52.67	51.50	.....	63.00	61.50	57.67	68.17	66.17	64.50	79.17	75.83	.....
June	51.00	50.67	49.00	64.00	60.33	57.07	68.33	66.00	64.50	80.00	77.33	.....
July	52.17	51.25	51.82	65.00	61.33	58.83	71.50	69.50	67.67	.....	.....	.....
August	56.67	58.67	54.33	65.00	64.00	59.33	[1]80.75	76.50	77.80	.....	.....	.....
September	56.67	56.00	53.00	65.67	64.00	.....	80.00	77.33	77.33	.....	.....	.....
October	57.00	56.50	53.00	67.00	64.83	62.50	76.67	73.17	73.17	.....	.....	.....
November	57.17	57.17	53.83	66.25	65.33	62.50	76.67	74.00	73.17	.....	.....	.....
December	60.00	59.33	57.00	67.17	66.00	63.17	79.50	74.33	73.33	.....	.....	.....
Year	52.06	51.94	[3]49.74	64.26	62.40	[5]59.40	72.85	69.92	68.98	[3]79.42	[3]75.66	.....

[1] Average of prices for two dates.
[2] Price for one date only.
[3] Average, January-June.
[4] Average, March-December.
[5] Average for 11 months only.

TABLE 8.—*Average prices per ton of eight dairy feeds, f. o. b. factory, by months, January, 1915, to June, 1920, inclusive.*

Month.	20 to 24 per cent protein.				14 to 17.5 per cent protein.			
	No. 1, St. Louis.	No. 2, Memphis.	No. 3, New York State.	No. 4, St. Louis.	No. 5, Nebraska.	No. 6, Illinois.	No. 7, Memphis.	No. 8, New York State.
1915.								
January	$27.33	.....	.....	$24.83	$26.00	$22.67	.....	.....
February	27.83	.....	.....	25.33	26.00	23.50	.....	.....
March	28.00	.....	.....	25.50	27.00	23.50	.....	.....
April	27.83	.....	.....	25.33	27.00	23.50	.....	.....
May	27.83	.....	.....	25.33	27.00	23.17	.....	.....
June	26.00	.....	.....	24.00	28.50	22.50	.....	$25.75
July	26.00	.....	.....	24.00	28.50	22.75	.....	25.25
August	26.67	.....	.....	24.67	27.50	24.17	.....	25.25
September	27.50	.....	.....	25.00	27.50	23.50	.....	24.45
October	27.83	.....	.....	25.83	26.50	24.50	.....	22.64
November	28.17	.....	.....	26.33	26.50	22.83	.....	22.72
December	28.83	.....	.....	26.83	27.17	23.17	.....	23.24
Year	27.48	.....	.....	25.25	27.10	23.15	.....	[1]23.10

[1] Average for less than 12 months.

TABLE 8.—*Average prices per ton of eight dairy feeds, f. o. b. factory, by months, January, 1915, to June, 1920, inclusive*—Continued.

Month.	20 to 24 per cent protein.				14 to 17.5 per cent protein.			
	No. 1. St. Louis.	No. 2, Memphis.	No. 3, New York State.	No. 4, St. Louis.	No. 5, Nebraska.	No. 6, Illinois.	No. 7, Memphis.	No. 8, New York State.
1916.								
January	$30.00	.....	$33.50	$27.83	$27.67	$24.00	$26.82	$24.41
February	31.00	.....	33.50	28.50	28.00	24.83	28.15	25.50
March	29.83	.....	33.50	27.83	28.00	25.50	29.10	24.59
April	29.50	.....	33.42	27.50	28.33	24.00	28.13	24.68
May	29.50	.....	32.93	27.50	28.50	23.00	29.89	24.50
June	28.83	$28.20	33.00	26.83	26.50	23.50	28.52	25.26
July	28.50	.....	31.55	26.50	26.50	23.75	29.85	24.50
August	29.50	27.60	32.33	27.50	26.50	24.00	28.84	24.23
September	30.50	28.67	33.67	28.83	[2] 26.75	24.25	32.10	26.57
October	31.83	30.57	35.13	30.00	.....	25.00	32.76	27.27
November	37.17	32.46	39.40	35.00	.....	28.33	35.83	30.06
December	39.50	35.02	41.50	37.50	.....	30.67	36.73	32.12
Year	31.30	[3] 30.42	34.45	29.28	[3] 27.42	25.24	30.30	26.03
1917.								
January	39.50	30.83	41.87	37.50	38.00	32.00	38.71	32.33
February	39.50	35.15	44.27	37.50	39.00	33.83	38.34	32.85
March	39.50	39.50	46.47	37.50	.....	35.17	39.18	34.61
April	42.50	41.12	49.30	40.50	.....	39.67	43.83	38.80
May	45.67	45.08	54.30	44.67	.....	41.00	39.90	.....
June	45.67	42.00	53.13	43.67	.....	38.00	42.27	.....
July	46.83	44.56	51.30	45.17	.....	38.67	44.59	42.50
August	50.33	49.25	56.30	48.33	.....	42.50	53.33	44.97
September	50.50	43.03	54.50	48.50	.....	42.50	46.58	44.42
October	50.67	43.98	54.60	48.67	.....	41.83	47.88	45.17
November	53.83	49.31	56.73	52.00	.....	41.50	49.79	40.62
December	56.00	49.92	59.47	54.17	.....	42.50	51.56	40.89
Year	46.79	41.14	51.85	44.85	.....	39.10	43.91	[3] 37.69
1918.								
January	58.83	50.00	60.80	56.67	55.00	43.50	53.12	44.02
February	59.50	53.94	60.80	57.00	54.00	43.67	55.80	45.30
March	59.83	57.04	61.80	57.33	54.33	46.00	56.56	42.76
April	58.17	56.00	.....	55.17	58.67	45.33	56.64	53.50
May	53.33	54.44	63.07	50.33	53.00	44.00	56.03	51.23
June	50.50	53.27	62.13	47.50	51.33	43.25	57.05	43.87
July	53.83	53.73	61.80	51.83	52.67	43.25	57.80	43.72
August	59.00	54.82	62.70	56.00	54.33	44.25	50.19	42.96
September	62.00	57.56	64.83	59.00	58.00	44.92	51.46	43.57
October	62.83	58.07	65.47	[3] 59.75	57.50	46.25	52.78	42.15
November	63.00	62.85	65.80	[4] 60.00	56.67	46.25	53.98	40.07
December	63.17	58.47	66.40	60.00	56.00	45.58	53.14	41.41
Year	58.67	55.85	[2] 63.24	55.88	55.13	44.69	54.19	43.13
1919.								
January	64.17	60.35	66.70	59.83	56.33	46.58	53.66	42.43
February	62.67	60.00	63.95	56.50	55.00	46.25	53.43	46.14
March	61.83	60.00	62.20	56.17	56.00	46.25	51.51	42.60
April	64.00	58.00	63.50	58.50	57.00	46.25	52.07	47.00
May	65.50	58.25	64.57	59.67	57.00	46.58	52.49	49.34
June	65.50	57.63	63.60	59.17	58.00	45.42	52.52	50.55
July	69.50	63.08	69.30	61.17	59.67	44.08	53.70	53.50
August	76.83	65.13	76.30	67.33	67.33	53.75	53.26	57.35
September	74.50	66.53	75.80	65.50	61.33	53.75	59.40	56.60
October	71.00	65.49	69.80	62.83	60.83	53.08	57.88	55.75
November	72.33	64.92	72.47	[4] 63.00	61.67	52.08	58.01	55.02
December	72.33	65.21	73.97	.....	63.33	51.08	60.49	54.36
Year	68.35	62.06	68.51	[2] 60.88	59.46	48.76	54.50	48.73
1920.								
January	73.33	65.52	75.30	.....	64.33	52.75	59.10	55.41
February	73.17	63.49	76.60	.....	63.67	52.75	60.44	55.26
March	72.33	66.00	77.30	.....	65.33	53.75	60.29	57.03
April	71.83	73.25	75.47	.....	68.00	55.75	.....	60.58
May	74.17	76.00	76.47	.....	[2] 69.50	59.42	.....	64.42
June	75.00	76.00	77.30	.....	70.00	62.42	.....	66.42
January–June	73.31	70.04	76.41	.....	66.81	56.14	.....	59.85

[2] Average of two dates only.
[3] Average for less than 12 months.
[4] Price for one date only.

TABLE 9.—*Average prices per ton of six brands of stock feeds, by months, January, 1913, to June, 1920, inclusive.*[1]

Month.	1913						1914					
	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.
January	.....	.....	$19.00	$21.17	$25.84	$25.17	.....	.....	$19.83	$24.00	$26.57	$28.83
February	.....	.....	18.50	21.50	25.98	24.83	.....	.....	19.50	24.50	26.46	28.42
March	.....	.....	18.33	21.33	24.48	23.83	.....	.....	19.33	24.83	25.95	28.25
April	.....	.....	18.83	21.00	25.33	23.50	.....	.....	20.50	25.00	27.96	28.67
May	.....	.....	19.00	21.00	25.32	24.50	.....	.....	21.00	24.33	26.35	28.67
June	.....	.....	19.00	22.17	24.60	25.50	.....	.....	20.00	24.83	26.48	29.42
July	.....	.....	19.00	22.50	24.80	26.25	$25.00	.....	18.50	24.50	25.75	28.67
August	.....	.....	19.83	25.00	25.39	27.83	25.00	.....	18.67	27.17	25.04	30.92
September	.....	.....	22.00	26.50	26.43	30.00	27.00	.....	19.00	29.50	26.13	32.33
October	.....	.....	22.00	25.83	27.07	29.42	28.00	.....	18.50	25.67	27.35	29.83
November	.....	.....	21.00	25.50	26.59	28.67	28.00	.....	18.33	24.50	25.63	28.50
December	.....	.....	19.50	25.17	25.60	29.00	28.00	.....	18.00	24.83	25.66	28.50
Year	.....	.....	19.67	23.22	25.58	26.54	[2]26.83	.....	19.26	25.31	26.27	29.25

Month.	1915						1916					
	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.
January	$28.00	[2]$24.00	$17.83	$25.44	$26.57	$29.75	$28.00	$27.17	$20.33	$25.05	$26.45	$30.08
February	28.00	24.67	17.50	26.65	25.58	31.33	30.00	28.50	22.67	25.66	26.13	30.33
March	28.00	25.00	17.67	26.50	26.98	29.83	30.00	28.50	22.00	25.29	28.68	29.17
April	27.00	25.00	18.83	26.70	26.38	30.08	30.00	28.50	22.33	25.29	27.39	29.33
May	27.00	25.00	19.00	27.36	26.54	31.50	30.00	28.50	22.50	25.47	26.54	29.83
June	28.00	25.00	19.00	27.24	26.77	31.08	30.00	28.50	22.50	24.52	29.51	28.67
July	28.00	25.00	19.00	26.85	26.08	31.50	30.00	28.83	22.50	25.63	27.52	29.42
August	28.00	25.00	18.83	28.00	26.23	33.00	30.00	29.00	22.50	26.49	29.66	31.50
September	28.00	26.00	19.33	26.64	25.61	31.83	30.00	29.67	22.83	[2]28.76	30.06	33.50
October	28.00	26.00	20.00	24.15	26.39	29.58	32.00	30.67	23.17	28.69	29.89	33.83
November	28.00	26.00	20.00	23.64	26.29	28.08	36.00	33.50	25.33	33.32	30.07	[2]39.50
December	28.00	26.33	20.00	23.92	25.42	29.25	36.00	34.50	26.00	34.64	30.88	41.08
Year	27.83	25.25	18.92	25.89	26.20	30.57	31.00	29.65	22.89	26.95	28.17	32.19

Month.	1917						1918					
	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.
January	$40.00	$34.50	$26.00	$35.24	$34.45	$41.25	$53.00	$53.33	$38.00	$49.69	$50.99	$58.40
February	40.00	37.00	26.17	37.73	36.36	43.67	53.00	53.50	37.00	52.50	52.81	59.50
March	42.00	37.33	28.50	39.09	38.37	[3]46.00	53.00	51.83	39.67	57.69	57.76	64.00
April	44.00	40.33	32.17	43.40	38.99	[4]55.50	53.00	49.83	39.33	57.29	56.50	60.83
May	46.00	42.00	34.17	53.46	38.70	56.83	53.00	47.67	35.00	49.36	56.75	.....
June	46.00	43.00	33.50	48.28	39.16	53.67	53.00	45.83	33.33	43.56	55.22	[5]50.00
July	48.00	45.83	33.83	49.26	40.95	53.67	51.00	48.00	34.00	45.91	55.51	55.83
August	48.00	48.83	34.17	53.66	48.10	63.17	51.00	50.67	39.00	46.52	51.93	58.17
September	50.00	49.17	33.50	50.12	46.81	55.25	51.00	54.00	44.00	47.40	54.25	57.00
October	52.00	48.50	35.00	48.35	44.45	54.83	51.00	54.00	[2]43.50	46.92	50.39	57.67
November	53.00	49.50	37.50	47.23	46.64	54.33	51.00	53.33	40.67	46.08	49.96	55.67
December	53.00	50.67	39.33	47.97	47.86	58.50	51.00	53.00	39.33	46.61	50.43	58.17
Year	46.83	43.89	32.82	46.23	40.92	53.06	52.00	51.25	38.57	48.31	53.90	[5]57.75

[1] Prices are f. o. b. factory except those for brand No. 6, which are for deliveries Boston freight rate points.
[2] Average of prices for two dates.
[3] Price for one date only.
[4] Average for 6 months.
[5] Average, 11 months.

TABLE 9.—*Average prices per ton of six brands of stock feeds, by months, January, 1913, to June, 1920, inclusive*—Continued.

Month.	1919						1920					
	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Nebraska.	No. 4, Ohio.	No. 5, New Orleans.	No. 6, Boston.
January	$51.00	$53.00	$38.67	$49.08	$50.97	$59.00	$50.00	$51.67	[6]$40.00	$53.54	$53.23	$63.33
February	51.00	48.83	36.00	47.25	52.03	53.00	52.00	52.00	.....	56.20	51.84	64.00
March	50.00	50.00	36.00	47.20	49.99	53.17	52.00	55.33	42.67	56.94	58.36	65.00
April	48.00	51.50	39.00	51.55	49.25	55.83	52.00	60.83	[6]39.50	60.72	51.97	66.17
May	46.00	51.17	37.67	52.75	48.98	59.83	53.33	64.33	[7]45.00	66.33	64.74	71.33
June	45.00	50.67	37.00	52.99	50.65	61.50	54.00	63.33	45.00	[8]68.00	64.50	76.67
July	45.00	52.17	37.00	54.94	50.74	64.50	.....	.....	.....	.....	.....	.....
August	48.00	55.00	36.00	60.72	51.49	69.00	.....	.....	.....	.....	.....	.....
September	48.00	52.67	35.33	57.48	50.57	64.67	.....	.....	.....	.....	.....	.....
October	48.00	50.50	35.00	54.19	50.66	60.83	.....	.....	.....	.....	.....	.....
November	48.00	51.67	37.33	52.05	49.94	60.67	.....	.....	.....	.....	.....	.....
December	50.00	51.33	39.00	51.96	49.74	61.83	.....	.....	.....	.....	.....	.....
Year	48.17	51.54	37.00	52.16	50.48	60.32	$52.22	$57.92	[9]42.43	$60.29	$57.44	$67.75

[6] Average of prices for two dates.
[7] Price for one date only.
[8] Average, January-June.
[9] Average for five months.

TABLE 10.—*Average prices of six brands of horse and mule feeds, f. o. b. factory, by months, January, 1913, to June, 1920, inclusive.*

Month.	1913						1914					
	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.
January	$20.92	$28.54	$26.47	$23.00	.....	.....	$25.00	$28.32	$28.24	$28.00	$28.00	$23.50
February	21.25	29.55	24.62	23.00	.....	.....	24.67	28.32	27.74	27.33	27.50	23.00
March	21.83	28.35	25.23	23.00	.....	.....	25.33	27.55	27.39	27.17	27.75	23.00
April	22.67	28.05	25.45	23.33	.....	.....	26.00	28.90	28.19	27.33	27.75	23.00
May	23.67	29.95	25.30	24.00	.....	.....	26.50	28.35	28.36	27.00	28.00	23.00
June	24.33	28.38	25.16	25.00	.....	.....	26.33	28.31	28.22	27.50	28.75	23.00
July	24.67	24.49	26.51	26.00	.....	.....	26.00	27.05	27.72	26.83	28.00	23.17
August	26.67	28.35	26.02	26.83	.....	.....	27.83	27.31	29.49	29.17	29.25	24.67
September	27.50	27.12	27.40	28.17	.....	.....	28.00	29.27	29.21	29.50	30.50	26.33
October	26.33	26.77	27.45	28.17	.....	.....	26.33	26.72	28.59	28.17	29.50	24.17
November	26.50	27.59	27.81	27.83	.....	.....	25.67	25.66	27.01	27.67	28.50	24.00
December	25.83	28.88	27.69	28.17	.....	.....	24.67	26.48	28.61	26.33	26.00	26.70
Year	24.35	26.86	26.22	25.54	.....	.....	26.03	27.59	28.09	27.67	28.29	23.96

Month.	1915						1916					
	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.
January	$26.33	$27.14	$28.16	$27.50	$27.75	$26.60	$26.50	$28.05	$28.35	$28.50	$27.50	$26.86
February	27.33	27.74	28.57	29.17	29.00	27.31	28.00	27.80	26.48	30.50	28.00	27.09
March	28.67	28.00	28.51	28.33	29.25	28.04	27.50	29.15	29.27	30.00	27.50	29.17
April	27.83	28.28	29.24	28.67	29.25	27.94	28.67	29.50	29.59	29.83	27.50	27.85
May	28.67	28.47	28.56	29.50	29.50	27.76	29.67	30.56	30.21	30.00	28.00	28.55
June	27.83	28.32	28.33	29.17	28.75	27.71	29.00	30.57	29.82	29.33	27.50	29.12
July	27.83	28.22	27.86	28.67	28.50	27.16	29.33	30.05	28.55	30.67	27.50	29.08
August	28.00	27.17	27.92	29.17	29.00	27.57	29.50	30.99	32.22	31.50	27.75	30.14
September	27.00	27.46	26.28	28.00	28.75	26.55	29.83	32.25	32.01	32.83	29.00	30.82
October	24.83	26.27	26.67	27.00	26.75	24.99	31.00	32.18	31.94	33.50	29.75	31.58
November	24.83	25.97	25.65	26.67	27.00	25.12	35.83	34.39	36.73	37.83	34.25	36.56
December	25.67	26.25	26.16	27.67	27.00	25.38	33.67	35.48	36.09	37.17	35.00	34.42
Year	26.90	27.77	27.57	28.29	28.37	26.45	29.88	31.80	30.16	31.81	29.10	32.12

TABLE 10.—*Average prices of six brands of horse and mule feeds, f. o. b. factory, by months, January, 1913, to June, 1920, inclusive*—Continued.

Month.	1917						1918					
	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.
January	$34.67	$35.91	$37.07	$37.00	$36.50	$36.80	$55.00	$54.59	$52.70	$60.33	$50.50	[1] $51.96
February	37.17	36.70	38.76	39.50	37.00	38.36	57.00	56.61	61.13	62.17	51.00	[1] 54.21
March	40.17	36.45	38.42	41.00	38.75	39.27	59.67	56.16	61.14	61.83	51.50	[1] 60.14
April	45.67	38.42	42.26	47.67	.....	46.69	58.33	56.99	61.34	58.33	50.00	[1] 66.80
May	51.17	41.79	42.14	55.67	.....	51.08	55.33	54.64	62.95	54.33	47.50	52.95
June	50.00	42.81	41.54	54.00	.....	52.30	52.83	55.11	56.61	52.33	42.50	50.01
July	54.67	52.62	52.55	57.33	.....	51.82	54.83	52.92	57.71	55.33	44.25	[1] 51.06
August	58.33	54.84	56.66	58.67	.....	55.61	58.00	54.59	58.44	58.00	45.00	51.51
September	57.33	56.30	51.37	57.17	52.00	49.89	57.67	54.87	55.73	58.33	45.00	52.72
October	56.50	54.99	51.52	55.67	51.00	50.51	51.00	54.27	54.08	56.83	50.00	51.99
November	57.50	50.23	49.52	57.33	53.00	[1]49.45	50.00	53.65	55.97	55.33	46.50	51.50
December	56.83	53.81	54.02	59.33	54.00	50.93	52.33	53.57	56.25	56.00	48.00	[1] 50.77
Year	50.00	41.33	43.39	51.69	[2]46.04	44.07	55.18	54.74	58.62	57.43	47.65	52.78

Month.	1919						1920					
	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.	No. 1, Nebraska.	No. 2, Memphis.	No. 3, Memphis.	No. 4, St. Louis.	No. 5, St. Louis.	No. 6, Ohio.
January	$53.00	$52.19	$56.07	$56.00	$52.00	$50.76	$57.33	$51.48	$53.46	$53.33	$58.25	[1] $51.51
February	49.00	52.18	55.21	50.67	49.25	48.24	56.67	52.19	57.36	53.67	59.50	54.69
March	51.17	48.08	52.44	53.17	49.50	43.41	59.00	54.25	58.30	57.50	61.00	56.76
April	56.33	51.71	51.29	56.33	53.00	51.36	63.33	.....	68.25	62.83	63.00	[2] 60.20
May	57.00	51.41	54.03	58.17	57.25	52.18	[3]66.50	.....	76.00	69.00	65.75	67.50
June	58.50	52.98	52.46	58.17	59.50	50.72	68.00	.....	74.50	68.83	[2]72.00	[2] 69.00
July	61.00	55.13	54.96	60.17	59.75	52.85	.....	.....	.....	.....	.....	.....
August	61.00	57.27	54.76	62.00	63.00	55.99	.....	.....	.....	.....	.....	.....
September	55.50	54.23	52.01	55.17	58.00	51.07	.....	.....	.....	.....	.....	.....
October	51.17	46.10	49.98	51.67	54.25	49.42	.....	.....	.....	.....	.....	.....
November	53.33	54.62	51.78	51.67	54.25	49.89	.....	.....	.....	.....	.....	.....
December	55.50	52.01	52.92	52.50	56.00	51.11	.....	.....	.....	.....	.....	.....
Year	55.21	52.58	52.85	55.47	55.48	50.22	[4]61.81	.....	[4]64.65	[4]60.86	[4]63.25	[4] 59.94

[1] Average of prices for two dates.
[2] Price for one date only.
[3] Average for 7 months only.
[4] Average, January-June.

TABLE 11.—*Average prices per ton of four brands of hog feeds, f. o. b. factory, at central western points, by months, January, 1916, to June, 1920, inclusive.*

Month.	1916		1917				1918			
	No. 1, Illinois.	No. 2, St. Louis.	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Chicago.	No. 4, Nebraska.	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Chicago.	No. 4, Nebraska.
January	$29.00	$27.67	$40.00	$35.00	$44.87	.....	$56.00	$58.50	$57.77	$51.00
February	29.33	28.50	41.00	37.00	45.50	$40.17	57.83	59.67	61.37	51.00
March	29.50	28.50	41.67	37.83	46.23	41.33	62.67	60.83	67.03	54.67
April	29.50	29.50	46.67	43.33	51.07	45.33	61.67	58.17	64.33	56.67
May	29.50	30.00	50.00	50.67	53.57	54.00	59.67	52.00	59.83	54.33
June	29.50	30.00	50.50	50.50	51.50	53.00	57.92	50.17	60.17	50.33
July	29.50	30.00	51.17	50.50	57.67	53.00	58.92	55.00	61.93	54.67
August	29.84	30.00	56.67	53.00	64.43	58.33	61.92	59.33	64.50	58.33
September	31.50	31.67	57.00	50.33	61.80	65.00	62.58	63.83	59.57	61.00
October	33.17	32.00	55.00	50.00	61.70	65.00	63.25	64.00	61.10	60.67
November	36.83	35.50	55.00	53.00	63.53	[1] 65.00	63.25	61.33	61.90	.....
December	38.83	35.00	56.00	56.33	60.80	.....	63.25	61.00	66.00	.....
Year	31.33	30.69	50.06	47.29	55.22	[2] 55.02	60.74	58.65	62.12	[2] 55.27

[1] Price for one date only.
[2] Average for 10 months.

TABLE 11.—*Average prices per ton of four brands of hog feeds, f. o. b. factory, at central western points, by months, January, 1916, to June, 1920, inclusive*—Continued.

Month.	1919				1920			
	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Chicago.	No. 4, Nebraska.	No. 1, Illinois.	No. 2, St. Louis.	No. 3, Chicago.	No. 4, Nebraska.
January	$64.58	$62.33	$62.33	$60.33	$69.75	$68.67	$69.92	$71.33
February	63.25	59.50	58.50	58.33	69.78	68.33	68.83	70.00
March	63.25	60.17	62.60	59.33	71.42	71.17	69.50	71.33
April	63.58	63.67	66.17	62.00	71.75	75.17	73.00	74.00
May	66.25	65.50	68.90	62.00	77.75	79.17	76.67	[3] 75.00
June	68.08	65.33	67.00	63.00	80.75	79.33	76.17	75.00
July	70.08	66.33	69.93	65.00	.....	.....	.....	.....
August	75.75	72.33	76.50	73.67	.....	.....	.....	.....
September	74.75	68.33	72.70	68.67	.....	.....	.....	.....
October	70.08	65.17	67.33	67.67	.....	.....	.....	.....
November	69.42	67.67	69.40	67.67	.....	.....	.....	.....
December	68.75	68.83	72.08	71.00	.....	.....	.....	.....
Year	68.15	65.43	67.79	64.89	[4] 73.53	[4] 73.64	[4] 72.35	[4] 72.78

[3] Average of two prices only.
[4] Average, January–June.

TABLE 12.—*Average prices per ton of three brands of calf meal, f. o. b. factory, at central western points, by months, January, 1916, to June, 1920, inclusive.*

Month.	1916		1917			1918		
	No. 1, St. Louis.	No. 2, Illinois.	No. 1, St. Louis.	No. 2, Illinois.	No. 3, Illinois.	No. 1, St. Louis.	No. 2, Illinois.	No. 3, Illinois.
January	$53.00	$55.00	$56.00	$56.00	.....	$85.67	$83.00	$79.00
February	50.00	55.00	57.00	57.67	.....	87.50	83.17	82.00
March	50.00	51.00	57.67	62.67	[1] $59.00	88.50	85.50	85.67
April	50.00	51.00	64.00	71.00	60.33	87.67	85.50	87.00
May	50.00	51.00	69.67	71.00	67.33	87.00	85.50	87.00
June	50.00	51.00	70.00	71.00	69.00	83.83	85.75	87.00
July	50.00	51.00	74.67	[2] 73.50	69.00	85.83	85.75	87.00
August	50.00	51.00	80.67	81.00	74.00	90.00	85.75	86.00
September	50.00	51.00	83.00	81.00	75.00	93.00	85.75	86.00
October	50.00	51.00	82.33	81.00	75.67	92.33	85.75	84.67
November	53.00	56.00	81.83	81.00	77.00	90.33	85.75	84.00
December	55.67	56.00	80.83	83.00	79.00	90.00	85.75	84.00
Year	50.97	52.50	71.47	72.49	[2] 70.53	88.47	85.24	84.94

Month.	1919			1920		
	No. 1, St. Louis.	No. 2, Illinois.	No. 3, Illinois.	No. 1, St. Louis.	No. 2, Illinois.	No. 3, Illinois.
January	$91.33	$87.08	$84.00	$100.00	$99.75	$96.00
February	91.33	87.75	86.00	103.33	99.75	97.33
March	91.33	88.42	86.00	104.67	99.75	98.00
April	90.00	88.08	86.00	107.33	99.75	100.00
May	90.00	89.08	86.00	109.33	107.42	102.00
June	90.00	91.25	86.00	108.67	107.75	103.00
July	93.33	92.08	86.00	.....	.....	.....
August	100.00	100.75	90.00	.....	.....	.....
September	99.33	100.75	92.00	.....	.....	.....
October	96.00	100.75	92.00	.....	.....	.....
November	96.00	100.08	93.33	.....	.....	.....
December	99.67	98.75	94.67	.....	.....	.....
Year	94.03	93.73	88.50	[3] 105.55	[3] 102.36	[3] 99.39

[1] Average of prices for two dates.
[2] Average, March–December.
[3] Average, January–June.

TABLE 13.—*Average prices per ton of four brands of scratch feed, by months, January, 1913, to June, 1920, inclusive.*[1]

Month.	1913				1914			
	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.
January	$32.33	.....	$29.00	$26.00	$36.08	$29.86	$34.00	$30.00
February	32.00	.....	29.00	26.13	35.67	31.92	32.00	30.00
March	32.00	.....	29.00	26.13	36.00	31.41	32.40	30.50
April	32.00	.....	29.00	26.67	36.50	31.39	33.00	30.50
May	32.50	.....	29.00	27.00	36.17	31.25	34.00	30.33
June	33.92	.....	29.40	28.67	36.83	31.46	34.00	31.33
July	34.75	.....	31.00	29.67	36.00	31.35	31.50	29.83
August	35.75	$31.17	32.00	31.00	39.17	33.39	35.00	33.17
September	37.58	31.09	31.40	32.33	41.58	33.26	37.60	36.17
October	37.42	31.27	36.00	31.50	39.17	33.42	35.40	33.33
November	37.00	31.83	36.00	31.33	38.58	32.40	34.60	32.83
December	37.00	30.96	34.00	31.33	37.50	30.29	33.00	31.67
Year	34.52	[2] 31.30	31.48	28.98	37.44	31.94	33.88	31.64

Month.	1915				1916			
	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.
January	$39.08	$34.09	$35.60	$33.83	$38.25	$31.50	$35.00	$32.33
February	42.00	35.03	39.40	36.50	39.33	29.85	35.60	33.33
March	40.83	35.85	37.00	36.00	38.50	30.20	34.40	31.50
April	41.50	35.05	37.60	35.67	38.83	28.40	34.00	32.00
May	42.00	35.43	37.60	35.83	39.00	30.27	34.00	32.17
June	41.17	31.32	36.40	34.33	38.33	31.89	33.60	31.67
July	41.00	31.16	35.40	34.17	39.00	29.91	34.60	33.00
August	41.33	31.03	35.40	34.00	42.17	30.83	38.40	36.67
September	39.58	28.62	33.00	31.83	44.83	34.13	41.00	38.83
October	37.50	28.31	32.00	29.83	45.83	33.70	42.60	40.67
November	36.08	26.75	32.00	29.67	51.58	40.31	48.40	45.67
December	36.42	26.76	33.40	31.17	51.33	44.78	46.40	44.00
Year	39.87	30.31	35.40	33.57	42.25	33.09	38.17	35.99

Month.	1917				1918			
	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.
January	$52.00	$44.64	$48.60	$45.67	$81.17	$70.39	$75.40	$73.00
February	54.17	45.50	50.00	47.17	80.33	71.36	79.00	75.00
March	[3] 57.00	43.90	51.60	49.67	84.00	72.71	80.40	77.67
April	[4] 66.50	50.00	59.40	57.67	80.83	77.80	77.00	76.33
May	72.33	58.92	68.40	65.67	79.33	71.81	74.40	72.33
June	72.17	47.05	66.60	65.83	77.33	68.15	70.40	69.00
July	75.00	69.18	70.00	69.33	78.00	71.72	71.40	70.00
August	83.00	76.11	79.60	76.33	78.67	72.30	74.00	71.67
September	81.83	70.78	79.40	75.17	78.17	71.19	74.60	71.00
October	81.83	68.68	76.60	73.33	76.17	66.86	70.60	65.67
November	82.83	67.85	73.00	75.00	72.67	64.24	67.00	62.67
December	83.67	69.31	71.60	73.00	72.00	64.97	69.00	65.17
Year	71.86	62.78	66.23	64.49	78.22	69.82	73.60	70.79

[1] Prices are f.o.b. factory except those for brand No. 1, which are for deliveries Boston freight-rate points.
[2] Average, August-December.
[3] One price only.
[4] Average of two prices only.

TABLE 13.—*Average prices per ton of four brands of scratch feed, by months, January, 1913, to June, 1920, inclusive*—Continued.

Month.	1919				1920			
	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.	No. 1, Boston.	No. 2, Memphis.	No. 3, St. Louis.	No. 4, Chicago.
January	$71.50	$65.68	$69.40	$65.33	$76.17	$66.75	$76.00	$72.17
February	66.00	60.20	64.60	58.83	76.50	68.22	73.40	70.17
March	65.33	62.67	68.00	60.50	77.83	68.44	74.00	74.00
April	71.17	67.13	72.40	65.83	79.83	71.50	78.60	78.00
May	72.67	68.96	74.00	69.00	86.17	77.00	85.60	86.67
June	75.00	71.46	78.00	71.33	90.33	78.67	82.00	85.50
July	79.83	74.91	81.60	76.33	.....	.....	.....	.....
August	84.67	76.55	85.60	82.00	.....	.....	.....	.....
September	80.00	63.20	77.40	75.00	.....	.....	.....	.....
October	74.33	63.58	71.60	69.00	.....	.....	.....	.....
November	73.83	64.70	73.60	70.50	.....	.....	.....	.....
December	75.33	.....	75.60	72.83	.....	.....	.....	.....
Year	74.14	[5] 66.72	74.32	69.71	[6] 81.14	[6] 71.76	[6] 78.27	[6] 77.75

[5] Average, 11 months.
[6] Average, January-June.

TABLE 14.—*Average prices per ton of 5 brands of scratch feed, f. o. b. factory, at specified points, by months, January, 1915, to June, 1920, inclusive.*

Month.	1915					1916				
	No. 1, New York State.	No. 2, Ohio.	No. 3, St. Louis.	No. 4, Illinois.	No. 5, Memphis.	No. 1, New York State.	No. 2, Ohio.	No. 3, St. Louis.	No. 4, Illinois.	No. 5, Memphis.
January	.....	[1] $33.71	$33.00	$34.83	$31.77	$33.59	$32.54	$32.25	$32.00	$29.88
February	.....	[1] 35.83	37.00	35.50	34.67	35.24	[1] 33.59	33.00	33.67	28.28
March	.....	35.48	35.00	35.83	35.90	35.00	[1] 31.39	32.00	33.50	29.85
April	.....	35.49	35.00	36.33	35.01	34.00	31.44	32.00	32.00	29.96
May	.....	35.75	36.00	38.00	35.09	34.38	[1] 32.95	32.00	32.67	30.15
June	$36.57	34.92	33.50	37.00	33.24	34.21	32.08	32.00	33.00	30.05
July	36.50	34.12	33.00	37.00	32.23	34.91	32.56	31.00	33.17	30.12
August	36.50	34.16	33.50	36.50	32.85	37.43	36.23	37.00	35.33	33.10
September	36.38	31.97	33.25	35.17	29.95	40.98	39.31	40.50	40.00	36.79
October	35.17	29.42	31.00	34.50	27.23	42.25	40.04	41.50	41.50	38.31
November	34.09	29.73	31.50	31.50	28.42	46.89	46.53	47.00	48.50	40.73
December	33.29	28.91	31.50	31.17	29.13	46.20	44.96	47.00	46.17	43.65
Year	[2] 35.86	31.56	33.60	35.28	31.63	38.23	35.79	36.44	36.79	32.92

Month.	1917					1918				
	No. 1, New York State.	No. 2, Ohio.	No. 3, St. Louis.	No. 4, Illinois.	No. 5, Memphis.	No. 1, New York State.	No. 2, Ohio.	No. 3, St. Louis.	No. 4, Illinois.	No. 5, Memphis.
January	$46.25	$46.08	$47.00	$45.83	$41.80	$80.13	$74.70	$75.25	$71.83	$66.44
February	48.30	48.46	49.00	47.83	42.41	80.05	76.45	78.75	74.33	66.39
March	49.88	49.57	52.75	50.17	42.65	79.06	[3] 80.40	80.50	80.00	67.21
April	54.19	[1] 58.91	.....	59.17	45.37	79.36	.....	76.25	77.67	70.12
May	65.22	66.80	.....	67.17	49.27	74.05	75.33	73.00	71.67	68.43
June	66.77	67.15	.....	65.83	51.89	71.61	70.43	68.00	64.75	67.91
July	66.43	67.96	.....	68.83	65.99	71.50	72.16	69.00	69.75	67.76
August	70.70	79.54	.....	75.83	74.05	71.77	70.70	69.00	74.25	68.76
September	78.75	74.05	[3] 76.00	74.67	68.37	73.60	71.63	69.00	71.58	66.62
October	78.90	67.36	75.00	73.17	69.97	70.00	64.55	71.00	65.58	67.18
November	76.56	73.97	75.50	70.83	62.89	67.42	62.62	68.00	64.08	64.96
December	78.83	79.81	75.00	70.83	63.43	64.75	64.47	69.50	64.58	59.94
Year	65.80	63.67	[2] 64.32	64.18	56.83	72.44	[2] 68.53	72.27	70.84	67.14

[1] Average price for two dates.
[2] Average for less than 12 months.
[3] Price for one date only.

TABLE 14.—*Average prices per ton of five brands of scratch feed, f. o. b. factory, at specified points, by months, January, 1915, to June, 1920, inclusive*—Continued.

Month.	1919					1920				
	No. 1, New York State.	No. 2, Ohio.	No. 3, St. Louis.	No. 4, Illinois.	No. 5, Memphis.	No. 1, New York State.	No. 2, Ohio.	No. 3, St. Louis.	No. 4, Illinois.	No. 5, Memphis.
January	$65.10	$65.67	$71.00	$67.58	$62.81	$72.88	$71.34	$76.50	$72.25	$64.31
February	62.55	60.03	65.50	64.92	61.82	72.36	73.17	73.75	69.92	65.00
March	61.14	60.56	67.00	62.92	57.69	75.94	73.59	72.25	71.92	65.88
April	63.81	67.41	71.50	66.58	61.66	78.00	77.10	73.75	76.58	.....
May	69.10	70.24	73.25	69.25	61.47	81.00	86.67	77.50	82.92	.....
June	71.50	69.08	75.50	73.08	67.80	83.83	89.00	[5] 83.00	84.25	.....
July	73.90	75.51	77.75	75.75	68.99	.....	.....	.....	.....	.....
August	78.91	81.35	85.00	81.92	72.35	.....	.....	.....	.....	.....
September	79.28	72.41	73.00	74.58	71.46	.....	.....	.....	.....	.....
October	72.40	67.88	68.25	68.92	70.15	.....	.....	.....	.....	.....
November	71.45	68.65	70.00	69.58	60.78	.....	.....	.....	.....	.....
December	71.63	70.51	74.25	70.42	63.80	.....	.....	.....	.....	.....
Year	72.74	68.39	72.67	70.46	66.16	[4] 77.34	[4] 78.48	[4] 76.12	[4] 76.31	.....

[4] Average, January–June.
[5] Price for one date only.

TABLE 15.—*Average prices per ton of two brands of poultry mash, f. o. b. Boston and St. Louis, respectively, by months, January, 1913, to June, 1920, inclusive.*

Month.	1913		1914		1915		1916	
	No. 1, Boston.	No. 2, St. Louis.	No. 1, Boston.	No. 2, St. Louis.	No. 1, Boston.	No. 2, St. Louis.	No. 1, Boston.	No. 2, St. Louis.
January	$31.50	$32.00	$38.17	$37.00	$39.00	$38.60	$38.00	$38.00
February	35.17	32.00	38.00	35.00	40.00	42.40	38.83	38.60
March	37.00	32.00	38.00	35.40	39.00	40.00	38.67	37.40
April	37.00	32.00	39.00	36.00	40.17	37.60	38.50	37.00
May	37.00	32.00	38.17	37.00	40.17	37.60	38.50	37.00
June	37.50	32.40	38.00	37.00	40.50	37.00	37.50	36.60
July	37.50	34.00	38.00	34.60	40.00	37.00	37.50	37.60
August	38.17	35.00	39.83	38.00	40.00	38.00	38.83	41.40
September	39.00	37.40	40.50	40.60	39.00	36.00	41.83	44.00
October	38.67	39.00	38.50	38.40	38.00	35.00	42.67	42.60
November	38.50	39.00	38.50	37.60	37.00	35.00	43.83	44.40
December	38.67	37.00	38.67	36.00	37.17	36.40	45.83	43.60
Year	37.14	34.48	38.61	36.88	39.17	37.55	40.21	39.85

Month.	1917		1918		1919		1920	
	No. 1, Boston.	No. 2, St. Louis.	No. 1, Boston.	No. 2, St. Louis.	No. 1, Boston.	No. 2, St. Louis.	No. 1, Boston.	No. 2, St. Louis.
January	$46.33	$44.40	$69.67	$65.60	$73.00	$74.60	$76.17	$77.00
February	48.67	45.60	71.00	68.60	70.00	71.60	78.83	77.00
March	[1] 50.00	49.00	73.50	69.60	70.17	72.00	79.67	78.60
April	[2] 60.00	56.60	73.00	67.00	71.00	75.60	82.17	82.00
May	61.67	63.40	73.00	65.60	72.00	74.00	85.67	86.30
June	59.33	62.40	73.00	65.00	72.33	74.00	87.50	84.30
July	59.67	64.40	75.00	63.40	73.33	75.60	.....	.....
August	64.00	65.40	73.00	64.60	76.33	80.60	.....	.....
September	61.50	64.60	72.67	72.00	76.83	76.60	.....	.....
October	62.50	65.00	71.67	72.00	74.50	73.60	.....	.....
November	65.17	65.00	71.00	72.00	74.33	75.00	.....	.....
December	67.17	66.00	71.00	74.00	75.33	75.40	.....	.....
Year	58.83	59.32	72.13	68.28	73.26	74.88	[3] 81.67	[3] 80.90

[1] Price for one date only.
[2] Average of prices for two dates.
[3] Average, January–June.

TABLE 16.—*Average prices per ton of three brands of poultry mash, f. o. b. factory, at northern Illinois points, by months, January, 1917, to June, 1920, inclusive.*

Month.	1917			1918			1919			1920		
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.
January	$43.67	$43.17	.....	$61.67	$65.50	$69.00	$68.08	$68.83	$73.00	$79.75	$74.00	$82.00
February	46.33	44.83	.....	63.00	70.83	72.00	68.75	61.50	74.33	79.75	75.33	82.67
March	45.67	47.33	[1]$51.00	64.00	71.50	75.67	70.75	64.83	73.00	79.75	78.17	83.00
April	54.00	55.33	51.00	62.00	69.33	77.00	74.75	67.50	73.00	79.75	80.67	85.00
May	57.67	61.00	58.33	59.33	67.17	77.00	81.25	71.50	73.00	88.42	84.67	88.00
June	58.50	62.33	60.00	58.58	65.83	72.00	82.75	71.00	73.00	89.75	85.33	91.00
July	58.83	65.33	60.00	58.42	66.33	72.00	83.08	74.50	73.00	.....	.....	.....
August	61.50	67.83	68.33	62.42	69.50	75.00	86.75	78.92	79.67	.....	.....	.....
September	61.50	63.50	66.00	65.42	72.67	75.00	86.08	75.67	83.00	.....	.....	.....
October	61.50	59.50	67.33	66.25	67.00	73.67	81.75	72.00	80.00	.....	.....	.....
November	60.67	63.33	66.00	66.92	68.00	73.00	79.75	72.17	80.00	.....	.....	.....
December	60.00	63.67	69.00	66.75	69.83	73.00	78.08	73.17	80.67	.....	.....	.....
Year	55.82	58.10	[2]61.70	62.90	68.62	73.69	78.48	71.22	76.31	[3]82.86	[3]79.36	[3]85.28

[1] Average of two prices.
[2] Average March–December.
[3] Average January–June.