

Oklahoma Agricultural Experiment Station,

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FATTENING STEERS; USING COTTONSEED, COTTONSEED MEAL, WHEAT MEAL, WHEAT STRAW AND HAY.

I—CONDITIONS AND RESULTS.

INTRODUCTION.

The steer feeding experiments herein detailed were carried on during the winter of 1901-2 at the Oklahoma Experiment Station farm. The plan for the winter's steer feeding experiments had been to continue a series of experiments, that had been under way for the two previous winters, in which corn meal, Kafir meal, alfalfa hay and Kafir stover were being compared as beef producers, but due to the condition, related later, the work was postponed to a more opportune time for completion, and steer feeding work with cottonseed products, which had been contemplated for some time, was started with the view of continuing it at some future time.

The widespread drouth of the summer of 1901 caused a great shortage in the corn crop of the Mississippi valley and central west, a total failure in many parts, and a material shortage in other feeds, which was followed by a corresponding rise in the price of feed stuffs, and a decline in the price of feeding stock throughout the country. Corn or Kafir corn was not obtainable in the locality of the experiment

station at anything like a reasonable price in comparison with other feed stuffs, hence they were not used in the feeding experiments of the winter. Due to the fact that a good average wheat crop was harvested the summer of 1901, wheat was a much more available stock food than corn in this locality, as well as in many others in the west, and was cheaper in price, and for these reasons it was substituted in our rations where corn would have been used under ordinary circumstances.

The extremely high prices of feeds in the fall of 1901 kept many feeders from putting their cattle on full feed and many cattle which ordinarily would have been fattened that winter were roughed through to be fattened later. Due to the low price of feeding steers at this point and a prospect for a fair market for fat cattle in the spring, we predicted that there was as good an opportunity for profit in fattening cattle that winter as usual, and we realized our expectations as we made handsome profits on the steers above the cost of steers and feed.

Not many years ago, nine-tenths of the steers were fattened on corn with anything as corn stover, wheat straw or low grade prairie hay for roughage, and the remark was frequently made, "the less roughage they would eat the more corn they will consume and so much the better." Although this old idea has been hard to eradicate, the ration for the fattening steer is usually much different at the present time and the progressive feeder realizes the importance and economy of adding some nitrogenous feed as the oil meals, mill by-products, alfalfa hay, etc., to the corn to balance up the ration. Although corn will usually constitute the bulk of the most economical ration for fattening steers, there are many instances, particularly in the southern states, where it is wholly left out and in many of these instances other feeds have been used in its place with economy. Some of these are products of the cotton crop. They are very important factors in steer feeding operations today, not only in the South, but in the great corn districts of the Mississippi valley and Central West. Except where alfalfa is very cheap they are probably a necessary portion of the most economical ration for fattening steers in any part of the great beef producing districts of the United States. The true feeding value of the cottonseed products is not understood by many and they are wastefully used in a large number of cases.

SELECTING AND COMPOUNDING RATIONS.

The farmer today who does not consider well the composition or digestibility of the feeds to be used and compare the same closely

with the market values of the respective feeds, and use them accordingly, is very likely to come out of his steer feeding operations with the balance on the debtor side of his ledger. He must get the idea out of his head that a pound of cottonseed meal differs but a little from a pound of corn meal, or that a fork full of alfalfa hay is but little different from a bundle of corn stover or wheat straw, and he must not draw the conclusion that whatever feed is the handiest, or costs the least per pound is the article to feed the steer. He must learn that the cottonseed meal and alfalfa hay are foods that belong to a group that are termed nitrogenous foods, since they contain a large per cent of the compound that the chemist calls protein, which is the most important ingredient in the composition of feeds.

If the feeder would investigate he would find that if a few pounds of cottonseed meal were substituted for a few pounds of the corn where nothing but corn and corn stover or wheat straw were being fed the steers, the gains would be increased twenty-five to fifty per cent and the cost of gain greatly reduced although the cottonseed meal might have cost a third more or double as much as the corn replaced. On the other hand if nothing but cottonseed meal and hulls were being fed, if a few pounds of corn or a like feed were added he would obtain better gains from his steers and, as a rule, at a less cost.

Along with the ingredient, protein, found in all feeds, there are two other substances in feeds that are considered in selecting and compounding rations. One of these is known by the name carbohydrates, a substance made up of the starch, sugars and fiber of plants. The third substance is called fat, which is made up principally of the oils of the plants or feeds. The carbohydrates and fats of feeds are very similar in their composition, and perform very much the same functions in building up or maintaining the animal body. They differ in composition from protein, principally in that they do not contain nitrogen, which is a very important element in protein. The muscles, nerves, tendons, blood, etc., of the animal contain a large amount of protein. They are built up in the animal system from life like substances found in the feeds, of which the gluten, that makes wheat gum, which is familiar to all, is a very good example. No matter in what abundance the carbohydrates and fats are furnished in the feeds, they cannot take the place of the protein and if the protein is not present in the feed in sufficient quantity, growth or increase will be retarded accordingly. The scientist has found that in order to obtain the greatest gains on the least amount of feed, the ration must contain these compounds, protein,

carbohydrates and fats, in certain proportions and amounts, which vary for the different kinds of animals and under different conditions. The information obtained by investigators has been arranged in tables called feeding standards and others giving the composition and digestibility of the feeds, which if properly used by the feeder will greatly aid him in selecting and mixing the feeds he is to use. The dry matter given in the feeding standards and in the tables giving the digestible nutrients or their composition, is the water free material of the feed. It is given in the feeding standards as a guide in obtaining the proper bulk or volume in the ration.

More space cannot be taken here to explain these terms and related matter that is important for every feeder to know and understand, and if the reader has not informed himself on these lines he is advised to procure some of the current books and station bulletins on feeds and their compositions, or write to the experiment station for reports that have been published here to explain these subjects. A full understanding of the matter will enable the reader to profit much more by the study of this bulletin.

PURPOSE OF THE EXPERIMENT.

The principal object of this experiment was to study the best combinations and the feeds with which to mix the products of the cotton crop in order to produce the most desirable rations for fattening steers, and to what degree steers so fed should be ripened.

FEEDS USED.

The local condition at the time of this experiment made it seem expedient to use cottonseed, cottonseed meal, wheat meal, wheat straw, prairie hay and alfalfa hay in our rations.

The cottonseed was purchased at the gins of Stillwater. Some of it was from the first pickings, and some from the late pickings of cotton. It was fed in the condition just as brought from the gins. The ginner had not adopted the up-to-date cleaners, consequently the seed had the usual amount of dirt and sand in it, which generally collected in the feed trough more or less after each feed, particularly where the cottonseed was fed as the exclusive grain ration. The seed was considered good average quality and was fairly closely ginned.

The cottonseed meal was purchased from stock produced by the cottonseed oil mills at Guthrie and Oklahoma City, towns 50 and 80 miles from the station. It was from the crop of 1901 and was a first-class article.

The wheat used consisted of both hard and soft varieties raised in this locality, and was very good milling wheat. It was ground fine with a Bowsher No. 8 feed grinder, run by electric power.

The wheat straw was purchased among the farmers who delivered the most of it baled. Due to the open dry season, it was very bright and in first-class shape. The portion which was fed mixed with the grain fed to one lot of steers was cut into pieces about an inch long by running through a power feed cutter.

The prairie hay was from the native meadows in the locality of the Station and contained the usual mixture of grasses found in such fields, although the hay was very free of the weeds that are present in so many native meadows. The hay had been well put up and was of a very good quality.

The alfalfa was raised on the Station farm and was of a good average quality.

COST OF FEEDS.

The prices, given in Table I, column No. 1, were used in calculating the cost of the rations that were planned to be used at the beginning of the experiment. As the season advanced prices advanced and average prices of these feeds for the time during the experiment are given in column 2, table I, which were taken in computing the cost of the gains of the steers and the profits. The prices given are about twenty per cent higher than the usual price of these feeds in this locality, with the exception of the wheat straw in which there is an increase of three hundred per cent and wheat which is about normal.

TABLE I.

GIVING COST OF FEED AT BEGINNING OF THE EXPERIMENT AND AVERAGE COST FOR THE TIME OCCUPIED BY THE EXPERIMENT.

| | No. I. Price per Ton | No. II. Price per Ton |
|----------------------|-------------------------|--------------------------|
| Cottonseed..... | \$14 00 | \$16 28 |
| Cottonseed Meal..... | 25 00 | 25 72 |
| Wheat Meal..... | 23 00 | * 23 60 |
| Wheat Straw..... | 4 00 | 5 00 |
| Prairie Hay..... | 8 00 | 9 89 |
| Alfalfa Hay..... | | 14 00 |

* 68 cents per bu. and 5 cents per cwt. for grinding.

In determining the combinations and proportion of the feeds to use in the rations at the beginning of the experiment, the prices of the feeds given in column 1, as well as the composition of the feeds were considered.

STOCK USED.

Twenty-five head of native grade steers raised in the locality of the Station were used in the experiment. With the exception of five head they were purchased by the Experiment Station as yearlings the fall of 1900. The ones then purchased were roughed through that winter, run on grass the following summer, at the close of which they were put into the experiment. When purchasing the steers the idea was kept in mind that they were later to be divided into lots for comparison in experimental feeding and from the time they were purchased a close study was made of each individual with the view of later dividing the bunch into lots for such use. The other five head were purchased in the fall of 1901, a few weeks before the beginning of the experiment.

Shorthorn blood predominated in the bunch but some individuals were considerably mixed. The steers were gathered with the view of representing an average bunch of native grade steers such as are found in Oklahoma. They were very much mixed in quality and mostly quite low, a few were classed as "good," most of them as "medium," and some as "inferior," according to the market classes for feeders. They were taken off the grass in medium flesh, the individuals varying in this respect. They were not as fleshy as good grass steers generally are, as the season had been very dry and for a month previous to October 30, the day they were taken off the pasture, their feed had been a stalk field and dry pasture. At the beginning of the experiment the twenty-five head averaged near 1000 pounds in weight and 18 months in age. From the time they were taken from the pasture until they were put into the experiment, November 26, they were on a preliminary grain and roughage ration, which filled them up fairly well.

The cattle feeders at the cottonseed oil mills, who are purchasers of hundreds of cattle in this country, paid \$3.00 to \$3.25 per hundred-weight for feeders in this locality the fall of 1901, and the steers put into this experiment were valued at \$3.25 per hundred weight.

PRELIMINARY FEEDING.

In order to get the steers well adjusted into lots, and accustomed to the surroundings, and partially on to feed before the experiment proper

began, they were handled as follows: On being brought from the pasture October 30, they were at once put on corn stover for roughage and a mixture of one-third cottonseed, one-third cottonseed meal and one-third wheat chop for grain. At first the grain consisted of one pound per day per steer and was raised very slowly and at the beginning of the experiment, November 26, they were receiving only four pounds per day per steer although at one time they had been as high as six pounds. The idea was not to get the amount of grain too high before changing to their special rations. A week was taken in which to make the change from the preliminary grain ration to the special rations of the different lots, which was complete at the beginning of the experiment. Meantime the roughage had been gradually changed.

OUTLINE OF THE EXPERIMENT.

Where cattle are fattened largely on cottonseed meal, trouble has usually occurred when such cattle have been fed longer than ninety to 100 days, and they are usually marketed after so long a feeding period, at the end of which time they are about in such condition as short fed corn cattle, considerably under ripened. Accordingly it was decided to market these steers after about three months feeding.

The experiment proper began November 26, 1901, and closed March 11, 1902, covering a period of 105 days. This time was divided into three equal periods of thirty-five days each which are designated as Periods I, II and III. The experiment, as well as each period commenced in the middle of the forenoon, after the morning's grain had been fed but before the roughage for that day had been fed, and the time of ending corresponded.

The twenty-five head were divided into five lots of five steers each, giving due attention to the important point of so dividing the steers that the lots would be closely comparable, which with our previous knowledge of the steers was done with a fair degree of satisfaction. The groups of five were designated Lots 1, 2, 3, 4 and 5.

Each lot of five steers was put in a separate pen 50x110 feet which contained a well built shed 14x16 feet with the south side open. A grain trough 4x8 feet by 6 inches deep, and a box rack 5x10 feet, with a rail 2 feet above the edge for the steer's neck to go under was the equipment for receiving the feed, where the steers in each lot were fed together. The pens were fairly well drained; fillings were made in the sheds and around the feed racks and boxes with dirt and the yards were not uncomfortably muddy for the steers for any considerable

time. The sheds were kept fairly well bedded with some material that the steers would not eat.

Water was furnished in each pen from a tank arranged with an automatic valve to keep the tank full all the time. The source of the water was a large pond, so located that the quality of the water was not first-class and not the most desirable for fattening steers. During the very cold spells the water was kept from freezing by the use of tank heaters. Salt boxes in the corners of the sheds were kept filled by weighing the salt in.

The day's allowance of grain was divided into two equal feeds and fed at 7:30 o'clock a.m. and 5:30 o'clock p. m. The appetites of the steers were watched very closely and they were given all the grain they would eat up clean within a half hour after being fed, up to a limited amount, in some cases limited to prevent scouring, the idea being to give them all they would eat without getting off feed. If a steer refused to eat or left the trough when there was still considerable grain in it, his share or portion of it was taken out at once. This was not followed with lot 5 for as a rule they always left some of their cottonseed and this was not taken out until the next feed was put in. All changes in the amount of the grain rations were made very gradually, as a rule not over one-half pound per day per steer, with several days between changes. Once in a while, frequently no cause could be assigned for it, a steer or several steers would go off feed, and often take to scouring. At such time the grain ration would at once be reduced half for several feeds until the steer or steers were all right. It always brought about a speedy recovery, generally in a day's time.

The roughage was fed once a day about 9:30 o'clock in the morning after the refuse of the preceding day had been removed. The idea was carried out to limit the prairie hay to the amount prescribed in the rations planned at the beginning. Of the straw, they were given all they would eat and from a fifth to a third more was fed than was eaten, but still most of them did not eat what was calculated for them in the starting rations. The feeds were all carefully weighed and sampled for analyses to be made at the chemical laboratory.

At the time of sampling, from one to three weeks' allowance of the feeds were weighed up, and as a matter of regularity, this was weighed again when fed to the steers daily. In the cases where more than one grain was in the ration, these were thoroughly mixed when the week's allowance was weighed out. The hay and straw were weighed up separately but were thoroughly mixed at the time of feeding. In the

lot that had the cut straw fed with the cottonseed meal, these materials were mixed in the feed trough at time of feeding. As the refuse was gathered it was stored until the end of each period when it was weighed at the time of sampling. Before subtracting it from the feed fed it was calculated to the same water content as when fed.

The steers were weighed individually on a small bullock scale. Each steer had a different number which was made in the ears by a system of notches. For the beginning weights of the experiment and the closing weights of each period of thirty-five days, weighings were made on three consecutive days and an average of these weights was taken for the weights from which to calculate the gains. In addition to this, one weighing was made at the beginning of every seventh day to aid in studying certain matters. On weigh days the covers on the water tanks were closed in the morning before the steers had time to drink, and the steers were weighed at 8:00 a. m. after the morning grain had been eaten.

Two fairly thrifty shoats were placed behind each lot of five steers at the beginning of the experiment and the same individuals were kept there until the close of the experiment. When put into the pens the lots of pigs averaged 176 to 220 pounds. It was not anticipated from our previous experience that the hogs would be able to obtain much sustenance in the droppings of the steers. Judging by former work we knew that they would not do at all well if compelled to live wholly on such droppings, no matter how much they had access to, so the plan was adopted to feed them some grain additional. This was ground wheat in all lots and the amount was varied from time to time as a matter of study. The idea was to give a very light feed in order to force the pigs to utilize the droppings, although they might not do first-class in the meantime.

The season taken altogether was fairly favorable for steer feeding. The cold weather set in earlier than usual, December being much colder than ordinarily, several days reaching zero or near to it. A couple of light snows fell during this month. Freezing and stormy weather prevailed the latter part of January and first of February, which time coincided with the latter part of the second period that closed February 4. But during the entire time of the experiment, the temperature did not go lower than two degrees below zero and then for only a day or so at a time, and there were many fine bright days when it hardly reached freezing. The rainfall was light and few storms

hindered in the least, and most of the time, the yards were in very good condition.

RATIONS USED IN THE EXPERIMENT.

The following combinations of feeds were decided upon to be used at the beginning of the experiment; how long they should be continued without change to be governed by the results obtained; as to how the steers would eat and fatten on them.

Ration I A.—Cottonseed, 12 pounds; cottonseed meal, 3 pounds; wheat straw, 10 pounds; prairie hay, 4 pounds

Ration II A.—Wheat meal, 11½ pounds; cottonseed meal, 3½ pounds; wheat straw, 10 pounds; prairie hay 4 pounds.

Ration III A.—Cottonseed, 12 pounds; wheat meal, 5 pounds; wheat straw, 10 pounds; prairie hay, 4 pounds.

Ration IV A.—Cottonseed meal, 10 pounds; wheat straw, 20 pounds (one-half of the straw to be cut and mixed with the meal as fed.)

Ration V A.—Cottonseed, 13 pounds; wheat straw, 10 pounds; prairie hay, 4 pounds.

These rations were to be fed to lots I, II, III, IV, and V, respectively. They were compounded as a day's feed for a steer weighing 1000 pounds, and the feeds in each ration were so combined with the idea of coming as near to furnishing the nutrients prescribed for such an animal in the recognized feeding standards as the feeds in the different rations would permit, and still keep the cost of the same at the minimum.

DIGESTIBLE NUTRIENTS IN FEEDS OF AVERAGE QUALITY.

In calculating the rations to be used, the per cents of digestible nutrients in the various feeds were taken as given in table II. With the exception of prairie hay, which was taken from bulletin No. 81, Kansas Experiment Station, they were taken from Henry's "Feeds and Feeding."

TABLE II.
DIGESTIBLE NUTRIENTS IN FEEDS.

| | Dry Matter in 100 Pounds | Digestible Nutrients in 100 lbs. of Feed. | | | Nutritive Ratio |
|----------------------|--------------------------------|--|--------------------|------|--------------------|
| | | Protein | Carbo- hydrates | Fats | |
| Cottonseed | 89.7 | 12.5 | 30. | 17.3 | 1: 5.7 |
| Cottonseed Meal..... | 91.8 | 37.2 | 16.9 | 12.2 | 1: 1.2 |
| Wheat..... | 89.5 | 10.2 | 69.2 | 1.7 | 1: 7.2 |
| Wheat Straw..... | 90.4 | .4 | 86.3 | .4 | 1:93.1 |
| *Prairie Hay..... | 85. | 3.5 | 41.8 | 1.4 | 1:12.9 |
| Alfalfa Hay..... | 91.6 | 11. | 39.6 | 1.2 | 1: 3.9 |

*Kan. B. 81.

FEEDING STANDARD AND DIGESTIBLE NUTRIENTS IN RATIONS I A TO V A.

In Table III is given the amount of food nutrients required per day for a 1000 pound steer according to the recognized feeding standards, and the nutrients that the different rations I A to V A would have furnished according to Table II, if all of each ration had been eaten by the steers.

TABLE III.
NUTRIENTS REQUIRED AS PER FEEDING STANDARDS AND THOSE CALCULATED
(ACCORDING TO TABLE I.) AS FURNISHED IN RATIONS I A TO V A.

| | Pounds per Day per 1000 lb. Steer. | | | | | | |
|------------------------|------------------------------------|------------|--------------------|-------|--------------------|-----------------|-------|
| | Dry Matter | Digestible | | | Nutritive Ratio | * Cost Cents | |
| | | Protein | Carbo- hydrates | Fat | | | |
| Standard { | First Period | 30 | 2.5 | 15.00 | 0.5 | 1 : 6.5 | |
| | Second Period | 30 | 3. | 14.50 | 0.7 | 1 : 5.4 | |
| Ration No. I A..... | 26 | 2.79 | 9.41 | 2.53 | 1 : 5.5 | 15 3-4 | |
| Ration No. II A | 26 | 2.65 | 13.85 | 0.72 | 1 : 5.8 | 21 1-5 | |
| Ration No. III A | 28 | 2.19 | 12.36 | 2.26 | 1 : 8.1 | 17 3-4 | |
| Ration No. IV A..... | 27 | 3.8 | 8.95 | 1.30 | 1 : 3.2 | 16.5 | |
| Ration No. V A..... | 24 | 1.8 | 9.20 | 2.34 | 1 : 8.2 | 12 3-4 | |

* See Column I, Table I.

It should be noted wherein rations I A to V A differ radically from the standard. A pound above or below the protein given in the standard would be a wide variation, a difference of four pounds either way in the carbohydrates, and one pound too much of the fats, would be a wide variation. Variations as great as these will not enable the animal to utilize the food nutrients to the best advantage and in some cases, such variations may cause serious derangement in the animal system, as scouring, lack of appetite, etc. Compared with the nutrients in the standard, ration II A is very good and agrees very closely in every particular; in ration I A the most serious defect is that it contains about four times too much fat, 2.03 pounds above the standard, and is quite low in carbohydrates; ration III A has the same serious defect as ration I A in having far too much fat, and it is a little low in protein and carbohydrates; ration IV A is very high in protein and quite low in carbohydrates and quite high in fats; ration V A is irregular in every respect, being quite deficient in protein and carbohydrates and very high in fats. As has been stated these were the rations that were planned to be fed to lots I, II, III, IV and V respectively, but there was a doubt about getting the steers to eat all of some of the rations, and now the portions which were eaten and what changes had to be made should be noted.

CHANGES IN RATIONS.

First, the preliminary feeding previous to the beginning of the experiment demonstrated that some alterations were necessary at once. The full amount, four pounds, of the prairie hay prescribed was fed and all eaten in the lots that received it. The prescribed amount of straw was not as well eaten, particularly by some of the lots of steers. Of the 10 pounds of straw in ration I A, not over seven-tenths was eaten at any time during periods I and II, and that amount for but one week, and for half of the time, not over four-tenths was eaten. With lot II it was much better, and for a week or two they ate more than the ten pounds of wheat straw and most of the time they ate more than three-quarters of the prescribed amount, but as with all the lots the amount varied from time to time. Lot III, for a very short time, ate about one-half of the ten pounds prescribed in ration III A, but during most of the time during periods I and II, they ate only two to three-tenths of the amount. In ration IV A it was found that the ten pounds of cut straw would be too much bulk to mix with a day's feed of grain, and the amount was reduced to four pounds which

made the mixture of the grain and straw about right and was practically all eaten by the steers. As the ration was planned this would have left sixteen pounds of whole straw per steer per day. For about a week they ate a trifle over twelve pounds but the amount gradually fell off and for four-fifths of the time it ran above five pounds. Of the ten pounds in ration V A about half was usually eaten during periods I and II. In all rations from a fifth to a third more straw was fed than was eaten.

Some difficulty was experienced in getting some of the lots to eat the amounts of grain prescribed in their rations. Although the steers had been on grain for several weeks previous to the beginning of the experiment, it was found not advisable to give them the full amount of grain prescribed in rations I A to V A for several weeks and some of the lots never reached the amount contained there. Where the grain in the rations was composed of a mixture, the proportion started with was always the same until a change, noted later, was made at the end of the tenth week or second period. Up to this time lot I was never able to eat the fifteen pounds of grain prescribed in ration I A. The amount eaten was usually about two pounds too low. After getting on full feed, lot II was very well satisfied with the fifteen pounds of grain in ration II A but during the greater part of the experiment, a little less than the full amount was eaten. (In this ration as in the others, with the exception of lot V, the grain per 1000 pounds of live weight is referred to.) Lot III, up to the time the change in the ration was made, lacked one to two pounds of eating the seventeen pounds of grain prescribed in ration III. Lot IV ate without trouble the full amount (ten pounds) of cottonseed meal in ration IV A, and more than this at times towards the close of the experiment. In ration V A only about two-thirds of the prescribed thirteen pounds of cottonseed was eaten at any time during the entire experiment. The amount eaten per steer per day was very close to eight pounds most of the time, sometimes over and sometimes under. The steers refusing to eat the amounts of feed in the rations as planned in I A to V A reduced the nutrients available, and changed their relations more or less which fact is noted later by referring to Table V. With these alterations that might be said to have been made mostly by the steers themselves, the rations as planned were fed during periods I and II, or 70 days of the experiment.

At the close of the second period a change was made in the grain mixtures of lots I and III, and in the roughage of lot V. In ration I,

the grain, that for periods I and II, rations I B and I C, had been twelve parts cottonseed and three parts cottonseed meal, was changed to eight parts and seven parts respectively, for period III, ration I D. In ration III, the grain, that for periods I and II, rations III B and III C, had been twelve parts cottonseed and five parts wheat meal, was changed to eight parts and nine parts respectively, for period III, ration III D. In ration V, the roughage, that for periods I and II, rations V B and V C, had been prairie hay and straw, was changed by the prairie hay being dropped at once and all the alfalfa the steers would eat gradually put in its place, for ration V D that was eaten during period III. The changes in the grain of lots I and III made it more appetizing but they did not eat any more grain per day than what they were eating before the changes; and per 1000 pounds weight they ate a little less. Lot I ate a little more straw, and III some less. The alfalfa was greatly relished by lot V and it was gradually raised in amount until they were eating about twenty pounds per day by the third week after the change. These changes were made for the reason that the steers in lots I, III and V were not making good gains on the former rations. This point is commented on fully later. Lot IV was making about the same gains as lots I and III, but no change was made in its ration as it was desired to ascertain what results could be obtained with such a ration for the entire feeding period, as a similar ration is quite commonly used by feeders in the south.

EXPLANATION OF TABLES.

In order to get such data, as the feed eaten and nutrients furnished by same, gains made, cost of gain, and the net returns, for each lot of steers fed on the various rations during the different periods, in form for ready comparison, the following tables are given:

The grain and roughage eaten by the different lots during the different periods are given in Table IV. The feed eaten is calculated as the daily average per steer per 1000 pounds weight. The rations eaten during period I are designated B; those eaten during period II, C; those eaten during period III, D.

TABLE IV.
GIVING FEED EATEN PER DAY DURING PERIODS I, II AND III, AND COST OF SAME.

| PERIOD I, 35 DAYS | POUNDS EATEN PER DAY PER STEER PER 1000 LBS. WEIGHT | | | | COST OF FEED † |
|---------------------------|--|---------------------------|----------------------------|-----------------------------|-------------------|
| | Grain Pounds ‡ | Wheat S' raw Pounds | Prairie Hay * Pounds | Total Roughage Pounds | Cents |
| Ration No. 1 B..... | 10.23 | 6.10 | 3.82 | 9.92 | 11.1 |
| Ration No. 2 B..... | 10.81 | 9.90 | 3.85 | 13.75 | 16.2 |
| Ration No. 3 B..... | 11.92 | 4.82 | 3.83 | 8.65 | 12.3 |
| Ration No. 4 B..... | 9.24 | †11.96 | | 11.96 | 13.9 |
| Ration No. 5 B..... | 7.96 | 7.12 | 3.84 | 10.96 | 8.5 |
| PERIOD II, 35 DAYS..... | | | | | |
| Ration No. 1 C..... | 12.47 | 4.07 | 3.63 | 7.70 | 12.3 |
| Ration No. 2 C..... | 14.68 | 8.14 | 3.51 | 11.65 | 20.2 |
| Ration No. 3 C..... | 14.08 | 2.80 | 3.61 | 6.41 | 13.7 |
| Ration No. 4 C..... | 10.29 | †10.04 | | 10.04 | 14.9 |
| Ration No. 5 C..... | 7.76 | 5.93 | 3.78 | 9.71 | 8.1 |
| PERIOD III, 35 DAYS | | | | | |
| Ration No. 1 D†..... | 12.39 | 3.74 | 3.45 | 7.19 | 13.9 |
| Ration No. 2 D..... | 14.16 | 5.44 | 3.29 | 8.73 | 19.0 |
| Ration No. 3 D†..... | 13.07 | 3.10 | 3.40 | 6.50 | 14.3 |
| Ration No. 4 D..... | 11.29 | †7.91 | | 7.91 | 15.7 |
| Ration No. 5 D†..... | 7.03 | 1.97 | *15.38 | 17.35 | 16.0 |

*Alfalfa hay instead of prairie hay, Ration 5 D.

†Four pounds of this was eaten as cut straw mixed with grain.

‡Note change in ration, pages 13 and 14.

§See Table I, column I, page 5.

¶For character of grain see pages 10 and 15.

In order that the reader may have the facts in mind at this point, the following statements are repeated:

The grain ration of lot II consisted of eleven and one-half parts of wheat meal and three and one-half parts of cottonseed meal by weight, for all the period without change. The grain ration of lot I, for periods I and II, consisted of twelve parts of cottonseed and three parts of cottonseed meal by weight; for period III the grain consisted of eight parts cot-

tonseed and seven parts cottonseed meal; the grain of lot III consisted of twelve parts cottonseed and five parts wheat meal during periods I and II; and eight parts cottonseed meal and nine parts wheat meal during period III; the grain of lot IV was cottonseed meal for all periods without change; the grain of lot V was cottonseed for all the periods without change.

In table V are given the food nutrients (calculated from Table II), contained in rations I to V, B, C and D that were eaten during periods I, II and III respectively, as given in Table IV. The rations in Table V are designated B, C, and D, to correspond with Table IV. In addition to these are given the nutrients as given in the feeding standards and the average daily gain per steer per lot for the different periods.

TABLE V,
GIVING FOOD NUTRIENTS REQUIRED FOR FATTENING STEERS, ACCORDING TO FEEDING STANDARDS, AND THE FOOD NUTRIENTS EATEN DURING PERIODS I, II AND III, BY THE DIFFERENT LOTS OF STEERS.

| | POUNDS PER DAY FOR A 1000lb STEER | | | | | Average Daily Gain Per Steer Pounds |
|---------------------------|-----------------------------------|----------------------|---------------------|------------|-----------------|-------------------------------------|
| | Dry Matter Pounds | DIGESTIBLE NUTRIENTS | | | Nutritive Ratio | |
| | | Protein Pounds | Carbohydrates, lbs. | Fat Pounds | | |
| Standard, 1st period..... | 30. | 2.5 | 15.0 | 0.5 | 1:6.5 | |
| Standard, 2nd period..... | 30. | 3.0 | 14.5 | 0.7 | 1:5.4 | |
| Standard, 3rd period..... | 26. | 2.7 | 15.0 | 0.7 | 1:6.2 | |
| 1ST 35 DAYS..... | | | | | | |
| Ration No. 1 B..... | 18. | 1.95 | 6.61 | 1.75 | 1:5.5 | 2.85 |
| Ration No. 2 B..... | 22. | 1.95 | 11.97 | .55 | 1:6.5 | 3.54 |
| Ration No. 3 B..... | 18. | 1.56 | 8.29 | 1.59 | 1:7.8 | 2.29 |
| Ration No. 4 B..... | 19. | 3.49 | 4.92 | 1.18 | 1:2.2 | 2.45 |
| Ration No. 5 B..... | 17. | 1.16 | 6.59 | 1.46 | 1:8.7 | 1.12 |
| 2ND 35 DAYS..... | | | | | | |
| Ration No. 1 C..... | 18. | 2.32 | 6.40 | 2.10 | 1:4.9 | .88 |
| Ration No. 2 C..... | 24. | 2.58 | 12.79 | .70 | 1:5.6 | 2.15 |
| Ration No. 3 C..... | 18. | 1.80 | 7.83 | 1.86 | 1:6.8 | 1.42 |
| Ration No. 4 C..... | 19. | 3.86 | 5.38 | 1.29 | 1:2.2 | 1.80 |
| Ration No. 5 C..... | 16. | 1.13 | 6.06 | 1.43 | 1:8.4 | .69 |
| 3RD 35 DAYS..... | | | | | | |
| Ration No. 1 D..... | 18. | 3.11 | 6.63 | 1.91 | 1:3.6 | 2.05 |
| Ration No. 2 D..... | 20. | 2.48 | 11.43 | .66 | 1:5.2 | 2.13 |
| Ration No. 3 D..... | 17. | 1.60 | 9.18 | 1.24 | 1:7.6 | 2.50 |
| Ration No. 4 D..... | 18. | 4.23 | 4.78 | 1.41 | 1:1.9 | 1.52 |
| Ration No. 5 D..... | 22. | 2.58 | 8.91 | 1.42 | 1:4.8 | 1.95 |

Table VI gives the average amount of grain, the average amount of roughage and the average amount of dry matter eaten for each pound of gain made by the steers; the average daily gain made per steer and the average cost of the feed eaten per pound of gain, for periods I, II and III, and the average of the above for periods I and II, and for I, II and III.

TABLE VI,
 GIVING AVERAGE DAILY GAIN PER STEER, AVERAGE AMOUNT OF GRAIN, ROUGH-
 AGE AND DRY MATTER EATEN PER POUND OF GAIN MADE BY THE
 STEERS, AND COST OF FEED EATEN PER POUND OF GAIN.

| PERIOD I, 35 DAYS..... | AM'T EATEN PER LB. OF GAIN | | | Average Daily Gain Per Steer Pounds | Average Cost of Feed Eaten Per Pound of Gain Cents * |
|--|----------------------------|-------------------------|---------------------------------|--|---|
| | Grain † Pounds | Rough- age Pounds | Total Dry Matter Pounds ‡ | | |
| Ration No. 1 B..... | 4.55 | 4.41 | 7.97 | 2.35 | 5.7 |
| Ration No. 2 B..... | 3.17 | 4.08 | 6.39 | 3.54 | 5.1 |
| Ration No. 3 B..... | 5.43 | 3.94 | 8.35 | 2.29 | 6.4 |
| Ration No. 4 B..... | 3.87 | 4.30 | 8.00 | 2.45 | 6.0 |
| Ration No. 5 B..... | 7.26 | 10.04 | 15.29 | 1.12 | 9.3 |
| PERIOD II, 35 DAYS | | | | | |
| Ration No. 1 C..... | 15.52 | 9.58 | 22.78 | .88 | 17.7 |
| Ration No. 2 C..... | 7.78 | 6.18 | 12.59 | 2.15 | 11.4 |
| Ration No. 3 C..... | 10.97 | 4.99 | 14.41 | 1.42 | 12.0 |
| Ration No. 4 C..... | 8.54 | 8.41 | 15.59 | 1.30 | 12.5 |
| Ration No. 5 C..... | 11.88 | 14.86 | 23.85 | .69 | 14.8 |
| AVERAGE FOR PERIODS I AND II, 70 DAYS | | | | | |
| Ration No. 1, B and C | 7.55 | 5.83 | 12.02 | 1.62 | 9.0 |
| Ration No. 2, B and C | 4.91 | 4.84 | 8.73 | 2.84 | 7.5 |
| Ration No. 3, B and C | 7.55 | 4.34 | 10.67 | 1.86 | 8.6 |
| Ration No. 4, B and C | 5.52 | 6.19 | 10.64 | 1.88 | 8.3 |
| Ration No. 5, B and C | 9.02 | 11.88 | 18.55 | .91 | 11.4 |
| PERIOD III, 35 DAYS | | | | | |
| Ration No. 1 D..... | 6.95 | 4.04 | 10.03 | 2.05 | 8.7 |
| Ration No. 2 D..... | 7.96 | 4.91 | 11.67 | 2.13 | 11.2 |
| Ration No. 3 D..... | 8.15 | 3.05 | 8.29 | 2.50 | 7.4 |
| Ration No. 4 D..... | 8.47 | 5.93 | 13.34 | 1.52 | 11.9 |
| Ration No. 5 D..... | 3.98 | 9.84 | 12.39 | 1.95 | 9.6 |
| AVERAGE OF PERIODS I, II AND III, 105 DAYS | | | | | |
| Rations No. 1, B, C, D | 7.32 | 5.13 | 11.25 | 1.77 | 8.8 |
| Rations No. 2, B, C, D | 5.75 | 4.86 | 9.54 | 2.62 | 8.5 |
| Rations No. 3, B, C, D | 7.01 | 3.82 | 9.71 | 2.07 | 8.1 |
| Rations No. 4, B, C, D | 6.37 | 6.09 | 11.42 | 1.76 | 9.3 |
| Rations No. 5, B, C, D | 6.05 | 10.67 | 15.36 | 1.25 | 10.5 |

*See Table II, Column II, for prices of feed used.

†See page 15 for character of grain.

‡As determined by analysis.

In Table VII is given the total gain made and the total cost of feed eaten by each lot of steers during the entire experiment, 105 days; and the selling price per hundred weight on the Kansas City market, and the net returns (amount sold for minus first cost of steers, cost of feed and expense of marketing, freight, yardage and commission), for each lot of five steers.

TABLE VII.

GIVING TOTAL GAINS; COST OF FEED FOR THE ENTIRE EXPERIMENT; SELLING PRICE PER CWT., AND NET RETURNS FOR EACH LOT OF STEERS.

| | Total Gain per lot | ** Av. Weight per Steer | * Total Cost of Feed per lot | Selling Price of Steers per cwt | Net Returns of Steers per lot |
|----------------|-----------------------|----------------------------|---------------------------------|------------------------------------|----------------------------------|
| Lot No. 1..... | 927 | 1190.8 | \$ 82 07 | \$ 5 20 | \$ 36 56 |
| Lot No. 2..... | 1374 | 1252.2 | 117 05 | 5 60 | 39 62 |
| Lot No. 3..... | 1088 | 1221.4 | 87 94 | 5 40 | 47 57 |
| Lot No. 4..... | 923 | 1167.8 | 86 39 | 5 25 | 35 28 |
| Lot No. 5..... | 659 | 1139.4 | 62 15 | 5 00 | 24 25 |

* See Table I, Column II, Page 5.

**Mar. 11, Last Wt. in Experiment.

FACTORS TO BE CONSIDERED IN COMPARING FEEDING RESULTS.

Many interesting and instructive points are revealed by a careful study and comparison of the data in Tables III, IV, V, VI and VII. In using the data in these tables and making comparisons between lots and between periods as to the desirability and efficiency of the different rations a few fundamental facts should be borne in mind, namely

First; With the fattening steer, the daily gains become less as the fattening period advances, granting that the character of the feed in the rations is not changed and the other conditions are uniform and normal during the meantime. In other words the fattening steer will gain more during the second month than during the fourth month. An example of conditions, other than a change in the character of the ration that would alter the above statement, would be a case where the weather was more favorable during the fourth month than during the second.

Second; The number of pounds of a given ration required to produce a pound of gain on a fattening steer, will increase in amount as the fattening period advances and the steer increases in weight, granting as in the first case, that the other conditions and factors that affect the

fattening steer, are normal and uniform throughout the time considered. For example the feed required to produce a pound of gain in the fourth month would be more than that required for the second month of the fattening period of the steer.

Third; The gain made by the fattening steer may be more, and the amount of feed or dry matter required to produce a pound of gain may be less, during the fourth month of the fattening period than during the second; if a change is made from the ration used during the second month or the early part of the fattening period, to a more suitable ration for the fourth month, or the latter part of the fattening period. By a more suitable ration is meant one that contains the nutrients nearer the normal amounts and proportions and furnished in palatable feeds. The normal amounts and proportions of nutrients can be considered to be those prescribed in the feeding standards.

Fourth; A ration that may be best, or give good results, for a portion of the fattening period of the steer may not without change give good or the best results for the entire fattening period. This may be the case even with what might be considered normal rations. A variety, and changes during the fattening period are desirable for several reasons and should be studied.

Fifth; As the fattening period advances the appetite of the steer becomes less vigorous and as he is usually fed, he eats less feed per day per 1000 pounds of his weight during the latter part of the feeding period than was the case during the early part. Particularly is this true if he is fed on the same ration without change during the fattening period, and more particularly if said ration differs widely from a normal ration or is unsuitable in some other respect.

Sixth; In the ration of the fattening steer, a certain bulk or volume is necessary for the best results. Usually a large part of this is furnished in the roughage, and if the roughage is unpalatable or fed in insufficient amounts, the grain and roughage will not be eaten in desirable proportions to obtain the proper volume or condition in the stomach. If the ration contains the most desirable proportion of grain to the roughage, the "dry matter" contained in the ration will not fall more than eight or ten pounds below the amount of dry matter prescribed in the feeding standards. This should be given close attention where the grain consists of meal of any kind.

Seventh; The largest gain in weight does not always cost the least

per pound or enable the steer to return the largest net profit when marketed.

Eighth; The gain in weight that costs the least per pound does not necessarily mean the largest net profit on the fattened steer.

Ninth; Taken singly, the gains made by the steers, the feed required to produce a pound of gain, the market value of the cattle when fattened do not tell which ration has given the most desirable or economical results. These factors should be considered in conjunction in order to decide which ration was the most desirable for beef production.

Tenth: The cost of feeds varies greatly due to different seasons and in different localities, consequently the cost of a given ration and the gain produced by it, will vary quite widely from time to time due to this so it is well to have in mind or in view, the number of pounds of a given ration required to produce a pound of gain, and the total gain produced or the market condition in which it puts the steer.

Eleventh; The manure made daily by a fattening steer will contain fertilizing ingredients in such amounts that if commercial fertilizers were purchased to obtain them, they would cost from six to ten cents per day. The fertilizing ingredients, nitrogen, phosphoric acid, and potash, in the manure produced during the 105 days by the different lots of steers in this experiment, would have cost, if they were purchased in commercial fertilizers, as follows: Lot I, \$47.52; lot II, \$52.61; lot III, \$37.37; lot IV, \$60.60; lot V, \$34.47. Averaging these results per day per steer, the following values in cents are obtained: Lot I, 9.05; lot II, 10.02; lot III, 7.11; lot IV, 11.54; lot V, 6.56. (These results are obtained by assuming that three-fourths of the fertilizing ingredients in the feeds fed, pass through the steer into the manure, and valuing them at the usual market price of these ingredients per pound; nitrogen, 15 cents; phosphoric acid, 7 cents; potash, 4.5 cents.)

REVIEW OF THE PALATABILITY OF THE RATIONS AND AMOUNTS EATEN.

Before comparing the results produced by the various rations with the gains made, grain eaten per pound of gain and cost, net returns, etc., the character of the feed in the rations and their effect on the appetite of the steers and the amount eaten, and the nutrients furnished by same, should be fully in the mind of the reader. The amount of grain and roughage eaten per steer per day by the different lots is

summarized in Table IV. Quite full comment has been made on this subject on page 13, so little comment further is necessary here. At this time it is well to recall the previous statement, that in feeding the steers, the idea was to feed them all the grain they would eat without getting them off feed. This was not carried out with lot IV.

The grain of lots I, II and III had a tendency to scour the steers when they were fed an unlimited quantity of it and for this reason the amount of grain fed to these lots was limited, but at times the amount given would reach a point where the steers would leave a little. This would, as a rule, be followed by scouring.

Lot V would eat about so much of the cottonseed and leave the rest in the trough. During the entire experiment they showed no signs of scouring.

Lot IV would have eaten considerable more of the cottonseed meal, but the fact was in our mind that large quantities of cottonseed meal fed to steers, for instance all they want, fourteen to eighteen pounds per day, will after about sixty days' feeding produce other very detrimental effects on the steers, and for this reason the amount of cottonseed meal fed to lot IV was limited, and at no time during the experiment did they show any signs of scouring.

Here it is well to bear in mind that the straw was fed in unlimited quantities and the prairie hay was given in a regular stated amount of four pounds per day per steer, and that the hay was all eaten, and that most of the lots could not be said to have been on full feed before the third week of the experiment. With the exception of the straw, lots II and IV ate the rations practically as planned in II A and IV A, page 10, while the other lots consumed considerably less grain and but a small portion of the straw figured on in rations A, as is clearly shown in Table IV.

THE FOOD NUTRIENTS IN THE RATIONS AS EATEN, COMPARED WITH THOSE IN THE STANDARDS.

A comparison of the nutrients furnished by the different rations as eaten with those prescribed in the standard, and in the rations that were planned to have been fed, affords an interesting study and valuable suggestions. Referring to Tables III and V it will be seen that the steers fed on rations II, B, C and D, were the only ones that got anywhere near the nutrients as prescribed in the standards; and that this lot, after

getting on a full feed of grain, obtained the nutrients practically as contained in II A, the ration as planned, which corresponded very closely with the standard; falling a little low in the protein and carbohydrates. Judging by the feeding standard, ration II would be considered about perfect, and referring to the gains made and the feed required to produce same, given elsewhere, the results produced will be seen to be highly satisfactory. (See Table VI and VII, lot II.)

In rations IV, B, C and D, the carbohydrates are materially less, and the protein more than was planned for in ration IV A, which makes a still greater variation from the standard. Quite a portion of the straw in IV A being refused reduced the carbohydrates, and more cottonseed meal being eaten than was figured on there, increased the protein. The point should be noticed, that more protein was eaten in ration IV, B, C and D than in any of the other rations, but the amount was only about thirty-three per cent above the standard in this respect, while the carbohydrates fall short about half and the fats are twice too high. The ration would be called a very highly nitrogenous ration and in most cases a wasteful and expensive one and not capable of producing maximum gains. (See Table VII, lot IV.)

The character of rations II and IV was not changed during the entire experiment, while at the end of period II, the changes given on page 13 were made in I, III and V. By referring to rations I, III and V, B and C in Table V, the excessive amount of fat in each of them is a very striking point, although the amount is not as much as was figured on in the A rations. Rather than eat the very excessive amount of fat in the A rations, the steers were willing to subsist upon a smaller amount of feed that did not furnish the other nutrients in sufficient quantity. Still the other nutrients did not lack to the degree that the fat was in excess. From the amounts given in the standards, the protein fell twenty-two per cent to sixty-two per cent short, the carbohydrates forty-four per cent to fifty-eight per cent short, while the fat was 104 per cent to 250 per cent too high. These figures are for periods I and II. The change to rations I D, III D and V D at the beginning of the third period enabled the steers to eat a larger amount of total nutrients without eating any more fat than they were eating in periods I and II, and with III D the amount of fat was materially reduced. By noting the gains made during period III over those of period II the beneficial effect of reducing the excessive proportion of fat can be seen. From the above it can be said to be unwise to figure on a ration for a fattening steer,

that would contain over one and one-half pounds of fat per day and as a rule the maximum should be placed at one and one-quarter pounds. By comparing the gains made on I C and I D, and III C and III D, it seems as important not to have the fat run too high in the rations of fattening steers as it is not to have the protein too low. The change from I C to I D increased the protein from 2.43 pounds to 3.11 pounds, fifteen per cent above the standard, and decreased the fat from 2.10 pounds to 1.91 pounds, 173 per cent above the standard. The change from III C to III D decreased the protein from 1.80 pounds to 1.60 pounds, forty-one per cent below the standard, and decreased the fat from 1.86 pounds to 1.24 pounds, seventy-eight per cent above the standard. Nevertheless the gain on III D was 438 pounds, on I D, 360 pounds, per lot; III D lacking forty per cent in protein, thirty-nine per cent in carbohydrates and having seventy-eight per cent too much fat, gave much better gains than I D, having fifteen per cent too much protein, fifty-nine per cent too little carbohydrates and 173 per cent too much fat. On comparing the results produced by rations I, III and IV and V with the results produced on such a ration as II, that comes very close to the requirements of the standards, it will be seen that rations I, III, IV and V were not very efficient in producing gains. (See Tables VI and VII.)

The foregoing results demonstrate the advisability of using the feeding standards and the tables giving the nutrients in the different feeds, as guides in compounding rations; also the need of more experimentation to determine the feeding value of certain feeds and in what combinations to feed them.

DAILY GAINS MADE AND FEED REQUIRED PER POUND OF GAIN.

The feeder will probably take more interest in studying Tables VI and VII than he has with the foregoing. Referring to Table VI, it will be seen that ration II which consisted of cottonseed meal and wheat meal for grain, and wheat straw and prairie hay for roughage, produced very good gains throughout the experiment, 105 days, and the amount of feed or dry matter required to produce a pound of gain was very satisfactory. In these points this ration was quite superior to any of the others given in Table VI, with the exception of III D which is really not comparable with ration II D for reasons mentioned elsewhere. The results of ration IV, which consisted of cottonseed meal and wheat straw, are referred to next as it, as well as ration II, was fed throughout the experiment without change. For rations of this kind the gains are very good and they stand second to those of ration II in the averages of periods

I and II. While the gains are much smaller than those produced by a well balanced ration, as II, the steers were put in a fair marketable condition on the ration without injurious effect to the steers, and at a profit that will be noted later.

The gains produced on the other rations and likewise the pounds of feed required to produce a pound of gain varied much in the different periods. Ration I, B and C, that during periods I and II consisted of twelve parts of cottonseed and three parts of cottonseed meal for grain, and wheat straw and prairie hay for roughage, produced during period I the third best gains, 2.35 pounds daily per steer; fair results but much below those produced on a good ration. The same ration I C differing only in amount, produced but .88 of a pound per day per steer in the second period and dropped down next to the lowest gain produced by any of the other rations. The gains were so inferior that for period III, the ration was changed from the above to eight parts of cottonseed and seven parts cottonseed meal, retaining the same roughage as before, and during period III, the gains increased to 2.05 pounds per day per steer. The increase in the gains in the third period over those in the second is remarkable but just what results ration I D would have produced if it had been fed from the beginning of the experiment is a question that can be answered only by further experimenting.

Ration III, B and C, that contained twelve parts cottonseed and five parts wheat meal for grain, and wheat straw and prairie hay for roughage during periods I and II, produced slightly smaller gains during period I than were produced by ration I B given above, but during period II the gains produced by ration III C was considerably better than those produced by ration I C, and slightly better than those produced by ration IV C (cottonseed meal for grain) for the same period. Due to the very small gains made during the second period, ration III, as given above, was altered by changing the grain to eight parts cottonseed and nine parts wheat meal. This ration fed during period III, produced a large increase in the gain over those obtained in period II; and a very important point to notice is that gains made in period III were larger than the gains made during period I; on ration III B. As with ration I D, the question arises what would have been the results if III D had been fed during periods I and II. It should be noted that the ration III D produced better gain in period III than were produced on ration II D, but the conclusion must not be drawn that it is a better ration or even as good a one as ration II D, as the steers in the two lots at the beginning of period III were altogether in different conditions and not comparable.

Ration V, B and C, consisting of cottonseed for grain, and wheat straw and a limited quantity of prairie hay for roughage, gave very small gains, by far smaller than any of the other lots, during periods I and II and was considered a flat failure as a ration for fattening steers. By substituting for the limited amount of prairie hay, all the alfalfa the steers would eat in ration V D, fed during period III, a gain was produced that was larger than the total gain made during periods I and II on the ration without the alfalfa. The gains made on this ration V D in period III are not quite as good as can be obtained on corn and alfalfa for a like period but the ration may prove practical in many cases for fattening steers.

TOTAL GAINS, HEALTH AND CONDITION OF STEERS.

By referring to Table VII it will be seen that for the 105 days, the entire time of the experiment, the lots of five steers each, that were fed the ration corresponding to their number, rank as follows in the total gains made: Lot II, first; lot III, second, falling below lot II by 346 pounds; lot I, third, falling below lot II 447 pounds; lot IV fourth, falling below lot II, by 450 pounds; Lot V fifth, falling below lot II by 715 pounds. The gains made by lot II were very fair but those made by the other lots were quite meager. During the experiment no serious break occurred in the health of the steers. Steer No. 50 in lot II had a swelling on one jaw for a time that resembled lumpy jaw but it did not interfere much with his eating or his health. It appeared December 7th, and was at its worst a few days later, and had disappeared within a week. While none of the lots had the scours seriously during the experiment, lot I was troubled during a portion of the last week of period II by two steers scouring, and the steers did not have time to recuperate after the scouring before the weighing for the close of the period was made, which partially accounts for the small gains made by lot I during period II. On an occasion or two in lots II and III a steer or two was affected with very light cases of scours but not at a critical time as in lot I. No scours appeared in lots IV or V. Lot IV gave every sign of perfect health with the exception that one steer in the lot was accustomed to vomiting at times. It did not seem to affect his appetite or health otherwise. From all appearances the steers in lot IV could have been continued for several weeks on the feed they were receiving without causing any detrimental results in their health. Aside from having a very dejected look nothing could be seen out of the way in the health of lot V.

NOT—Table VII may be found on Page 19.

At the close of the experiment there was quite a difference in the finish or the degree to which the different lots were fattened. None of the lots could be said to be fully finished. While lots II and III were fairly well fattened for cattle of their class, they would be classed as short fed cattle, particularly lot III. Lots I and IV would be said to be only well warmed up as they were rough and bare. Lot V would be classed as nothing more than fleshy feeders and their quality made them appear quite rough and coarse.

SELLING PRICE COMPARED WITH THE GAINS.

The lots were sold on the Kansas City market in the lots of five, just as they were fed and the buyer was requested to price each individual lot on its merit, and as if it were a carload. Table VII gives the selling price per hundred weight of the different lots which corresponds fairly well with the gains made by the different lots. Considering the first cost of the steers, \$3.25 per hundred weight, and the total cost of the feed eaten by each lot, and the selling price it will be seen by Table VII that the steers in lot III returned \$47.57 net; lot II, \$39.62; lot I, \$36.56; lot IV, \$35.28; lot V, \$24.25. In considering these net profits it should be borne in mind that the margin between the price of the feeder steer and the finished bullock is very wide in these cases, much wider than can be counted on as a rule. The prices of the feeds in another season or a price nearer normal for the feeders would make a marked difference in the net returns.

RESULTS FROM PIGS FOLLOWING THE STEERS.

As has been stated, each lot of steers was followed by two shoats and the idea was carried out to make the pigs subsist to quite an extent upon the droppings, although they might not make the gains that would compare with well fed hogs. From the beginning of the experiment, November 26 to January 6 each lot of pigs was fed two pounds of wheat meal per day per pig. With this amount the pigs worked the droppings over very well but were quite hungry and made very little gain in weight. For the above reason the wheat meal was raised on January 6 to five pounds per day per pig and kept at this amount until February 5. On the change the gains were better, but still small, and the droppings were not worked over as well. For further results on a smaller amount of grain, the wheat meal was reduced on February 5 to two pounds per day per pig and the amount continued until February 19. This made the pigs look after the droppings closer but they were making very small

gains so the wheat meal was raised again to five pounds per day per pig and the amount continued until the close of the experiment. For four days interval between the close of the experiment and the shipping, the pigs were given a liberal amount of feed. Table VIII gives the final weight of each lot of pigs, total gains made during the experiment, and grain eaten per lot and per pound of gain.

TABLE VIII.

GIVING GAINS OF PIGS FOLLOWING STEERS, AND GRAIN FED PER LOT PER LB. OF GAIN.

| | Results per Lot of 2 Pigs each | | | | |
|---|--------------------------------|-----------|-----------|-----------|-----------|
| | Lot No. 1 | Lot No. 2 | Lot No. 3 | Lot No. 4 | Lot No. 5 |
| | Pounds | Pounds | Pounds | Pounds | Pounds |
| Total Weight of Pigs Nov. 26..... | 207 | 221 | 225 | 209 | 177 |
| Total Gain in Pounds | 188 | 150 | 160 | 163 | 200 |
| Daily Gain Pounds per Pig, average..... | .87 | .71 | .76 | .78 | .95 |
| Total Grain Fed, lbs. | 620 | 620 | 620 | 620 | 620 |
| Grain, lbs. Fed per Pound of Gain..... | 3.39 | 4.13 | 3.87 | 3.80 | 3.10 |

There was somewhat of a variation in the gains made by the different lots but how far it could be attributed to the character of the droppings of the different lots of steers is a question. At the close of the experiment the pigs were in a condition to be marketed as light hogs and were shipped with the steers to Kansas City and sold in one bunch at \$6.15 per hundred weight. From Table VIII it will be seen that the amount of grain that was fed for each pound of gain is very low as compared with the amount of grain required to produce one pound of gain when pigs are fattened on a full grain ration fed from the trough. Considering only the grain fed to pigs, the gain cost considerably less than it sold for and with the very wide margin between the price of the pigs when put in the experiment and when taken out the profits on the pigs were remarkably good and added much to the net outcome of the steers. The fact should be noted that all the pigs lived, and part of them were behind steers that were fed cottonseed meal as grain.

SHIPPING AND MARKETING THE STEERS.

The experiment closed on the morning of March 11, but in order to ship the steers on a stock train they had to be held until the morning

of the 16th, on which date they were loaded on the cars about 4 o'clock a. m. They arrived at the Kansas City stock yards about 7 o'clock the next morning, the 17th, and were sold about 10:30 o'clock.

From the close of the experiment the feed was not changed in kind or amount until the morning of the 14th, two days before shipping. At this time the grain ration was reduced one-half, and in addition to the straw the steers were getting, they were given all the prairie hay they would eat. This was continued until the evening preceding the morning they were put on the cars. At noon on the 16th, sixteen hours before they were put on the cars, all water was shut away from them. On the evening of the 16th and in the night they were given all the grain they would eat and the following amounts were eaten: Lot I, eighty-one pounds; lot II, eighty-nine pounds; lot III, forty-seven pounds; lot IV, sixty-five pounds; lot V, fifty pounds. Lot V was fed the same kind of grain ration as lot III and lot V was given prairie hay. Towards midnight the steers were driven quietly and slowly to the railroad yards that are about a mile from the Station farm and loaded about 1 o'clock in the morning. A weight was made of each lot of steers on the morning of the 15th to use in determining the shrinkage of the steers in shipping. The per cent, shrinkage per lot, and the pounds shrinkage per steer, is given in Table X. The steers went through the shipping without scouring and made a very good fill, but not abnormal, and were in first class shape when sold. They were handled by the Evans-Snyder-Buel Commission Co., who were very careful to see that all our wishes were carried out in dividing the steers in the lots as they were fed, and selling each lot on its merits. The different packers rendered valuable assistance by carefully looking over the small lots and pricing each one separately. The steers were purchased by the Ruddy Packing Co., who very kindly made a slaughter test with each lot and furnished the data in this line given in Table IX. The prices that the different lots sold for are given in Table VII and the financial statement on page 32.

SLAUGHTER TEST.

The steers were slaughtered in lots of five as they were fed and sold and the results in Table IX obtained. In addition to the slaughter data given in that table the weights of each lot as sold in Kansas City and the last weight taken at the Station are given in order to show the shrinkage in shipping.

TABLE IX.
GIVING SLAUGHTER TEST DATA AND SHRINKAGE OF STEERS IN SHIPPING.

| | Lot 1 | | Lot 2 | | Lot 3 | | Lot 4 | | Lot 5 | |
|--------------------------------|-------|---------------|-------|---------------|-------|---------------|-------|---------------|-------|---------------|
| | Total | Av. per Steer | Total | Av. per Steer | Total | Av. per Steer | Total | Av. per Steer | Total | Av. per Steer |
| Wt. at Stillwater Mar. 15 ... | 5969 | 1193.8 | 6257 | 1251.4 | 6092 | 1218.4 | 5871 | 1174.2 | 5784 | 1156.8 |
| Wt. at K. C. Mar. 17..... | 5910 | 1182 | 6100 | 1220 | 6000 | 1200 | 5820 | 1164 | 5630 | 1126 |
| Shrinkage | 59 | 11.8 | 157 | 31.4 | 92 | 18.4 | 51 | 10.2 | 154 | 30.8 |
| Per Ct. Shrinkage | | .99 | | 2.5 | | 1.5 | | 8.6 | | 2.6 |
| Dressed Wt. of Carcasses | 3146 | 629 | 3512 | 702 | 3367 | 673 | 3300 | 660 | 3111 | 619 |
| Dressed Out per cent..... | | 53.2 | | 57.6 | | 56.1 | | 56.7 | | 55.3 |
| Wt. of Hides... | 294 | | 314 | | 301 | | 307 | | 288 | |
| Per Ct. of Hides | | 5 | | 5.1 | | 5 | | 5.3 | | 5.1 |
| Wt. of Tallow | 160 | | 440 | | 365 | | 375 | | 285 | |
| Per Ct. Tallow | | 3 | | 7.2 | | 6.1 | | 6.4 | | 4.2 |

Attention is called to the small shrinkage in shipping made by the different lots. Since the shrinkage is figured in a very fair way it speaks well for the method of preparing the steers for shipping. The dressed carcasses were carefully examined by the expert dressed-beef men of the Ruddy Packing Co., and the following is their report on the carcasses in the cooler.

“With reference to the beef from these cattle will say that lot 5 killed off-color and when cut did not show up quite as bright as the other lots. Lot 2 proved to be the best covered and the best cutting lot of the 25 cattle and you will note the yield was better than the other lots. Lot 1 did not come up to our expectations. While they were decently covered and did not cut bad, they did not have the appearance of lots Nos. 2, 4 and 3, nor did they prove to yield a comparative per cent. of beef. Lot No. 4 when dressed showed up satisfactory and cut well, while lot No. 3 appeared to be fair quality beef and a lot on which we could make no complaint. We expected, however, better results from them than the cattle in lot No. 4 but the latter lot when dressed show up better.”

On close questioning they stated that there was nothing objectionable about the color of any of the lots further than noted. This is an important point to note in connection with lot 4. The average steer fattened on cottonseed meal in the ordinary way has a dirty yellow fat and is objected to very much by the packers.

FINANCIAL OUTCOME OF THE FEEDING.

The reader should bear in mind that while it is important to know the profit or loss made on a given experiment, it is of more importance to study the gains produced by the different rations and the pounds of the feed required to produce 100 lbs. of gain and the market condition it will put the bullock in. The cost of feed and the relative price of the feeder and fat steer are very variable factors, and a ration that may have been fed at a profit one season may be fed at a loss the next. The relations of the profits between rations may be influenced likewise. In the financial statement is given the feed eaten by the different lots of steers and hogs, the cost of same, the first cost of the steers and pigs and their market value, and the cost of marketing.

FINANCIAL STATEMENT,

Giving profit or net returns on the different lots of steers and pigs over the first cost of the steers and the cost of feed, and expense of marketing.

LOT I—FIVE STEERS—TWO HOGS.

| | | |
|---|-----------|----------|
| | Dr. | |
| To 5 Steers 5027 lbs. at \$3.25 per cwt. | \$ 163.38 | |
| Feed as follows: | | |
| To 4761.47 lbs. Cotton Seed at \$16.28 per ton | 38.75 | |
| To 2025.36 lbs. Cotton Seed Meal at \$25.72 per ton .. | 26.04 | |
| To 2760.05 lbs. Wheat Straw at \$5.00 per ton | 6.90 | |
| To 2100.00 lbs. Prairie Hay at \$9.98 per ton | 10.38 | |
| Freight Stillwater to K. C., commission, yardage, feed | 20.70 | |
| | | \$266.15 |
| Expense of feed in holding last week | 4.61 | |
| | | \$270.76 |
| | Cr. | |
| By 5 Steers 5910 lbs. at \$5.20 per cwt. | \$307.32 | |
| Less | 270.76 | |
| | | \$36.56 |
| Total profit per lot | | 7.31 |
| Average profit per Steer | | |
| | Dr. | |
| To 2 Hogs 207 lbs. at \$3.50 per cwt. | \$7.24 | |
| To 620 lbs. Wheat Meal at \$23.60 per ton | 7.32 | |
| Freight from Stillwater to K. C., commission and yardage | 1.50 | |
| | | \$16.06 |
| Expense of feed during last week | .61 | |
| | | \$16.67 |
| | Cr. | |
| By 2 Hogs 408 lbs. at \$6.15 per cwt | \$25.09 | |
| Less | 16.67 | |
| | | \$8.42 |
| Total profits per lot | | 4.21 |
| Average profit per hog | | |
| | | \$44.98 |
| Total profits per lot on hogs & steers ... | | |

LOT II—FIVE STEERS—TWO HOGS.

| | | |
|--|----------|----------|
| | Dr. | |
| To 5 Steers 4887 lbs. at \$3.25 per cwt. | \$158.83 | |
| Feed as follows: | | |
| To 1844.05 lbs. Cotton Seed Meal at \$25.72 per ton.. | 23.71 | |
| To 6059.04 lbs. Wheat Meal at \$23.60 per ton | 71.50 | |
| To 4580.77 lbs. Wheat Straw at \$5.00 per ton | 11.46 | |
| To 2100.00 lbs. Prarie Hay at \$9.89 per ton | 10.38 | |
| Freight Stillwater to K. C., commission, yardage, feed | 21.23 | |
| | | \$297.11 |
| Expense of feed in holding last week | 4.87 | |
| | | \$301.98 |
| | | Cr. |
| By 5 steers 6100 lbs. at \$5.60 per cwt. | \$341.60 | |
| Less | 301.98 | |
| | | \$39.62 |
| Total profit per lot | | \$39.62 |
| Average profit per Steer | | 7.92 |
| | | Dr. |
| To 2 Hogs 221 lbs. at \$3.50 per cwt. | \$7.74 | |
| To 620 lbs. Wheat Meal at \$23.60 per ton | 7.32 | |
| Freight Stillwater to K. C., commission | 1.39 | |
| | | \$16.45 |
| Expense of feed during last week | .61 | |
| | | \$17.06 |
| | | Cr. |
| By 2 Hogs 396 lbs. at \$6.15 per cwt. | \$24.35 | |
| Less | 17.06 | |
| | | \$7.29 |
| Total profits per lot | | \$7.29 |
| Average profit per Hog | | 3.65 |
| Total profit per lot on Hogs and Steers | | \$46.91 |

LOT III—FIVE STEERS—TWO HOGS.

| | | |
|--|----------|----------|
| | Dr. | |
| To 5 Steers 5019 lbs. at \$3.25 per cwt. | \$163.12 | |
| Feed as follows: | | |
| To Cotton Seed 4733.64 lbs. at \$16.28 per ton | 38.53 | |
| To 2870.70 lbs. Wheat Meal at \$23.60 per ton | 33.88 | |
| To 2060.08 lbs. Wheat Straw at \$5.00 per ton | 5.15 | |
| To 2100.00 lbs. Prairie Hay at \$9.89 per ton | 10.38 | |
| Freight Stillwater to K. C., commission, yardage, feed | 20.95 | |
| | | \$272.01 |
| Expense of feed in holding last week | 4.42 | |
| Total Expenditures | | \$276.43 |
| | | Cr. |
| By 5 Steers 6000 lbs. at \$5.40 per cwt. | \$324.00 | |
| Less | 276.43 | |
| | | \$47.57 |
| Total profit per lot | | \$47.57 |
| Average profit per steer | | 9.51 |
| | | Dr. |
| To 2 Hogs 225 lbs. at \$3.50 per cwt | \$7.87 | |
| To 620 lbs. Wheat Meal at \$23.60 per ton | 7.32 | |
| Freight Stillwater to K. C., commission and yardage | 1.40 | |
| | | \$16.59 |
| Expense of feed during last week | .61 | |
| | | \$17.20 |
| | | Cr. |
| By 2 Hogs 399 lbs. at \$6.15 per cwt. | \$24.53 | |
| Less | 17.20 | |
| | | \$ 7.33 |
| Total profits per lot | | \$ 7.33 |
| Average profit per Hog | | 3.67 |
| | | 54.90 |
| Total profit per lot on Hogs and Steers | | 54.90 |

LOT IV.—FIVE STEERS—TWO HOGS.

| | | |
|---|----------|----------|
| To 5 Steers 4916 lbs. at \$3.25 per cwt. | \$159.77 | |
| Feed as follows: | | |
| To 588.27 lbs. Cotton Seed Meal at \$25.72 per Ton .. | 75.62 | |
| To 4311.09 lbs. Wheat Straw at \$5.00 per ton | 10.78 | |
| Freight Stillwater to K. C., commisson, yardage, feed | 20.45 | |
| | | <hr/> |
| | | \$266.62 |
| Expenses of feed in holding last week | 3.66 | |
| | | <hr/> |
| Total Expenditures | | \$270.28 |
| | | Cr. |
| By 5 Steers 5820 lbs. at \$5.25 per cwt. | \$305.55 | |
| Less | 270.28 | |
| | | <hr/> |
| Total profit per lot | | \$35.27 |
| Average profit per Steer | | 7.05 |
| | | Dr. |
| To 2 Hogs 209 lbs. at \$3.50 per cwt. | \$7.32 | |
| To 620 lbs. Wheat Meal at \$23.60 per ton | 7.32 | |
| Freight Stillwater to K. C., commission and yardage | 1.41 | |
| | | <hr/> |
| | | \$16.05 |
| Expense of holding last week | .61 | |
| | | <hr/> |
| | | \$16.66 |
| | | Cr. |
| By 2 Hogs 402 lbs. at \$6.15 per cwt. | \$24.72 | |
| Less | 16.66 | |
| Total profits per lot | | 8.06 |
| Average profit per Hog | | 4.03 |
| | | <hr/> |
| Total profit per lot on Hogs and Steers | | \$43.33 |

LOT V—FIVE STEERS—TWO HOGS.

| | |
|--|-----------|
| | Dr. |
| To 5 Steers 5038 lbs. at \$3.25 per cwt. | 163.74 |
| Feed as follows: | |
| To 4228.37 Cotton Seed at \$16.28 per ton..... | 34.40 |
| To 2760.31 lbs Wheat Straw at \$5.00 per ton | 6.90 |
| To 1400.00 lbs. Phairie Hay at \$9.89 per ton | 6.92 |
| To 2975 lbs. Alfalfa Hay at \$14.00 per ton | 20.83 |
| Freight Stillwater to K. C., commission, yardage, feed | 19.91 |
| | <hr/> |
| | \$252.70 |
| Expense of feed in holding last week | 4.53 |
| | <hr/> |
| Total Expenditures | \$ 257.23 |
| | Cr. |
| By 5 Stees 5630 at \$5.00 per cwt. | \$281.50 |
| Less | 257.23 |
| | <hr/> |
| Total profit per lot | \$24.27 |
| Average profit per steer | 4.85 |
| | Dr. |
| To 2 Hogs 177 lbs. at \$3.50 per cwt. | \$6.20 |
| To 620 lbs. Wheat Meal at \$23.60 per ton | 7.32 |
| Freight Stillwater to K. C., commission and yardage | 1.30 |
| | <hr/> |
| | \$14.82 |
| Expense of holding last week | .61 |
| | <hr/> |
| | \$15.43 |
| | Cr. |
| By 2 Hogs 367 lbs. at \$6.15 per cwt. | \$22.57 |
| Less | 15.43 |
| Total profit per lot | 7.14 |
| | <hr/> |
| Average profit per Hog | \$3.57 |
| Total profit per lot on Hogs and Steers .. | \$31.41 |

The value of the manure obtained can be considered to at least balance the labor bill in feeding steers and the interest on the investment. The freight rate was 28 cents per cwt. on the steers and 31 on the hogs. The commission for selling the steers was 50 cents, and the yardage 25 cents, per head. The hay was a little over eight cents per head on the steers. In considering the financial returns the fact should be kept well in mind that the conditions; as relating to price of feeds, feeding steers, and the fattened bullock; that existed during the winter of 1901-1902, were very unusual. The conditions were referred to, early in the bulletin. Much of the profit on the steers and hogs was due to the large advance obtained on the price of the finished animals over the ones put into the feed yard. Today the feeder steer is purchased with the expectation of getting an advance of 1-2 to 1 1-4 cents per pound on him when fattened. The margin between the feeders and the fattened steers used in this experiment ran from \$1.75 to \$2.35 per cwt. The superior degree to which Lot II was fattened gave them a market value of 20 cents per cwt. above the next best lot, Lot III but due to the more expensive ration of Lot II, Lot III gave the largest net returns. The returns for Lots I and III were very near the same. Even with the unsatisfactory ration of Lot V during periods I and II, they gave a net profit of \$24.25 for the 105 days, and not considering the profit of \$7.14 made on the hogs.

GENERAL SUGGESTIONS.

Judging from this and other experiments carried on at the Oklahoma Experiment Station, and observations made elsewhere, it is suggested where cottonseed is to be used in the ration of cattle, that not more than eight pounds of it be fed per day as a maximum amount, and generally four to six pounds will prove more satisfactory. In order to use it in the ration of the fattening steer, it must be fed with other highly nutritious feeds; and preferably those belonging to the nitrogenous group as alfalfa or cowpeas. Also it is desirable to mix the cottonseed with some other grain.

If ground grains or meals or small grain as Kafir corn or wheat are being fed to cattle, more thorough mastication and better results will be obtained if a few pounds of cottonseed are mixed with these feeds although other feeds as cottonseed hulls, some kind of chaffed hay or straw may answer the purpose.

While many steers are fattened in the South on cottonseed meal and cottonseed hulls, there is no doubt but what, as a rule, much

better gains would be procured and at a less cost, if some grain as corn, wheat, Kafir corn were mixed with the cottonseed meal and hulls, and it is a question if a little of some other roughage besides the hulls should not be used for the best and most economical results. In the experiment at this Station, steers were fattened successfully and economically on cottonseed meal and wheat straw by chaffing a portion of the straw and mixing it with the meal when fed, but very much larger gains were produced and much greater profit made on other steers fattened on a ration of 3 1-2 pounds of cottonseed meal and 11 1-2 pounds of wheat meal and a small amount of prairie hay and an unlimited amount of wheat straw. Again, as compared with the steers fattened on cottonseed meal and wheat straw, better gains and a greater profit were produced on other steers fattened on a ration in which cottonseed was mixed with the cottonseed meal. By mixing corn with the cottonseed meal similar results to those obtained with the wheat and cottonseed can be obtained but as a rule when the corn is used the profit will be greater as the corn will cost less than the wheat or cottonseed.

As related in the experiment in this bulletin, good gains were produced upon a grain ration of 11 1-2 pounds of wheat meal and 3 1-2 pounds of cottonseed meal and 4 pounds of prairie hay and an unlimited amount of wheat straw, but probably better results would have been obtained if some kind of chaffed hay or straw or cottonseed hulls had been mixed with the grain when fed. More prairie hay, or better still some alfalfa hay added to the roughage would have been very beneficial and probably economical.

Cottonseed and cottonseed meal are quite regular constituents in the grain fed to the herd of breeding cattle kept on the College Farm. The herd referred to includes bulls, cows and calves and numbers about thirty head. The addition of these feeds is found necessary for the most desirable and economical results. The rations for this stock are so planned that a mature cow will not as a rule get over two or three pounds of cottonseed meal, or three or four pounds of cottonseed, per day, and generally the amount does not reach the above. Corn or Kafir corn is always mixed with these feeds.

F. C. BURTIS,
Agriculturist.

II—CHEMICAL STUDY OF THE EXPERIMENT.

INTRODUCTION.

The discussion of the results of this experiment, from a feeder's standpoint (Part I), is based on average analyses and digestion coefficients which are available to feeders generally, except that actual figures for dry matter, as determined by analysis, were used. For the purpose of adding to the limited amount of available data as to the composition of some of the feeds used and of comparing the gains with the nutrients consumed by the different lots, chemical control of the experiment was maintained throughout. At the present stage of our investigations of this character, it was not practicable to make digestion trials with the different rations. Consideration of the digestibility of the different feeds has been omitted from the following brief summaries because of uncertainty as to the applicability of digestion coefficients, determined in the usual manner, to rations of this character being fed to fattening steers. Only the total nutrients were used in the calculations.

SAMPLING THE FEEDS.

During the first period, a sample of the grain ration as fed to each lot was taken for each week. During the second and third periods, samples of the separate grain feeds were taken before mixing the grain rations. Total moisture was determined in each sample as brought to the laboratory and later the samples for each lot, or of each feed, for each period of five weeks were combined for analysis.

One sample of wheat straw, representing that fed uncut to all lots, was taken when the straw was weighed out. Air-dry moisture was determined and later, the samples for each period were combined for analysis. The prairie hay and alfalfa were handled in the same manner. The cut wheat straw fed to Lot IV was sampled for the determination of air-dry moisture only.

The refused grain was saved until the end of each period, weighed, and sampled for analysis. Refused roughage was collected daily, stored, and sampled at the end of each period, giving one sample for each lot for analysis.

The hay, straw, and refused roughage were cut fine when sampled and 1000 grams were taken for the determination of air-dry moisture and subsequent combination for complete analysis, except in the case of refused roughage which was analyzed as sampled.

METHODS OF ANALYSIS.

The methods of the Association of Official Agricultural Chemists were, with minor exceptions, followed in making the analyses.

COMPARISON OF ANALYSES.

In the following table the average of the analyses made in this experiment are given and on the next line under each feed is the average analysis which was used in Part I.

TABLE X
ANALYSES MADE, COMPARED WITH AVERAGE ANALYSES.

| Source of Analysis | No. Analyses | Material | Water | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|----------------------|--------------|----------------------|-------|------|---------|-------|-----------------------|---------------|
| Okla | 3 | Cottonseed Meal... | 5.71 | 5.23 | 41.48 | 5.68 | 31.27 | 10.63 |
| "Feeds & Feeding"... | 35 | COTTONSEED MEAL..... | 8.20 | 7.20 | 42.30 | 5.60 | 23.60 | 13.10 |
| Okla | 3 | Cottonseed..... | 9.07 | 4.49 | 13.92 | 32.72 | 24.92 | 14.88 |
| "Feeds & Feeding"... | 5 | COTTONSEED..... | 10.30 | 3.50 | 18.40 | 23.20 | 24.70 | 19.90 |
| Okla | 2 | Wheat Meal..... | 9.86 | 1.52 | 14.14 | 2.85 | 69.75 | 1.88 |
| "Feeds & Feeding"... | 310 | WHEAT MEAL..... | 10.50 | 1.80 | 11.90 | 1.80 | 71.90 | 2.10 |
| Okla | 5 | Wheat Straw..... | 11.07 | 7.87 | 4.59 | 38.96 | 35.72 | 1.79 |
| "Feeds & Feeding"... | 7 | WHEAT STRAW..... | 9.60 | 4.20 | 3.40 | 38.10 | 43.40 | 1.30 |
| Okla | 3 | Prairie Hay..... | 11.03 | 6.39 | 4.72 | 33.31 | 42.41 | 2.14 |
| Kansas B. 103 | 1 | PRAIRIE HAY..... | 9.10 | 7.90 | 3.60 | 29.80 | 47.40 | 2.20 |
| Okla | 1 | Alfalfa Hay..... | 11.57 | 8.04 | 14.29 | 29.00 | 34.73 | 2.37 |
| "Feeds & Feeding"... | 21 | ALFALFA HAY..... | 8.40 | 7.40 | 14.30 | 25.00 | 42.70 | 2.20 |

The variations from average analyses are marked in the nitrogen-free extract and ether extract of cottonseed meal and in the protein and ether extract of cottonseed. Wheat meal differs widely from the average in protein and the protein in the wheat straw used is also higher than the average. Prairie hay is such a variable product that differences are to be expected. Alfalfa hay agrees very closely with the average.

SUMMARY OF FEEDING AND ANALYTICAL DATA.

In the following tables (XI to XIII) will be found summaries of the nutrients required to produce the gains which were obtained when the different rations were fed, and of the nutrients required to produce a pound of gain. The fodder analyses made in connection with the experiment are given in Table XIV.

While these results do not present sufficient data for the drawing of any conclusions, it appears from Table XIII that the usual digestion coefficients may not be applicable to rations of the sort fed in this experi-

ment. The wide variations in the amounts of dry matter required to produce a pound of gain, and especially the large amount required in Period II in each case, seem to indicate that the cottonseed and cottonseed meal had some physiological effect which is not understood. There appear to have been factors other than "digestibility" as the term is usually used. What these factors are and how they may be measured and controlled is an interesting problem.

JOHN FIELDS,
Chemist.

TABLE XI.

GAINS: TOTAL, FEED, DRY MATTER AND NUTRIENTS FED, REFUSED AND EATEN, lbs.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|-------------------------|--------------|------------|--------|---------|---------|-----------------------|---------------|
| Ration I B. | | | | | | | |
| Grain fed | 1988.00 | 1766.20 | 87.43 | 514.32 | 534.10 | 346.17 | 284.18 |
| Grain refused | 62.54 | 58.09 | 3.20 | 15.07 | 14.33 | 16.24 | 9.25 |
| Roughage fed | 2380.00 | 2061.50 | 166.65 | 105.15 | 825.18 | 915.38 | 49.14 |
| Roughage refused | 561.54 | 487.12 | 50.61 | 25.16 | 195.79 | 201.19 | 14.37 |
| Grain eaten | 1875.46 | 1708.11 | 84.23 | 499.25 | 519.77 | 329.93 | 274.93 |
| Roughage eaten | 1818.46 | 1574.38 | 116.04 | 79.99 | 629.39 | 714.19 | 34.77 |
| Total feed eaten | 3693.92 | 3282.49 | 200.27 | 579.24 | 1149.16 | 1044.12 | 309.70 |
| Gain | 412 | | | | | | |
| Ration I C. | | | | | | | |
| Grain fed | 2450.00 | 2243.71 | 116.81 | 462.49 | 545.16 | 732.35 | 386.90 |
| Grain refused | 43.63 | 39.95 | 2.58 | 8.09 | 9.91 | 11.98 | 7.44 |
| Roughage fed | 2030.00 | 1814.04 | 148.96 | 87.25 | 785.04 | 749.87 | 42.92 |
| Roughage refused | 554.44 | 486.54 | 40.27 | 17.71 | 221.74 | 193.67 | 13.15 |
| Grain eaten | 2406.37 | 2203.76 | 114.28 | 454.40 | 535.25 | 720.37 | 379.46 |
| Roughage eaten | 1485.56 | 1327.50 | 108.69 | 69.54 | 563.30 | 556.20 | 29.77 |
| Total feed eaten | 3891.93 | 3531.26 | 222.97 | 523.94 | 1098.55 | 1276.57 | 409.23 |
| Gain | 155 | | | | | | |
| Ration I D. | | | | | | | |
| Grain fed | 2505.00 | 2301.99 | 122.82 | 735.20 | 457.22 | 653.79 | 332.96 |
| Roughage fed | 1680.00 | 1509.09 | 116.41 | 81.29 | 662.19 | 623.90 | 25.30 |
| Roughage refused | 223.97 | 201.13 | 18.26 | 5.26 | 97.11 | 77.80 | 2.70 |
| Grain eaten | 2505.00 | 2301.99 | 122.82 | 735.20 | 457.22 | 653.79 | 332.96 |
| Roughage eaten | 1456.03 | 1307.96 | 98.15 | 76.03 | 565.08 | 546.10 | 22.60 |
| Total feed eaten | 3961.03 | 3609.95 | 220.97 | 811.23 | 1022.30 | 1199.89 | 355.56 |
| Gain | 360 | | | | | | |
| Feed for 105 days | 11546.88 | 10423.70 | 644.21 | 1914.41 | 3270.01 | 3520.58 | 1074.49 |
| Gain in 105 days | 927 | | | | | | |
| Ration II B. | | | | | | | |
| Grain fed | 1966.50 | 1792.39 | 45.89 | 418.88 | 63.45 | 1188.89 | 75.28 |
| Roughage fed | 2660.00 | 2308.82 | 187.79 | 117.70 | 930.30 | 1017.76 | 55.27 |
| Roughage refused | 159.84 | 138.69 | 17.84 | 6.66 | 52.64 | 57.92 | 3.63 |
| Grain eaten | 1966.50 | 1792.39 | 45.89 | 418.88 | 63.45 | 1188.89 | 75.28 |
| Roughage eaten | 2500.16 | 2170.13 | 169.95 | 111.04 | 877.66 | 959.84 | 51.64 |
| Total feed eaten | 4466.66 | 3962.52 | 215.84 | 529.92 | 941.11 | 2148.73 | 126.92 |
| Gain | 620 | | | | | | |
| Ration II C. | | | | | | | |
| Grain fed | 2945.00 | 2676.50 | 69.31 | 550.63 | 94.26 | 1866.24 | 96.06 |
| Grain refused | 18.41 | 16.73 | 0.43 | 3.39 | 0.65 | 11.57 | 0.69 |
| Roughage fed | 2800.00 | 2500.11 | 207.67 | 118.20 | 1098.27 | 1017.65 | 58.32 |
| Roughage refused | 475.43 | 424.60 | 36.43 | 19.73 | 188.71 | 168.01 | 11.72 |
| Grain eaten | 2926.59 | 2659.77 | 68.88 | 547.24 | 93.61 | 1854.67 | 95.37 |
| Roughage eaten | 2324.57 | 2075.51 | 171.24 | 98.47 | 909.56 | 849.64 | 46.60 |
| Total feed eaten | 5251.16 | 4735.28 | 240.12 | 645.71 | 1003.17 | 2704.31 | 141.97 |
| Gain | 376 | | | | | | |
| Ration II D. | | | | | | | |
| Grain fed | 3010.00 | 2739.08 | 72.69 | 676.19 | 113.55 | 1744.05 | 132.60 |
| Roughage fed | 2205.00 | 1986.13 | 155.68 | 107.01 | 886.88 | 805.83 | 30.73 |
| Roughage refused | 348.96 | 314.23 | 30.70 | 14.42 | 151.07 | 113.51 | 4.53 |
| Grain eaten | 3010.00 | 2739.08 | 72.69 | 676.19 | 113.55 | 1744.05 | 132.60 |
| Roughage eaten | 1856.04 | 1671.90 | 124.98 | 92.59 | 735.81 | 692.32 | 26.20 |
| Total feed eaten | 4866.04 | 4410.98 | 197.67 | 768.78 | 849.36 | 2436.37 | 158.80 |
| Gain | 378 | | | | | | |
| Feed for 105 days | 14588.86 | 13108.78 | 653.63 | 1944.41 | 2793.64 | 7289.41 | 427.69 |
| Gain in 105 days | 1374 | | | | | | |

TABLE XI--CONTINUED.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|-------------------------|--------------|------------|--------|---------|---------|-----------------------|---------------|
| Ration III B. | | | | | | | |
| Grain fed (a) | 2220.90 | 2028.89 | 81.67 | 861.63 | 584.99 | 762.70 | 237.40 |
| Grain refused | 48.48 | 39.34 | 2.64 | 6.47 | 9.36 | 15.54 | 5.33 |
| Roughage fed | 2380.00 | 2064.39 | 166.90 | 105.29 | 826.41 | 916.58 | 49.21 |
| Roughage refused | 800.38 | 694.11 | 69.81 | 28.89 | 255.68 | 321.66 | 18.07 |
| Grain eaten | 2177.42 | 1989.05 | 79.08 | 855.16 | 575.63 | 747.16 | 232.07 |
| Roughage eaten | 1579.62 | 1370.28 | 97.09 | 76.40 | 570.73 | 594.92 | 31.14 |
| Total feed eaten | 3757.04 | 3359.33 | 176.12 | 431.56 | 1146.36 | 1342.08 | 263.21 |
| Gain | 401 | | | | | | |
| Ration III C. | | | | | | | |
| Grain fed | 2765.02 | 2508.90 | 102.80 | 381.13 | 540.58 | 1137.47 | 346.92 |
| Grain refused | 33.13 | 29.99 | 1.79 | 5.41 | 7.58 | 11.46 | 3.75 |
| Roughage fed | 1855.00 | 1658.11 | 135.62 | 80.22 | 713.84 | 689.01 | 39.42 |
| Roughage refused | 612.90 | 547.32 | 52.79 | 24.93 | 237.81 | 217.32 | 14.47 |
| Grain eaten | 2731.89 | 2478.91 | 101.01 | 375.72 | 533.00 | 1126.01 | 343.17 |
| Roughage eaten | 1242.10 | 1110.79 | 82.83 | 55.29 | 476.03 | 471.69 | 24.95 |
| Total feed eaten | 3973.99 | 3589.70 | 183.84 | 431.01 | 1009.03 | 1597.70 | 368.12 |
| Gain | 249 | | | | | | |
| Ration III D. | | | | | | | |
| Grain fed | 2695.04 | 2430.92 | 81.34 | 408.96 | 407.39 | 1299.04 | 234.19 |
| Roughage fed | 1680.00 | 1509.11 | 116.41 | 81.29 | 662.20 | 623.91 | 25.30 |
| Roughage refused | 341.64 | 306.87 | 43.29 | 9.05 | 127.45 | 119.27 | 7.81 |
| Grain eaten | 2695.04 | 2430.92 | 81.34 | 408.96 | 407.39 | 1299.04 | 234.19 |
| Roughage eaten | 1338.36 | 1202.24 | 73.12 | 72.24 | 534.75 | 504.64 | 17.49 |
| Total feed eaten | 4033.40 | 3633.16 | 154.46 | 481.20 | 942.14 | 1803.68 | 251.68 |
| Gain | 438 | | | | | | |
| Feed for 105 days | 11764.43 | 10582.19 | 514.42 | 1343.77 | 3097.53 | 4743.46 | 883.01 |
| Gain in 105 days | 1088 | | | | | | |
| Ration IV B. | | | | | | | |
| Grain fed | 1665.00 | 1568.50 | 86.58 | 672.26 | 96.15 | 526.39 | 187.12 |
| Grain refused | 6.16 | 6.16 | 0.34 | 2.64 | 0.38 | 2.07 | 0.73 |
| Roughage fed | 2450.00 | 2130.15 | 182.08 | 108.10 | 905.34 | 881.79 | 52.84 |
| Roughage refused | 303.03 | 260.08 | 36.92 | 12.13 | 99.19 | 108.23 | 3.61 |
| Grain eaten | 1658.84 | 1562.34 | 86.24 | 669.62 | 95.77 | 524.32 | 186.29 |
| Roughage eaten | 2146.97 | 1870.07 | 145.16 | 95.97 | 806.15 | 773.56 | 49.23 |
| Total feed eaten | 3805.81 | 3432.41 | 231.40 | 765.59 | 901.92 | 1297.88 | 235.62 |
| Gain | 429 | | | | | | |
| Ration IV C. | | | | | | | |
| Grain fed | 1972.50 | 1851.27 | 103.30 | 745.51 | 97.38 | 709.22 | 195.86 |
| Grain refused | 5.56 | 5.22 | 0.29 | 2.10 | 0.28 | 2.00 | 0.55 |
| Roughage fed | 2520.00 | 2246.61 | 201.12 | 110.23 | 996.02 | 887.97 | 51.27 |
| Roughage refused | 602.43 | 536.75 | 42.74 | 22.75 | 235.39 | 223.22 | 12.65 |
| Grain eaten | 1966.94 | 1846.05 | 103.01 | 743.41 | 97.10 | 707.22 | 195.31 |
| Roughage eaten | 1917.57 | 1709.86 | 158.38 | 87.48 | 760.63 | 664.75 | 38.62 |
| Total feed eaten | 3884.51 | 3555.91 | 261.39 | 830.89 | 857.73 | 1371.97 | 233.98 |
| Gain | 228 | | | | | | |
| Ration IV D. | | | | | | | |
| Grain fed | 2275.00 | 2133.40 | 118.19 | 1041.95 | 142.73 | 589.03 | 241.50 |
| Grain refused | 20.51 | 19.23 | 1.06 | 9.39 | 1.29 | 5.31 | 2.18 |
| Roughage fed | 2030.00 | 1846.11 | 151.98 | 99.54 | 869.52 | 704.09 | 20.98 |
| Roughage refused | 452.17 | 411.42 | 42.44 | 11.85 | 188.36 | 158.64 | 10.13 |
| Grain eaten | 2254.49 | 2114.17 | 117.13 | 1032.56 | 141.44 | 583.72 | 239.32 |
| Roughage eaten | 1577.83 | 1434.69 | 109.54 | 87.69 | 681.16 | 545.45 | 10.85 |
| Total feed eaten | 3832.32 | 3548.86 | 226.67 | 1120.25 | 822.60 | 1129.17 | 250.17 |
| Gain | 266 | | | | | | |
| Feed for 105 days | 11522.64 | 10537.18 | 719.46 | 2716.73 | 2582.25 | 3799.02 | 719.72 |
| Gain in 105 days | 923 | | | | | | |

(a) Ration I B was fed during the first week.

TABLE XI--CONCLUDED.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|-------------------------|-----------------|---------------|--------|---------|---------|-----------------------------|------------------|
| Ration V B. | | | | | | | |
| Grain fed | 1560.00 | 1404.53 | 63.91 | 193.68 | 659.99 | 307.31 | 179.64 |
| Grain refused | 129.87 | 116.84 | 9.22 | 18.46 | 37.89 | 35.09 | 16.18 |
| Roughage fed | 2450.00 | 2123.49 | 171.95 | 108.29 | 851.53 | 941.05 | 50.67 |
| Roughage refused | 470.59 | 400.63 | 61.56 | 18.75 | 142.90 | 170.65 | 6.77 |
| Grain eaten | 1430.13 | 1287.69 | 54.69 | 175.22 | 622.10 | 272.22 | 163.46 |
| Roughage eaten | 1979.41 | 1722.86 | 110.89 | 89.54 | 708.63 | 770.40 | 43.90 |
| Total feed eaten | 3409.54 | 3010.55 | 165.08 | 264.76 | 1330.73 | 1042.62 | 207.36 |
| Gain | 197 | | | | | | |
| Ration V C. | | | | | | | |
| Grain fed | 1575.00 | 1433.75 | 73.26 | 222.95 | 418.66 | 447.04 | 271.84 |
| Grain refused | 136.60 | 124.23 | 9.50 | 19.18 | 32.71 | 44.15 | 18.69 |
| Roughage fed | 2205.00 | 1970.00 | 162.30 | 94.30 | 856.24 | 810.74 | 46.42 |
| Roughage refused | 406.48 | 392.89 | 37.72 | 17.22 | 177.43 | 150.47 | 10.05 |
| Grain eaten | 1438.40 | 1309.52 | 63.76 | 203.77 | 385.95 | 402.89 | 253.15 |
| Roughage eaten | 1798.52 | 1577.11 | 124.58 | 77.08 | 678.81 | 660.27 | 36.37 |
| Total feed eaten | 3236.92 | 2886.63 | 188.34 | 280.85 | 1064.76 | 1063.16 | 289.52 |
| Gain | 121 | | | | | | |
| Ration V D. | | | | | | | |
| Grain fed | 1435.00 | 1295.84 | 66.74 | 214.85 | 412.46 | 377.35 | 224.44 |
| Grain refused | 75.16 | 67.76 | 7.58 | 11.49 | 19.46 | 18.10 | 11.13 |
| Roughage fed | 3780.00 | 3373.49 | 300.44 | 466.32 | 1210.99 | 1316.71 | 79.03 |
| Roughage refused | 422.62 | 377.01 | 61.08 | 13.74 | 141.48 | 151.91 | 8.80 |
| Grain eaten | 1359.84 | 1228.08 | 59.16 | 203.36 | 393.00 | 359.25 | 213.31 |
| Roughage eaten | 3357.88 | 2996.48 | 239.36 | 452.58 | 1069.51 | 1164.80 | 70.23 |
| Total feed eaten | 4717.22 | 4224.56 | 298.52 | 655.94 | 1462.51 | 1524.05 | 283.54 |
| Gain | 341 | | | | | | |
| Feed for 105 days | 11363.68 | 10121.74 | 651.94 | 1201.55 | 3858.00 | 3629.83 | 780.42 |
| Gain in 105 days | 659 | | | | | | |

TABLE XII.
SUMMARY OF THE DATA GIVEN IN TABLE XI.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|-----------------------------|--------------|------------|--------|---------|---------|-----------------------|---------------|
| Lot I—Five steers. | | | | | | | |
| Grain eaten | 6786.83 | 6213.86 | 321.33 | 1688.85 | 1512.24 | 1704.09 | 987.35 |
| Roughage eaten | 4760.05 | 4209.84 | 322.88 | 225.56 | 1757.77 | 1816.49 | 87.14 |
| Total feed eaten | 11546.88 | 10423.70 | 644.21 | 1914.41 | 3270.01 | 3520.58 | 1074.49 |
| Total Gain | 927 | | | | | | |
| Lot II—Five Steers. | | | | | | | |
| Grain eaten | 7903.09 | 7191.24 | 187.46 | 1642.31 | 270.61 | 4787.61 | 303.25 |
| Roughage eaten | 6680.77 | 5917.54 | 466.17 | 302.10 | 2523.03 | 2501.80 | 124.44 |
| Total feed eaten | 14583.86 | 13108.78 | 653.63 | 1944.41 | 2793.64 | 7289.41 | 427.69 |
| Total Gain | 1374 | | | | | | |
| Lot III—Five Steers. | | | | | | | |
| Grain eaten | 7604.35 | 6898.88 | 261.38 | 1139.84 | 1516.02 | 3172.21 | 809.43 |
| Roughage eaten | 4160.08 | 3683.31 | 253.04 | 203.93 | 1581.51 | 1571.25 | 73.58 |
| Total feed eaten | 11764.43 | 10582.19 | 514.42 | 1343.77 | 3097.53 | 4743.46 | 883.01 |
| Total Gain | 1088 | | | | | | |
| Lot IV—Five Steers. | | | | | | | |
| Grain eaten | 5880.27 | 5522.56 | 306.38 | 2445.59 | 334.31 | 1815.26 | 621.02 |
| Roughage eaten | 5642.37 | 5014.62 | 413.08 | 271.14 | 2247.94 | 1983.76 | 98.70 |
| Total feed eaten | 11522.64 | 10537.18 | 719.46 | 2716.73 | 2582.25 | 3799.02 | 719.72 |
| Total Gain | 923 | | | | | | |
| Lot V—Five Steers. | | | | | | | |
| Grain eaten | 4223.37 | 3825.29 | 177.61 | 582.35 | 1401.05 | 1034.36 | 629.92 |
| Roughage eaten | 7135.31 | 6296.45 | 474.33 | 619.20 | 2456.95 | 2595.47 | 150.50 |
| Total feed eaten | 11363.68 | 10121.74 | 651.94 | 1201.95 | 3858.00 | 3629.83 | 780.42 |
| Total Gain | 659 | | | | | | |

TABLE XIII.

TOTAL FEED, DRY MATTER, AND NUTRIENTS REQUIRED PER POUND OF GAIN.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|-----------------------------------|--------------|------------|------|---------|-------|-----------------------|---------------|
| Ration I B. | 8.97 | 7.97 | 0.49 | 1.41 | 2.79 | 2.52 | 0.76 |
| Ration I C. | 25.11 | 22.78 | 1.44 | 3.38 | 7.09 | 8.23 | 2.64 |
| Ration I D. | 11.00 | 10.03 | 0.61 | 2.25 | 2.84 | 3.34 | 0.99 |
| Average of I B, I C, and I D.. | 14.69 | 13.59 | 0.85 | 2.35 | 4.24 | 4.69 | 1.46 |
| Ration II B. | 7.20 | 6.39 | 0.34 | 0.85 | 1.52 | 3.48 | 0.20 |
| Ration II C. | 13.97 | 12.59 | 0.63 | 1.72 | 2.67 | 7.19 | 0.38 |
| Ration II D. | 12.87 | 11.67 | 0.52 | 2.03 | 2.25 | 6.45 | 0.42 |
| Average of II B, II C, & II D.. | 11.35 | 10.22 | 0.50 | 1.53 | 2.15 | 5.71 | 0.33 |
| Ration III B. | 9.37 | 8.38 | 0.44 | 1.08 | 2.86 | 3.34 | 0.66 |
| Ration III C. | 15.96 | 14.41 | 0.74 | 1.73 | 4.05 | 6.41 | 1.48 |
| Ration III D. | 9.21 | 8.29 | 0.35 | 1.10 | 2.15 | 4.10 | 0.59 |
| Average of III B, III C, & III D. | 11.51 | 10.36 | 0.51 | 1.30 | 3.02 | 4.62 | 0.91 |
| Ration IV B. | 8.87 | 8.00 | 0.53 | 1.78 | 2.10 | 3.04 | 0.55 |
| Ration IV C. | 17.04 | 15.60 | 1.14 | 3.64 | 3.75 | 6.05 | 1.02 |
| Ration IV D. | 14.41 | 13.38 | 0.85 | 4.21 | 3.09 | 4.29 | 0.94 |
| Average of IV B, IV C, & IV D. | 13.44 | 12.33 | 0.84 | 3.21 | 3.98 | 4.46 | 0.84 |
| Ration V B. | 17.31 | 15.23 | 0.83 | 1.34 | 6.70 | 5.31 | 1.05 |
| Ration V C. | 26.75 | 23.85 | 1.56 | 2.32 | 8.80 | 8.78 | 2.39 |
| Ration V D. | 14.12 | 12.39 | 0.87 | 1.92 | 4.29 | 4.48 | 0.83 |
| Average of V B, V C, & V D. | 19.39 | 17.16 | 1.09 | 1.86 | 6.60 | 6.19 | 1.42 |

TABLE XIV.
COMPOSITION OF FEEDING STUFFS AS SAMPLED.
A. B. McREYNOLDS, Analyst.

| Sample Number | Material | POUNDS IN ONE HUNDRED POUNDS | | | | | |
|---------------|---|------------------------------|-------|---------|-------|-----------------------|---------------|
| | | Water | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
| 2964 | Cottonseed meal, Ration IV B..... | 5.41 | 5.22 | 40.54 | 5.80 | 31.75 | 11.28 |
| 3076 | Cottonseed meal, Rations I, II & IV, C..... | 5.92 | 5.25 | 37.89 | 4.95 | 36.04 | 9.95 |
| 3082 | Cottonseed meal, Rations I, II & IV, D..... | 5.79 | 5.22 | 46.01 | 6.30 | 26.01 | 10.67 |
| 2965 | Cottonseed, Ration V B..... | 9.43 | 4.12 | 12.49 | 42.56 | 19.82 | 11.58 |
| 3074 | Cottonseed, Rations I, III & V, C..... | 9.10 | 4.65 | 14.14 | 26.53 | 28.34 | 17.24 |
| 3080 | Cottonseed, Rations I, III & V, D..... | 8.69 | 4.70 | 15.14 | 29.06 | 26.59 | 15.82 |
| 3075 | Wheat meal, Rations II & III, C..... | 10.22 | 1.47 | 12.86 | 2.67 | 71.55 | 1.23 |
| 3081 | Wheat meal, Rations II & III, D..... | 9.51 | 1.57 | 15.42 | 3.02 | 67.95 | 2.53 |
| 2966 | Wheat straw, Rations I to V, B..... | 13.94 | 7.36 | 4.37 | 36.58 | 35.62 | 2.13 |
| 3053 | Wheat straw, Ration IV, D..... | 10.15 | 8.00 | 4.41 | 38.48 | 37.29 | 1.67 |
| 3071 | Wheat straw, Ration IV, C..... | 10.82 | 8.90 | 5.29 | 36.48 | 36.39 | 2.12 |
| 3072 | Wheat straw, Rations I to V, C..... | 10.94 | 7.62 | 4.02 | 40.66 | 34.76 | 2.00 |
| 3077 | Wheat straw, Rations I to V, D..... | 9.51 | 7.46 | 4.88 | 42.62 | 34.50 | 1.03 |
| 2967 | Prairie hay, Rations I, II, III & V, B..... | 10.84 | 6.26 | 4.60 | 30.61 | 45.76 | 1.93 |
| 3073 | Prairie hay, Rations I, II, III & V, C..... | 10.29 | 6.78 | 4.82 | 34.80 | 40.98 | 2.33 |
| 3078 | Prairie hay, Rations I, II & III, D..... | 11.96 | 6.13 | 4.74 | 34.53 | 40.48 | 2.16 |
| 3079 | Alfalfa hay, Ration V, D..... | 11.57 | 8.04 | 14.29 | 29.00 | 34.73 | 2.37 |
| 2961 | Grain, Ration I B..... | 8.22 | 4.54 | 26.73 | 27.75 | 17.99 | 14.77 |
| 2962 | Grain, Ration II B..... | 8.25 | 2.35 | 21.44 | 3.25 | 60.86 | 3.85 |
| 2963 | Grain, Ration III B..... | 9.02 | 3.75 | 14.83 | 26.67 | 35.76 | 9.97 |
| 2938 | Refused grain, Ration I B..... | 10.63 | 4.93 | 23.19 | 22.04 | 24.98 | 14.23 |
| 2939 | Refused grain, Ration III B..... | 10.58 | 5.99 | 14.70 | 21.28 | 35.33 | 12.12 |
| 2941 | Refused grain, Ration IV B..... | 19.65 | 6.00 | 19.13 | 19.34 | 30.98 | 4.90 |
| 2940 | Refused grain, Ration V B..... | 9.43 | 7.15 | 14.31 | 29.37 | 27.20 | 12.54 |
| 3025 | Refused grain, Ration I C..... | 9.20 | 5.75 | 18.38 | 22.52 | 27.24 | 16.91 |
| 3026 | Refused grain, Ration II C..... | 9.57 | 2.31 | 18.32 | 3.53 | 62.53 | 3.74 |
| 3027 | Refused grain, Ration III C..... | 9.13 | 5.42 | 16.39 | 22.95 | 34.74 | 11.37 |
| 3028 | Refused grain, Ration IV C..... | 16.62 | 5.51 | 24.43 | 15.30 | 31.40 | 6.74 |
| 3029 | Refused grain, Ration V C..... | 16.06 | 6.42 | 12.96 | 22.10 | 29.83 | 12.63 |
| 3062 | Refused grain, Ration II D..... | 9.89 | 2.56 | 10.76 | 3.73 | 69.44 | 3.62 |
| 3063 | Refused grain, Ration IV D..... | 12.24 | 6.41 | 33.20 | 12.14 | 27.42 | 8.59 |
| 3064 | Refused grain, Ration V D..... | 16.34 | 9.36 | 14.19 | 24.02 | 22.35 | 13.74 |
| 2930 | Refused roughage, Ration I B..... | 14.24 | 8.91 | 4.43 | 34.47 | 35.42 | 2.53 |
| 2931 | Refused roughage, Ration II B..... | 10.23 | 11.55 | 4.31 | 34.07 | 37.49 | 2.35 |
| 2932 | Refused roughage, Ration III B..... | 12.80 | 8.77 | 3.63 | 32.12 | 40.41 | 2.27 |
| 2933 | Refused roughage, Ration IV B..... | 16.29 | 12.06 | 3.89 | 31.79 | 34.84 | 1.13 |
| 2934 | Refused roughage, Ration V B..... | 15.39 | 13.00 | 3.96 | 30.18 | 36.04 | 1.43 |
| 3019 | Refused roughage, Ration I C..... | 12.65 | 7.23 | 3.18 | 39.81 | 34.77 | 2.36 |
| 3020 | Refused roughage, Ration II C..... | 12.00 | 7.55 | 4.09 | 39.11 | 34.82 | 2.43 |
| 3021 | Refused roughage, Ration III C..... | 13.74 | 8.32 | 3.93 | 37.48 | 34.25 | 2.28 |
| 3022 | Refused roughage, Ration IV C..... | 12.94 | 6.92 | 3.68 | 38.20 | 36.21 | 2.05 |
| 3023 | Refused roughage, Ration V C..... | 12.40 | 8.41 | 3.84 | 39.56 | 33.55 | 2.24 |
| 3065 | Refused roughage, Ration I D..... | 11.98 | 7.99 | 2.30 | 42.50 | 34.05 | 1.18 |
| 3066 | Refused roughage, Ration II D..... | 13.91 | 8.41 | 3.95 | 41.39 | 31.10 | 1.24 |
| 3067 | Refused roughage, Ration III D..... | 11.18 | 12.53 | 2.62 | 36.89 | 34.52 | 2.26 |
| 3068 | Refused roughage, Ration IV D..... | 12.65 | 9.06 | 2.46 | 39.96 | 33.69 | 2.18 |
| 3069 | Refused roughage, Ration V D..... | 12.22 | 14.22 | 3.20 | 32.94 | 35.37 | 2.05 |

BULLETIN NO. 59.

Reprints from Bulletins No. 47, 50, and 52, and Annual Reports, 8 to 11, will be issued in September, 1903. This bulletin will contain nothing which, in some form or other, has not been sent to all of the addresses on the station mailing list and it will be sent only in response to direct request.

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