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A. D. MELVIN, CHIEF OF BUREAU.

EXPERIMENTS IN BEEF PRODUCTION
IN ALABAMA.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., December 23, 1907.

SIR: I have the honor to transmit herewith for publication as a bulletin of this Bureau a manuscript entitled "Experiments in Beef Production in Alabama," by Director J. F. Duggar, of the Alabama Agricultural Experiment Station, and W. F. Ward, scientific assistant. The work was done before Director Duggar turned over this work to Prof. Dan T. Gray, who is now in charge.

The bulletin is the result of three years' cooperation with the Alabama Experiment Station in steer feeding, and covers in a comprehensive manner tests of different feeding methods in use by Alabama stockmen or considered worthy of trial in that section. This will be the first bulletin published by the Bureau giving results obtained as a direct result of the appropriation for experiments in animal breeding and feeding in cooperation with State agricultural experiment stations.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

PREFACE.

The investigations reported by Director Duggar and Mr. Ward in this bulletin, although complete in themselves, were planned to be preliminary to a systematic study of the economy of beef production under southern conditions, especially in sections east of the Mississippi River. As a basis for work it was important to know thoroughly the value of southern feeds in steer feeding.

The greatest agricultural necessity of the South to-day is live stock. There are several reasons for this, some of which are to supply local demands, to utilize the southern feedstuffs to best advantage, and to restore fertility to worn-out fields. To meet these demands, a study must be made of every phase of animal husbandry—the value of southern feeds, the value of purebred sires to improve the native stock, economy of production, the relation of southern markets to the development of the stock-raising industry, and the influence of soil and climatic conditions.

The results set forth in this bulletin add much valuable information to that in bulletins already published by southern experiment stations, especially as showing the relative values of various feeds and rations. The value of purebred sires has been generally acknowledged, but it is not yet put into practice to any great extent. Emphasis must be placed not only on the inferiority of native stock, but on the rapid improvement that can be made by using purebred sires. Two instances may be seen in Plate I of this bulletin.

As to economy of production, the results of these investigations show that much is to be learned, and as to market conditions there is a great deal more to be learned. Soil and climatic conditions have received very little attention and will repay close study.

With the progress of the campaign for the extermination of the cattle tick, these problems become still more pressing.

GEORGE M. ROMMEL,
Animal Husbandman, Bureau of Animal Industry.

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EXPERIMENTS IN BEEF PRODUCTION IN ALABAMA.

INTRODUCTORY.

Within the past decade there has been a decided increase in the interest manifested in the growing of beef cattle in the Gulf States east of the Mississippi River. This has been largely due to a decrease in the amount of labor available on farms and to the belief that the losses due to the presence in this region of the cattle tick are in a fair way of being eliminated, either by the artificial immunization of valuable breeding animals brought from higher latitudes or by the eradication of the tick. The outlook regarding the last-named solution of the difficulty is very encouraging, in view of the success attending the work now being done by the Bureau of Animal Industry with the cooperation of the State authorities and the cattle owners.

Numbers of bulls of the beef breeds have been brought into the South during the last decade; consequently the number of grade beef cattle has rapidly increased. Assuming that a grade animal of the beef breeds can be raised at a profit when making its living on pasturage on low-priced lands, there still remains the open question, so far as this region is concerned, whether there is most profit in marketing this animal directly from the pasture or in feeding it for one winter just before shipping so as to sell it at a considerably higher price per pound. Of course a variable answer to this question will be had, dependent (1) upon the difference in price paid for southern cattle from the pasture and from the feed lot; (2) upon the prices, always fluctuating, of southern feedstuffs; (3) upon the quality of the animals fed, and (4) upon a number of other conditions.

It was to throw light upon some of these questions that the following experiments were undertaken jointly by the Alabama Agricultural Experiment Station and the Bureau of Animal Industry of the United States Department of Agriculture.

Most of the feeding of cattle in Alabama for fattening purposes is done in the vicinity of the cotton-seed oil mills, and almost exclusively the ration consists of cotton-seed meal and cotton-seed hulls. The high prices of cotton-seed feed products prevailing during the past few years have tended to prevent the extension of winter feeding operations. Those who have been so situated that they could obtain

cotton-seed meal and cotton-seed hulls at a low price have been able to continue feeding. Usually cotton-seed meal is cheaper in the immediate vicinity of the cotton-oil mills, and when purchased under a contract made before the beginning of the crushing season. A favorite method of securing low prices for cotton-seed meal and for cotton-seed hulls by those who have the disposal of large amounts of cotton seed consists in the exchange by the farmer of cotton seed for the manufactured feed products of the oil mills.

The experimental work here described was at a disadvantage in all these respects, so that the feedstuffs cost more than would be the case with more extensive feeders who are more favorably circumstanced. Nevertheless, in spite of high prices of feed the experiments were entered upon with the expectation that they would afford some data as to the relative values of the principal southern feedstuffs, even though they should not afford profitable results while the prices of feed should continue high.

The principal inducement for farmers to feed cattle on purchased feeds, chiefly cotton-seed meal and cotton-seed hulls, is the great value of the manure produced from this rich ration. For the farmer who habitually purchases cotton-seed meal for use as a fertilizer it is sound policy first to pass this feed through cattle, after which its fertilizing value, if no losses occur, should be more than four-fifths of its original fertilizing value. Unfortunately fermentation, leaching, and mechanical losses of the manure and the cost of handling this bulky article must be taken into account as deductions from the theoretical value of the manure. Even after this is done such manure is a most profitable fertilizer, and these losses are merely noted here as a means of cautioning farmers to reduce them to the lowest possible limit when feeding is done chiefly as a means of obtaining a supply of manure. Doubtless if, in the following experiments, we had been able to determine the exact amount and value of the manure produced there would have been a profit from feeding operations which, as here figured, independent of the manure, were often unprofitable.

OBJECTS OF THE EXPERIMENTS.

In planning these experiments two main objects were in view. These were to throw additional light on the questions (1) whether farm-grown forage can be substituted profitably for cotton-seed hulls, the usual roughage, and (2) to determine the relative values of the most common southern concentrated feedstuffs—cotton seed, cotton-seed meal, and corn. The experiments were conducted with a total of 150 steers; 50 steers were fed for each of three winters under as nearly the same conditions as possible. The steers were 2-year-old grades of the beef and dual-purpose breeds, except that one pen each

year consisted of typical scrubs. The animals were divided into 10 lots of 5 steers each, in such a way that the results obtained would permit of the following comparisons:

1. Sorghum hay or fodder versus cotton-seed hulls.
2. Shredded corn stover versus cotton-seed hulls.
3. Sorghum hay or fodder versus shredded corn stover.
4. Corn-and-cob meal versus cotton seed as the principal concentrate.
5. Cotton-seed meal versus corn as an appetizer in a cotton-seed ration.
6. The effects of substituting corn-and-cob meal for a part of the cotton-seed meal.
7. The value, if any, of shelter in fattening southern steers.
8. A comparison of scrubs with grades of the beef breeds or dual-purpose breeds.

DETAILS OF THE EXPERIMENTS.

THE STEERS USED.

The grade steers used were in most cases 2-year-old half bloods. They were out of native cows from bulls of the Angus, Shorthorn, Red Polled, Hereford, and Devon breeds, and were obtained in Wilcox and Sumter counties in the central prairie region of Alabama. They were not as uniform as desirable, because of the fact that they were obtained from different men, as no one man had very many of the size and quality desired.

The steers used in the first experiment (1904-5) were smaller, thinner, and poorer in quality than those in the two following years. The steers were in quality from "common" to "good," the majority being classed as "medium feeders."

The scrubs used were about the average quality of scrubs and were typical specimens of their kind. They were 3 and 4 year olds. About half of them showed traces of Jersey blood, as do a considerable proportion of the scrub cattle of Alabama. They were thinner in flesh than the grades in the first experiment, and this undoubtedly accounts for their larger gains the first year.

The grade steers were valued at 3 cents a pound when put on feed. The scrub steers cost $2\frac{1}{2}$ cents a pound.

SHELTER, FEED LOTS, AND WATER SUPPLY.

The feed lots were 16 by 90 feet, the ground sloping away from the shed. These lots had a good slope, but still became very muddy in wet weather. The lot without shelter was at times several inches deep in mud, so that the steers had no dry place to lie down. None of the lots were bedded, though the sheds were. The feed troughs

were under the sheds. The water troughs were near the feed troughs and under the shed, the water being supplied from a well. The troughs had float valves, so that a fresh supply of water was kept in them at all times.

WEIGHING, ETC.

The steers were numbered by means of tags in the ears. At the beginning of the preliminary period the steers were weighed and divided as equally as possible with a view to getting the pens uniform in quality and weight. At the beginning and close of the feeding experiment proper the steers were weighed three days in succession to get an average weight. The weighing was begun at 10.30 a. m., the steers having had access to both feed and water. Each steer was weighed at the end of every week.

METHOD OF FEEDING.

The feed was weighed out twice daily and fed at 7 a. m. and 5.30 p. m. The roughage and concentrate were fed at the same time. The steers were fed all the roughage they would eat up clean. They were salted once a week, two days after weighing. They were started on a small grain ration, and this was gradually increased until they were eating a full grain ration. A close watch was kept on them to see that there was no scouring, as this is common in feeding cotton seed or cotton-seed meal in large quantities. There was little scouring, it being confined chiefly to the pens getting cotton seed. There was a greater tendency to scour as warm weather came on, so at times the grain ration had to be cut down slightly. The pens getting cotton-seed hulls had the concentrate mixed with the hulls in the feed troughs. Those getting sorghum had the grain mixed with the cut sorghum in the same way as the pens getting cotton-seed hulls. The cowpea hay and the corn stover were fed in racks just over the feed troughs, so that any waste would drop into the troughs.

Since the laxative effects of cotton seed restricted the amounts of concentrate fed to pens 8 and 9, it was necessary to reduce the corn ration of pen 10 far below the amount of corn usually fed, so that the amount of concentrates fed to these three pens would be the same. The feeding period occupied 84 days each year.

CHARACTER AND COST OF FEEDS USED.

The cotton-seed meal fed was of average quality, as were the cotton seed, corn, and cotton-seed hulls. The husked corn was coarsely ground, and 70 pounds was found to be equivalent to 1 bushel of shelled corn. The corn stover was inferior, being coarse and very dry.

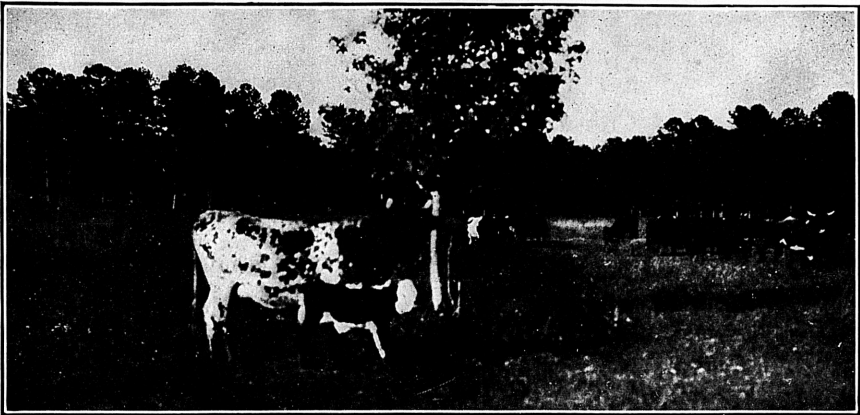


FIG. 1.—NATIVE ALABAMA COW WITH CALF BY PUREBRED HEREFORD BULL.



FIG. 2.—NATIVE ALABAMA COW WITH CALF BY PUREBRED HEREFORD BULL.

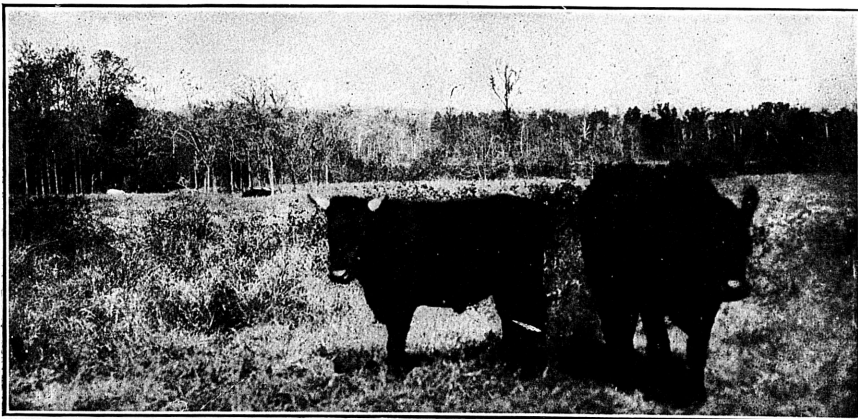


FIG. 3.—RELATIVE SIZE OF 3-YEAR-OLD SCRUB STEER AND PUREBRED ANGUS COW OF SAME AGE.

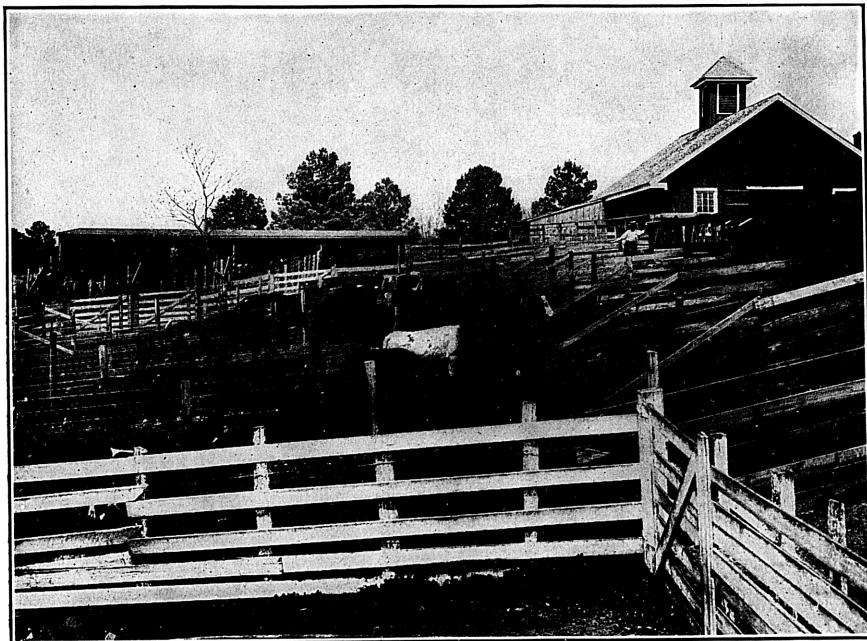


FIG. 1.—STEERS IN FEED LOTS—FIRST EXPERIMENT.

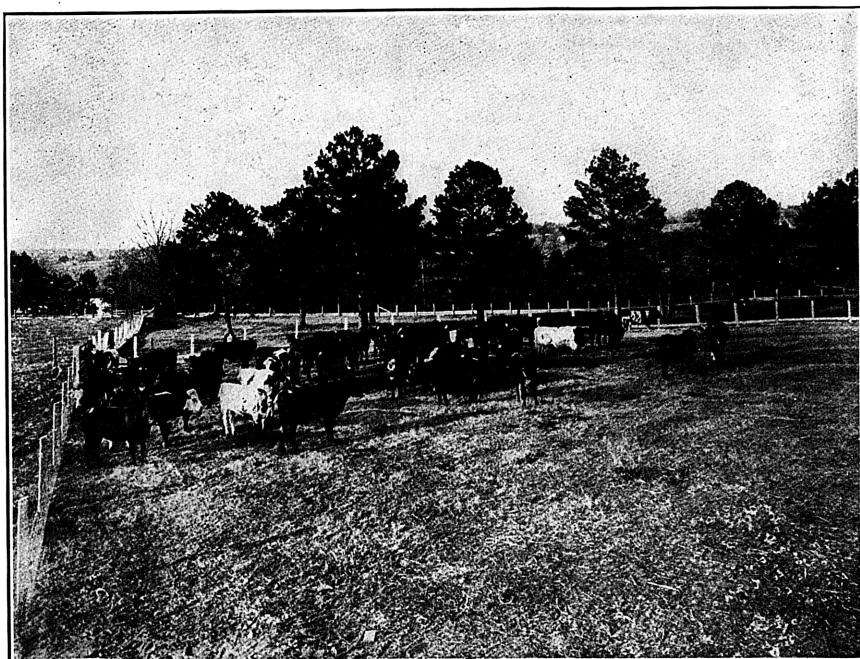


FIG. 2.—GENERAL VIEW OF STEERS IN SECOND EXPERIMENT.

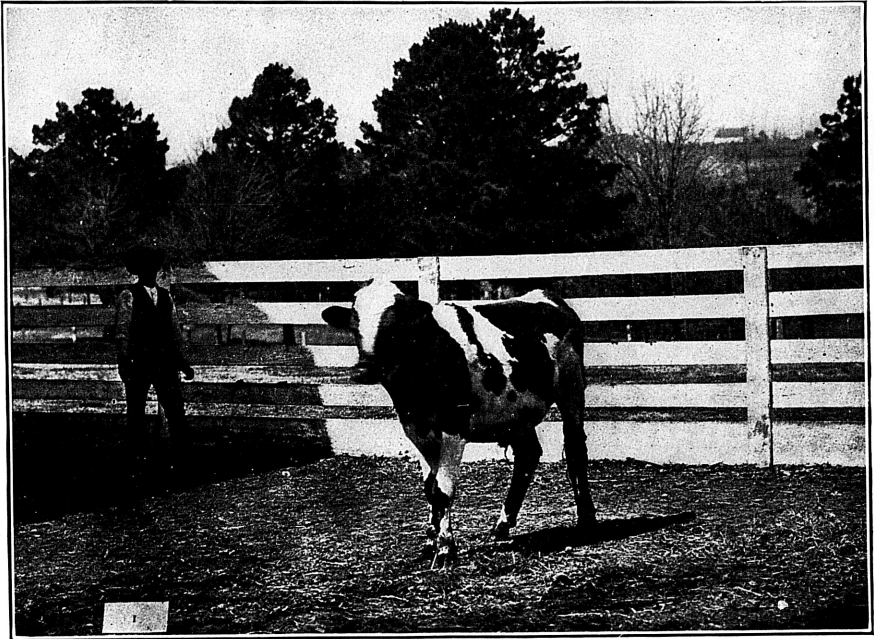


FIG. 1 —SCRUB STEER—FIRST EXPERIMENT.

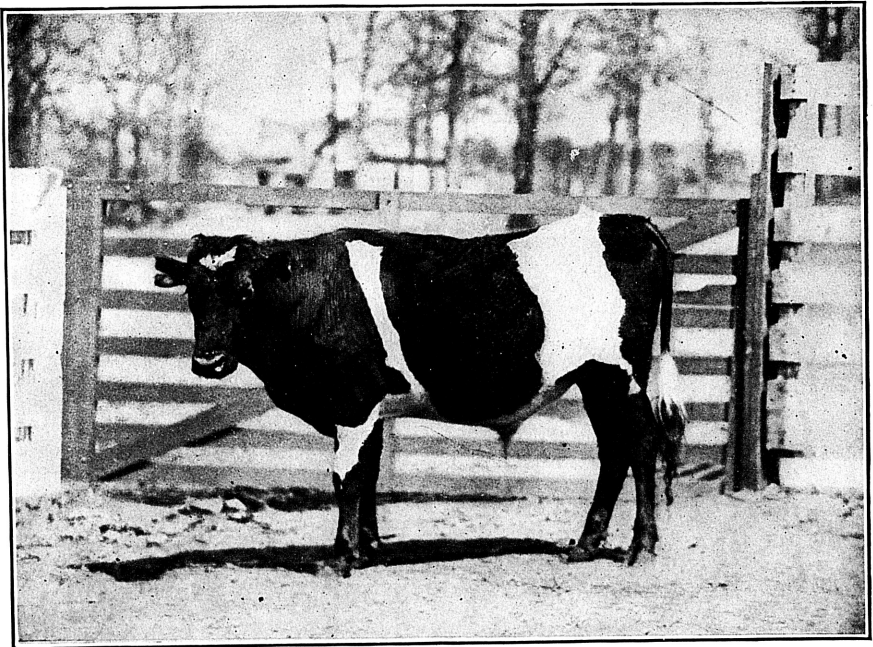


FIG. 2.—ANOTHER SCRUB STEER—FIRST EXPERIMENT.

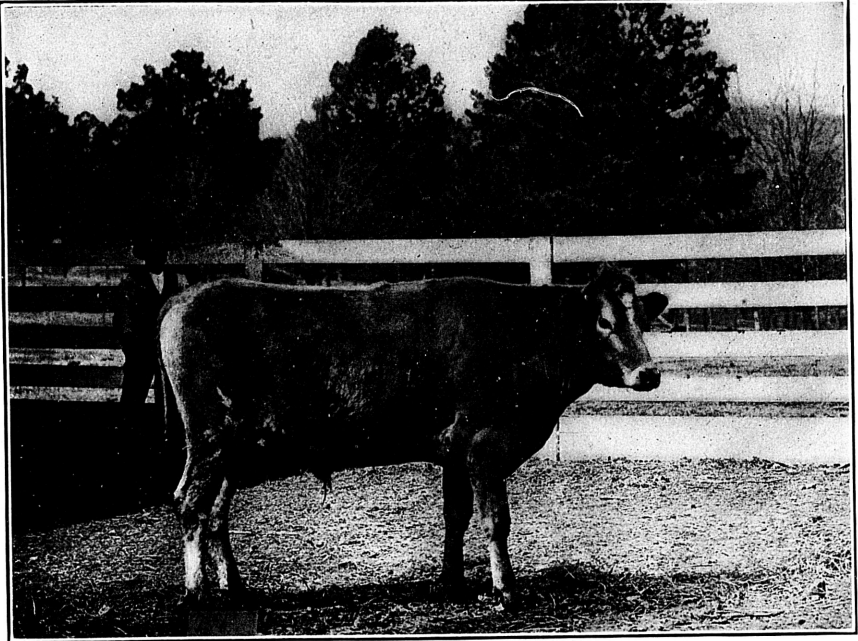


FIG. 1.—SCRUB STEER—FIRST EXPERIMENT.

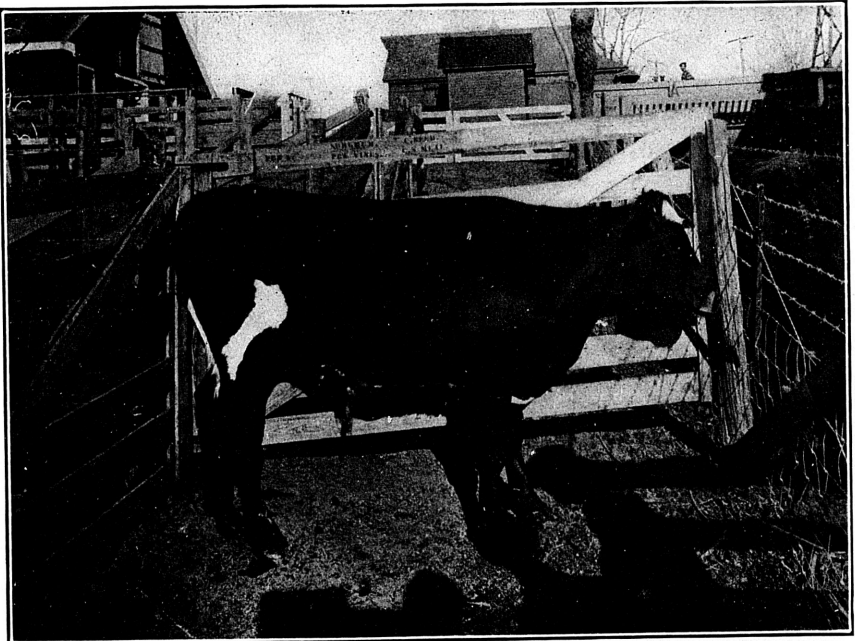


FIG. 2.—SCRUB STEER—SECOND EXPERIMENT.

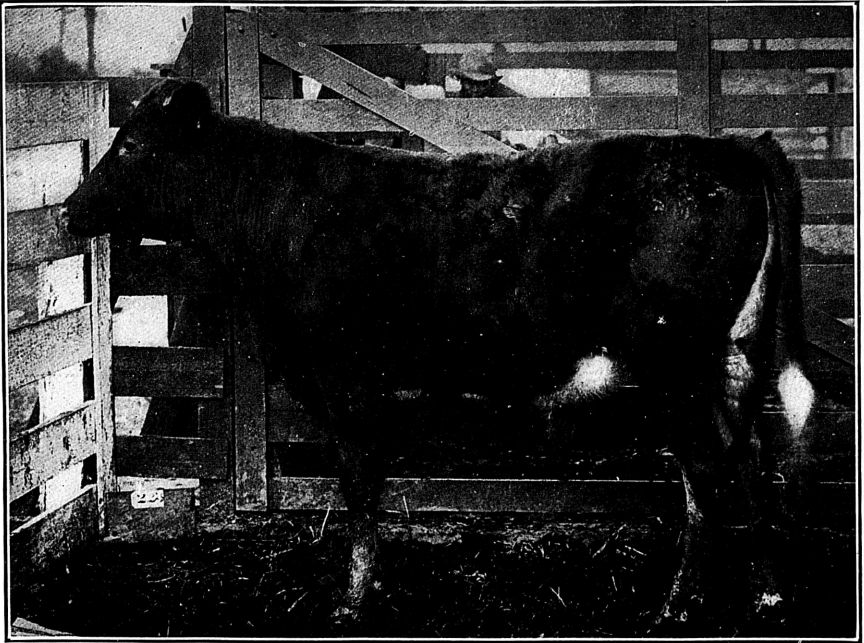


FIG. 1.—GRADE RED POLL—FIRST EXPERIMENT.



FIG. 2.—GRADE SHORTHORN—FIRST EXPERIMENT.

There was left in the troughs uneaten 29 per cent of the stover that was fed. This refuse consisted chiefly of the larger sections of the corn stalk, and, of course, its weight was charged to the steers. This waste material was removed from the troughs when necessary and used as bedding.

The sorghum forage fed varied considerably in different years, but was on the whole very inferior, being chiefly coarse and sometimes slightly moldy. Ten per cent of it was left in the troughs. The cowpea hay was below average quality, by reason of the fact that it contained a small amount of crab grass. The sorghum was cut into lengths of about three-fourths of an inch, but the cowpea hay was fed whole.

During the course of each experiment the local prices of corn and cotton-seed meal and hulls were abnormally high. The average market prices for the three years were approximately as follows:

| | Per ton. |
|--|----------|
| Cotton-seed meal..... | \$24.00 |
| Cotton seed..... | 14.00 |
| Corn (70 cents a bushel)..... | 25.00 |
| Corn-and-cob meal (corn 70 cents a bushel)..... | 20.00 |
| Cotton-seed hulls..... | 7.00 |
| Corn stover (home grown; unbaled; estimated)..... | 4.00 |
| Sorghum fodder (home grown; unbaled; estimated)..... | 6.67 |
| Cowpea hay (home grown; unbaled; estimated)..... | 10.00 |

Since the prices prevailing while these experiments were in progress were unusually high, the figures given above may be regarded as representing nearly the upper limit of prices for purchased feeds and the market value of the farm-grown roughage unbaled on the farm. By contracting in the summer for the necessary amounts, the purchasable feed can sometimes be obtained at about the following prices:

| | Per ton. |
|---|----------|
| Cotton-seed meal..... | \$20.00 |
| Cotton seed..... | 12.00 |
| Corn-and-cob meal (corn 50 cents per bushel)..... | 14.67 |
| Cotton-seed hulls..... | 4.00 |
| Corn stover (home grown)..... | 4.00 |
| Sorghum fodder (home grown)..... | 6.67 |
| Cowpea hay (home grown)..... | 10.00 |

Unless otherwise stated, all financial calculations in this bulletin are based on the last-named prices. The prices of the roughage grown on the farm would be much lower and the profits much greater than calculated in this bulletin if we could assume as the price of the stover and hay the actual cost of growing it. Unfortunately, there are no adequate data on record to establish the cost of growing a ton of each of these feeds.

THE RATIONS.

The rations fed to the various pens are shown in Table 1.

TABLE 1.—*The ration fed to each pen.*

| Pens and steers. | Concentrate. | Roughage. |
|---------------------------------|--|--|
| Pen 1 (scrubs)..... | Cotton-seed meal..... | Cotton-seed hulls. |
| Pen 2 (grades)..... | do..... | Do. |
| Pen 3 (grades)..... | $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn-and-cob meal. | Do. |
| Pen 4 (grades)..... | Cotton-seed meal..... | Shredded corn stover. |
| Pen 5 (grades)..... | do..... | Cut sorghum. |
| Pen 6 (grades; no shelter)..... | do..... | Cotton-seed hulls. |
| Pen 7 (grades)..... | $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn-and-cob meal. | Shredded corn stover. |
| Pen 8 (grades)..... | cotton seed, $\frac{1}{2}$ cotton-seed meal..... | $\frac{1}{2}$ cowpea hay, $\frac{1}{2}$ sorghum. |
| Pen 9 (grades)..... | cotton seed, $\frac{1}{2}$ corn-and-cob meal..... | Do. |
| Pen 10 (grades)..... | $\frac{2}{3}$ corn-and-cob meal, $\frac{1}{3}$ cotton-seed meal. | Do. |

HOGS FOLLOWING THE STEERS.

Very little corn being fed, and that being ground, hogs did not follow the steers except in the first winter. They made such slight gains that the inconvenience of having them in the pens was regarded as counterbalancing the gains made. Ten pigs, averaging 81 pounds live weight when put in the pens, followed the 50 steers for seventy-one days. They had access to all pens and received about 2 pounds of shelled corn per day. The average gains were 0.45 pound per day per pig, requiring 2.5 pounds of shelled corn to make 1 pound of gain. It appears that they made about half their living on the droppings. No pig showed any signs of cotton-seed meal poisoning, in spite of the fact that they often got into the steers' feed troughs. The pigs cost $4\frac{1}{2}$ cents a pound and sold in New Orleans at $5\frac{1}{2}$ cents a pound, live weight, March 28, 1905. The net profit per pig, with corn at 50 cents a bushel, was \$1.20.

COMPARISON OF DAILY GAINS.

Sorghum versus cotton-seed hulls (pens 2 and 5).—Comparing the daily gains, as shown in Table 2, of the pen fed on cut sorghum (pen 5) with those made by the check lot on cotton-seed hulls (pen 2), we find that cotton-seed hulls afforded larger daily gains in the second and third years and practically identical gains in the first winter. The lower average daily gain with sorghum (1.39 pounds, as compared with 1.55 pounds from feeding hulls) is believed to be partly due to the smaller amount of sorghum than of hulls consumed.

It should be mentioned that the selling price per hundredweight of the steers fed on sorghum was, each year, a little below the price of those fed on hulls.

*Shredded corn stover versus cotton-seed hulls (pens 2 and 4).—*Comparing shredded corn stover (pen 4) with the check lot fed on cotton-seed hulls (pen 2), we find in all three experiments that the daily gains were more rapid where the hulls were fed. The average daily gain for the three years with stover was only 1.19 pounds, as compared with 1.55 pounds when cotton-seed hulls were fed. This may have been due to the fact that the steers could not be induced to eat as much stover as hulls.

*Cotton seed versus corn-and-cob meal as the principal concentrate (pens 8 and 10).—*The average daily gain for the three years is very slightly in favor of pen 10, fed chiefly on corn-and-cob meal. However, as this difference in rapidity of gain represents less than 2 per cent, and since cotton seed was ahead in one of the three experiments, we are justified in regarding these experiments as indicating that a pound of cotton seed was practically equal to a pound of corn-and-cob meal.

*Cotton-seed meal versus corn-and-cob meal as an appetizer when fed in connection with cotton seed (pens 8 and 9).—*In the preceding paragraph, the corn and cotton seed constituted two-thirds of the weight of the concentrate. We now make a comparison between rations in which cotton-seed meal and corn-and-cob meal made up only one-third of the ration.

The average results for three years are in favor of cotton-seed meal as a supplementary feed. Pen 8, which received cotton-seed meal mixed with cotton seed, gave an average daily gain of 1.68 pounds, as compared with 1.52 pounds for pen 9, which received corn-and-cob meal mixed with cotton seed. However, the results of the three different experiments are not in accord.

Effect of substituting corn-and-cob meal for one-third of the cotton-seed meal when fed with (a) hulls or (b) corn stover (pens 2 and 3, and 4 and 7).—(a) Pen 2 was fed, as is common in the South, on a ration of cotton-seed meal and cotton-seed hulls. Pen 3 was similarly fed, except that corn-and-cob meal was substituted, pound for pound, for one-third of the cotton-seed meal, thus widening the nutritive ratio. The average results for three years show a slightly more rapid gain from the use of corn-and-cob meal. In two of the experiments corn-and-cob meal afforded the more rapid gain, while in the third experiment the rates of gain were identical for the two rations.

(b) Likewise corn-and-cob meal was substituted, pound for pound, for one-third of the cotton-seed meal where the roughage was shredded corn stover (pens 4 and 7). The result in this case was also favorable to the use of corn-and-cob meal, the average daily gain being slightly larger for pen 7, receiving a partial ration of corn-and-cob meal, than for pen 4, receiving only cotton-seed meal as a concentrate.

TABLE 2.—Average daily gains and consumption.

| Pen No. | Ration. | | Average daily gain, 1904-5 (84 days). | Average daily gain, 1905-6 (84 days). | Average daily gain, 1906-7 (84 days). | Average daily gain, whole period (252 days). | Average amount consumed per steer per day, whole period. | |
|-------------|--------------------------------------|---------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--|--|-----------|
| | Concentrate. | Roughage. | | | | | Con- | Rough- |
| | | | | | | | centrate. | age. |
| 1 (scrubs.) | Cotton-seed meal. | Cotton-seed hulls. | Lbs. 2.20 | Lbs. 1.55 | Lbs. 1.30 | Lbs. 1.68 | Lbs. 5.1 | Lbs. 18.5 |
| 2 | do. | do. | 1.88 | 1.51 | 1.27 | 1.55 | 5.6 | 19.5 |
| 3 | cotton-seed meal, corn and-cob meal. | do. | 1.93 | 1.87 | 1.27 | 1.69 | 6.5 | 19.4 |
| 4 | Cotton-seed meal. | Shredded corn stover. | 1.84 | 1.15 | .57 | 1.19 | 5.5 | 17.4 |
| 5 | do. | Out sorghum. | 1.89 | 1.12 | 1.17 | 1.39 | 5.5 | 15.9 |
| 6 | do. | Cotton-seed hulls. | 1.62 | 1.29 | 1.50 | 1.47 | 5.5 | 21.3 |
| 7 | cotton-seed meal, corn and-cob meal. | Shredded corn stover. | 1.77 | 1.29 | .90 | 1.32 | 6.5 | 16.6 |
| 8 | cotton seed | $\frac{1}{2}$ cowpea hay | 1.85 | 2.00 | 1.19 | 1.68 | 7.1 | 15.6 |
| | cotton-seed meal | $\frac{1}{2}$ cut sorghum | | | | | | |
| 9 | cotton seed | $\frac{1}{2}$ cowpea hay | 2.10 | 1.48 | .99 | 1.52 | 7.2 | 14.9 |
| | corn and-cob meal. | $\frac{1}{2}$ cut sorghum | | | | | | |
| 10 | corn and-cob meal. | $\frac{1}{2}$ cowpea hay | 2.10 | 1.70 | 1.34 | 1.71 | 7.2 | 16.1 |
| | $\frac{1}{2}$ cotton-seed meal | $\frac{1}{2}$ cut sorghum | | | | | | |

Effects of shelter.—The animals in pen 2 were fed under an open shed, and pen 6 had no shelter. The average daily gain for the three years was 1.55 pounds for the pen under shelter and 1.47 pounds for the lot without shelter. In the two wet winters (1904-5 and 1905-6) the largest daily gains were made by the lot under shelter; but in the mild and rather dry winter of 1906-7 the lot without shelter made more rapid gains.

Scrubs versus grades.—Pen 1 consisted of scrubs—that is, of native cattle without admixture of any improved beef blood. Pen 2 contained grades of the beef and dual-purpose breeds as described on page 11. The scrubs made an average gain for three years of 1.68 pounds and the grades an average daily gain of 1.55 pounds. In the first experiment the scrubs were notably thinner than the grades at the beginning of the feeding period, and hence the scrubs made more rapid gains. In the other two experiments the scrubs and the grades made almost identical daily gains.

FEED REQUIREMENTS.

Sorghum versus cotton-seed hulls (pens 2 and 5).—The average of three years' results shows that 1 pound of gain was made with the consumption of only 3.66 pounds of concentrated feed in the case of the lot getting cotton-seed hulls, as compared with 4.23 pounds for the lot fed on sorghum. Every year there was a smaller consumption of roughage per pound of gain in the sorghum lot than in the lot fed on hulls, the figures being, respectively, 11.95 and 13.47 pounds of roughage. Special attention is called to the very small amounts of

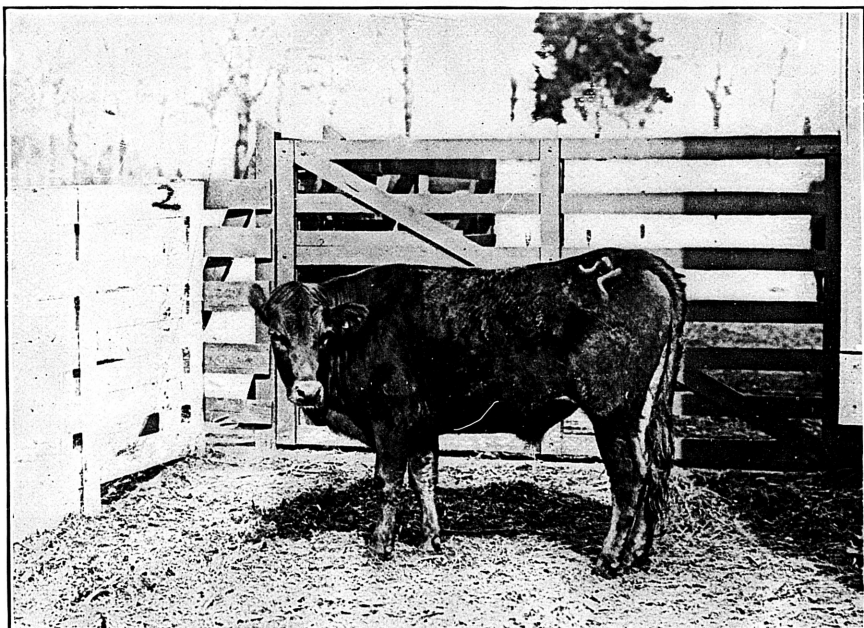


FIG. 1.—GRADE RED POLL—FIRST EXPERIMENT.

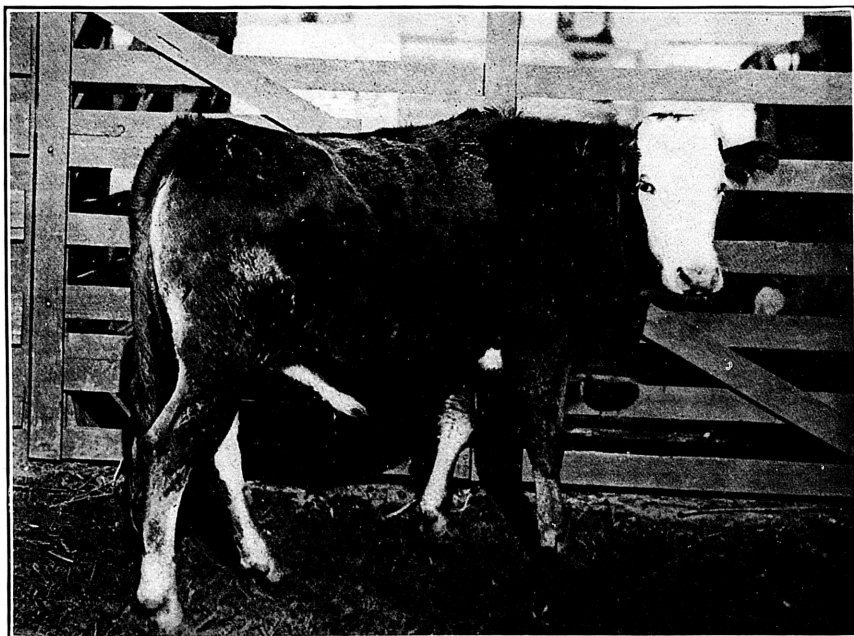


FIG. 2.—GRADE HEREFORD—FIRST EXPERIMENT.

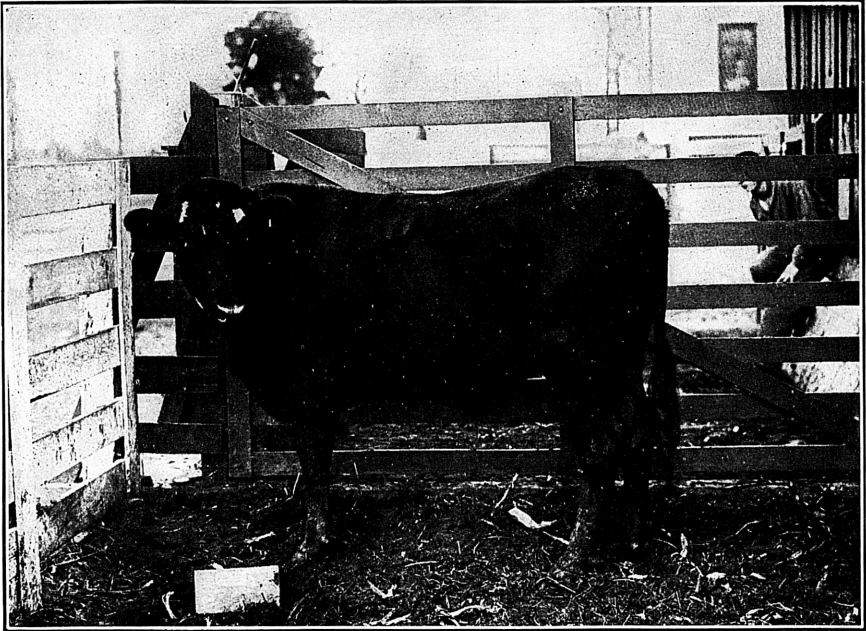


FIG. 1.—GRADE ABERDEEN-ANGUS STEER—FIRST EXPERIMENT.

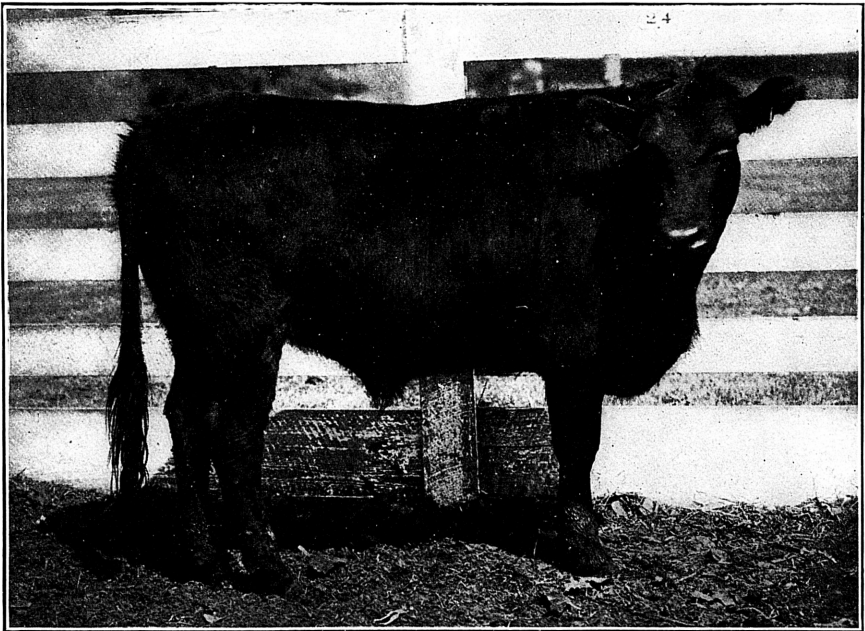


FIG. 2.—GRADE ABERDEEN-ANGUS STEER—FIRST EXPERIMENT.

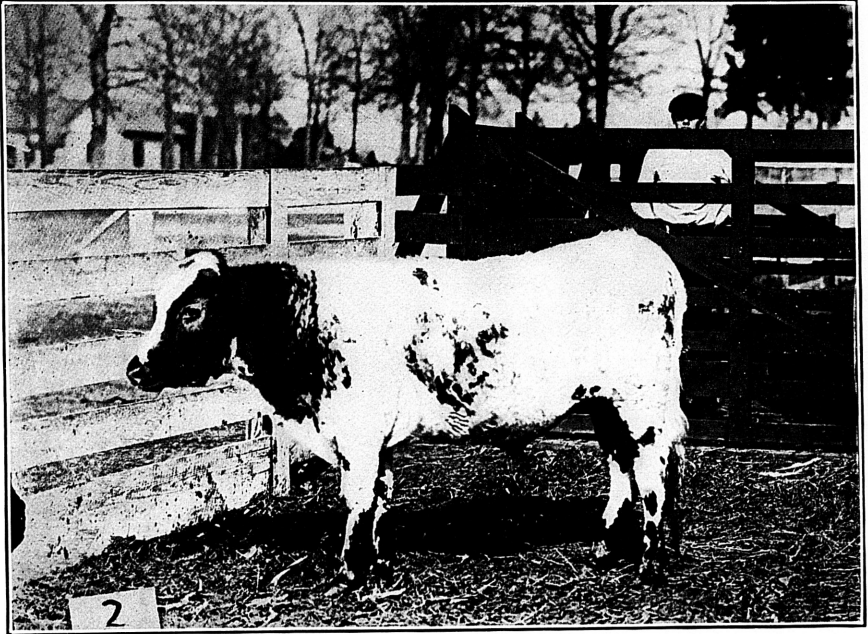


FIG. 1.—GRADE SHORTHORN—FIRST EXPERIMENT.

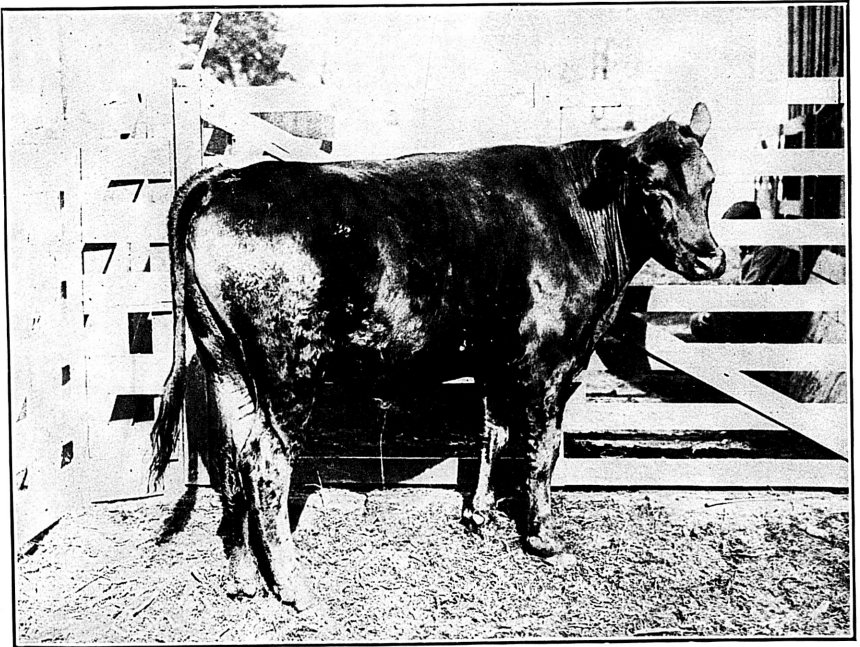


FIG. 2.—GRADE ABERDEEN-ANGUS—FIRST EXPERIMENT.



FIG. 1.—PEN OF SCRUBS—FIRST EXPERIMENT.

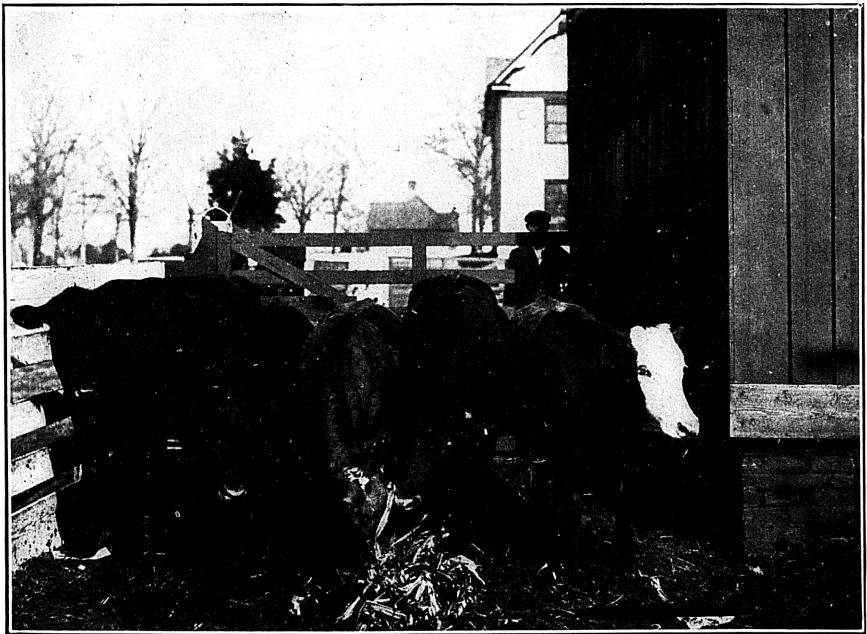


FIG. 2.—PEN OF GRADES—FIRST EXPERIMENT.

concentrated feed (cotton-seed meal) required to make 1 pound of gain. When corn alone is fed in the corn belt the amount required is often 10 to 13 pounds of corn for each pound gain in live weight. In this experiment pen 2 required only about one-third the usual amount of concentrate to produce a pound of increase in live weight, which emphasizes the relatively high fattening value of cotton-seed meal.

Corn stover versus cotton-seed hulls (pens 2 and 4).—When corn stover was fed ad libitum together with a limited amount of cotton-seed meal it required 5.78 pounds of concentrate for 1 pound of gain, as compared with 3.66 pounds of cotton-seed meal when fed in connection with hulls. In the same rations it required for 1 pound of growth 18.47 pounds of shredded corn stover as compared with only 13.47 pounds of cotton-seed hulls. In other words, it required 59 per cent more of cotton-seed meal to make 1 pound of gain when fed with stover than when fed with hulls. Moreover, to make 1 pound of gain there was required 37 per cent more stover than hulls.

Cut sorghum versus shredded corn stover (pens 4 and 5).—Comparing the amounts of these two feeds to make a pound of gain, there was required only 11.95 pounds of sorghum as compared with 18.47 pounds of stover, or 54 per cent more of stover. To produce the same effect required only 4.23 pounds of cotton-seed meal when fed with sorghum as compared with 5.78 pounds of cotton-seed meal when fed with stover, or 37 per cent more concentrate in the stover ration.

Cotton-seed meal versus corn-and-cob meal as the principal concentrate (pens 8 and 10).—Taking the average figure for the three experiments, the amount of concentrate required to produce a pound of gain in a ration consisting chiefly of cotton seed was 4.39 pounds as compared with 4.29 pounds of concentrate in a ration consisting chiefly of corn-and-cob meal. With the corn there was a slightly less roughage (mixed hay) required. However, these differences were both less than 2.5 per cent, so that we may properly interpret these results as showing practical equality in the nutritive effect of cotton-seed and corn-and-cob meal, pound per pound.

Cotton-seed meal versus corn-and-cob meal as a supplementary feed with cotton seed (pens 8 and 9).—When only one-third of the ration consisted of cotton-seed meal or corn-and-cob meal, used to make cotton seed more palatable, there were required 17 per cent more concentrate and 10 per cent more roughage to make 1 pound gain in the ration containing corn-and-cob meal. In other words, cotton-seed meal was slightly more efficient than corn-and-cob meal when used as a supplementary concentrate or appetizer.

Effect of substituting corn-and-cob meal for one-third of the cotton-seed meal when fed with (a) hulls or (b) corn stover (pens 2

and 3, and 4 and 7).—(a) When hulls constituted the roughage the substitution of corn for one-third of the cotton-seed meal slightly increased the amount of concentrate required per pound of gain (3.66 pounds to 3.96 pounds) and slightly reduced the amount of hulls required per pound of gain (from 13.47 pounds to 11.91 pounds). This shows that the substitution of corn and the consequent widening of the nutritive ratio effected practically no economy in the feed required.

(b) When a similar substitution was made in a ration in which the roughage was shredded corn stover, this substitution of corn-and-cob meal for an equal weight of cotton-seed meal gave contradictory results in the different experiments.

Effect of shelter (pens 2 and 6).—In two experiments out of three and in the average for three years, shelter resulted in a slight economy in use of concentrated feed and a slight loss in the use of roughage. In other words, shelter on the whole saved 0.2 of a pound of cotton-seed meal per pound gain and lost 0.49 of a pound of roughage. The steers out of doors consumed a larger ration of roughage.

Scrubs versus grades (pens 1 and 2).—The averages agree with each of the three experiments in showing that the scrubs required slightly less concentrate and roughage to make 1 pound of gain than did the grades. These results are chiefly due to the fact that in the first year's experiments the scrubs were thinner than the grades. In the other two years there was practically no difference in condition at the beginning of the experiment and very little in economy of feed.

TABLE 3.—Feed required to make 1 pound of gain.

| No. of pen. | Ration. | | 1904-5 | | | 1905-6 | | |
|-------------|---|---|-------------------------------|--|-----------|-------------------------------|--|-----------|
| | Concentrate. | Roughage. | Average daily gain per steer. | Pounds of food required per pound of gain. | | Average daily gain per steer. | Pounds of food required per pound of gain. | |
| | | | | Concentrate. | Roughage. | | Concentrate. | Roughage. |
| 1 | Cotton-seed meal..... | Cotton-seed hulls.... | 2.20 | 1.90 | 3.36 | 1.55 | 3.92 | 10.57 |
| 2 | do..... | do..... | 1.88 | 2.75 | 9.75 | 1.51 | 4.16 | 14.27 |
| 3 | $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn - and - cob meal. | do..... | 1.93 | 3.06 | 9.52 | 1.87 | 3.89 | 10.94 |
| 4 | Cotton-seed meal..... | Shredded corn stover. | 1.84 | 2.78 | 9.59 | 1.15 | 5.47 | 14.82 |
| 5 | do..... | Cut sorghum..... | 1.89 | 2.70 | 8.64 | 1.12 | 5.53 | 13.06 |
| 6 | do..... | Cotton-seed hulls.... | 1.62 | 3.14 | 11.45 | 1.29 | 4.84 | 13.86 |
| 7 | $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn - and - cob meal. | Shredded corn stover. | 1.77 | 3.33 | 8.68 | 1.29 | 5.63 | 12.84 |
| 8 | $\frac{2}{3}$ cotton seed, $\frac{1}{3}$ cotton-seed meal. | $\frac{1}{2}$ sorghum, $\frac{1}{2}$ pea hay. | 1.85 | 3.69 | 8.52 | 2.00 | 3.86 | 7.91 |
| 9 | $\frac{2}{3}$ cotton seed, $\frac{1}{3}$ corn-and-cob meal. | do..... | 2.10 | 3.37 | 7.37 | 1.48 | 5.19 | 9.40 |
| | do..... | do..... | 2.10 | 3.37 | 7.92 | 1.70 | 4.51 | 9.26 |

TABLE 3.—Feed required to make 1 pound of gain—Continued.

| No. of pen. | Ration. | | 1906-7 | | | Average for 3 experiments. | | |
|-------------|---|---|-------------------------------|--|-----------|-------------------------------|--|-----------|
| | Concentrate. | Roughage. | Average daily gain per steer. | Pounds of food required per pound of gain. | | Average daily gain per steer. | Pounds of food required per pound of gain. | |
| | | | | Concentrate. | Roughage. | | Concentrate. | Roughage. |
| 1 | Cotton-seed meal..... | Cotton-seed hulls..... | 1.30 | 4.01 | 16.06 | 1.68 | 3.28 | 11.66 |
| 2 | do..... | do..... | 1.27 | 4.08 | 16.39 | 1.55 | 3.66 | 13.47 |
| 3 | $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn - and - cob meal. | do..... | 1.27 | 4.94 | 15.26 | 1.69 | 3.96 | 11.91 |
| 4 | Cotton-seed meal..... | Shredded corn stover. | .57 | 9.10 | 31.00 | 1.19 | 5.78 | 18.47 |
| 5 | do..... | Cut sorghum..... | 1.17 | 4.45 | 14.15 | 1.39 | 4.23 | 11.95 |
| 6 | do..... | Cotton-seed hulls..... | 1.50 | 3.59 | 13.61 | 1.47 | 3.86 | 12.98 |
| 7 | $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn - and - cob meal. | Shredded corn stover. | .90 | 7.00 | 19.88 | 1.32 | 5.32 | 13.80 |
| 8 | $\frac{2}{3}$ cotton seed, $\frac{1}{3}$ cotton-seed meal. | $\frac{1}{2}$ sorghum, $\frac{1}{2}$ pea hay. | 1.19 | 5.63 | 12.97 | 1.68 | 4.39 | 9.80 |
| 9 | $\frac{2}{3}$ cotton seed, $\frac{1}{3}$ corn-and-cob meal. | do..... | .99 | 6.80 | 15.54 | 1.52 | 5.12 | 10.77 |
| 10 | $\frac{2}{3}$ corn-and-cob meal, $\frac{1}{3}$ cotton-seed meal. | do..... | 1.34 | 5.00 | 11.81 | 1.71 | 4.29 | 9.66 |

FINANCIAL STATEMENT.

Table 4 shows the average, for three years, of the weights of the steers at the beginning and end of the experiment proper, the shrinkage in shipment, the average selling price in New Orleans, the average shipping and selling expenses per steer, the total cost of feed at high and at low prices (see p. 13), and the gain or loss per steer (exclusive of manure) calculated for both high and low prices of feed.

TABLE 4.—Weights, shrinkage, and financial statement (average for three years).

| No. of pen. | Average weight per steer at beginning of experiment. | Average weight per steer at Auburn at end of experiment. | Shrinkage per steer in shipping. | Selling price per hundred weight at New Orleans. | Shipping expenses per steer. | Total cost of feed per steer at high price of feed. | Total cost of feed per steer at low price of feed. | Loss per steer at high price of feed. | Profit (+) or loss (-) per steer at low price of feed. |
|-------------|--|--|----------------------------------|--|------------------------------|---|--|---------------------------------------|--|
| | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | | | | | | |
| 1 | 654 | 795 | 92 | \$4.05 | \$3.27 | \$10.62 | \$7.43 | \$1.78 | +\$1.42 |
| 2 | 734 | 865 | 82 | 4.42 | 3.27 | 11.36 | 7.96 | 2.05 | + 1.34 |
| 3 | 737 | 878 | 86 | 4.32 | 3.27 | 11.80 | 8.34 | 2.93 | + .53 |
| 4 | 708 | 808 | 63 | 4.11 | 3.27 | 8.49 | 7.56 | 2.40 | - 1.47 |
| 5 | 698 | 815 | 67 | 4.18 | 3.27 | 10.01 | 9.09 | 2.92 | - 2.00 |
| 6 | 714 | 837 | 73 | 4.29 | 3.27 | 11.02 | 7.81 | 3.14 | + .07 |
| 7 | 689 | 799 | 69 | 3.97 | 3.27 | 8.95 | 7.87 | 4.16 | - 3.07 |
| 8 | 700 | 841 | 74 | 4.19 | 3.27 | 10.61 | 9.41 | 2.77 | - 1.58 |
| 9 | 688 | 816 | 72 | 4.12 | 3.27 | 10.05 | 8.62 | 3.33 | - 1.90 |
| 10 | 722 | 866 | 82 | 4.25 | 3.27 | 12.04 | 10.50 | 3.68 | - 2.13 |

Shrinkage.—The shrinkage in shipping to market in New Orleans was in all three experiments larger than it would have been under normal conditions. In the absence of facilities for loading cattle at Auburn the steers at the end of the first experiment had to be driven 7 miles before being loaded. In the second and third experiments there were unusual delays in transportation; in one case the steers were on the road forty-two hours between Auburn and New Orleans (a distance of 380 miles), because of delayed trains and a strike of railroad switchmen in New Orleans. If the steers had reached their destination on schedule time, which is about nineteen hours after leaving Auburn, the shrinkage would undoubtedly have been less and the financial results more favorable. To prepare the steers for shipment, they were all put on a ration consisting chiefly of hay for one day before leaving Auburn.

It is interesting to note that cotton seed, although a very laxative food, did not increase the amount of shrinkage of pens 8 and 9 as compared with other feeds. The steers fed on corn stover (pens 4 and 7) shrunk least.

Average selling price in New Orleans.—Taking the average selling price in New Orleans for the three experiments, we find that the highest average return was \$4.42 per hundredweight, for pen 2, consisting of grade steers fed exclusively on cotton-seed meal and hulls. The next highest price, \$4.32, was obtained for pen 3, in which corn-and-cob meal was substituted for a part of the cotton-seed meal. The third highest price, \$4.29 per hundredweight, was paid for pen 6, fed without shelter on cotton-seed meal and hulls. This is a reduction in price of 13 cents per hundredweight as the apparent loss from feeding in the open. This was due to the steers without shelter having a rougher, duller coat.

The steers getting corn-and-cob meal (pen 10) as the principal concentrate sold a little higher than those fed on cotton seed, but not as high as those fed on cotton-seed meal and hulls. The steers from pens 4 and 7, getting corn stover as roughage, sold lower than any of the other grades, not being so fat. Pen 5, getting sorghum as roughage, sold better than the stover pens and about the same as the pens getting cotton seed and hay, but not so well as the others.

The scrubs (pen 1) sold for about two-thirds of a cent less per pound than grades getting the same ration, and sold lower than any others except pen 7, fed stover for roughage. They were probably a little fatter than most of the grades because they were older and had fattened during the experiment instead of growing, as some of the younger grades had done.

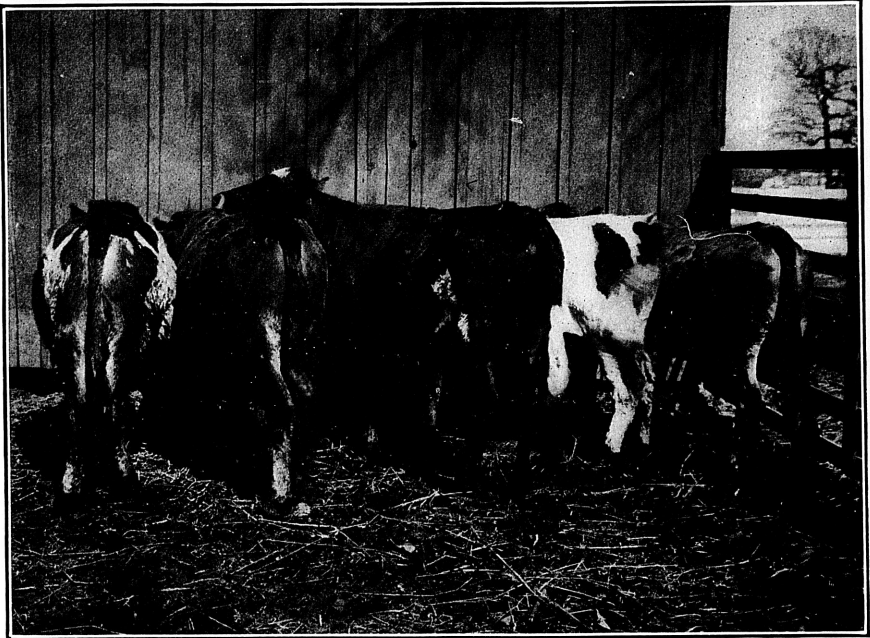


FIG. 1.—PEN OF SCRUBS—SECOND EXPERIMENT.

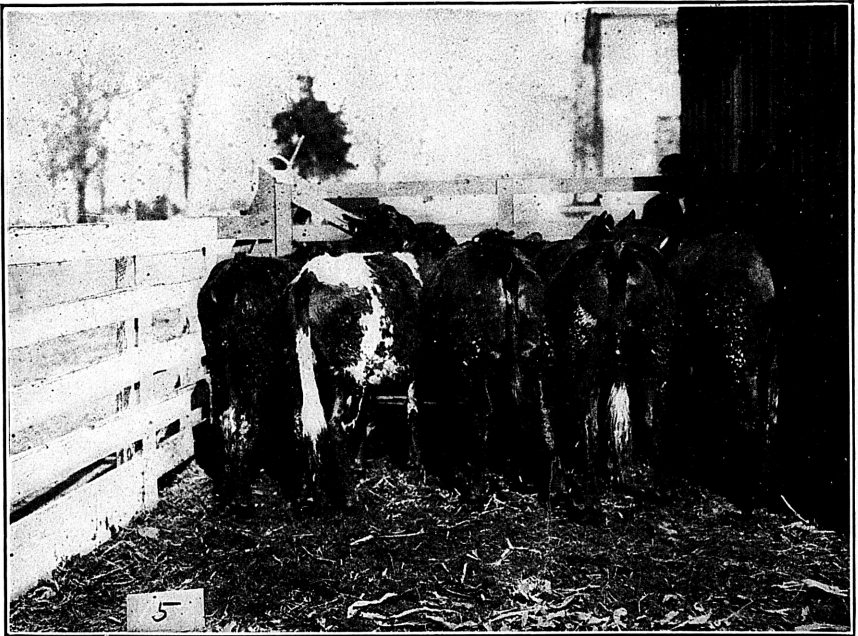


FIG. 2.—PEN OF GRADES—FIRST EXPERIMENT.



FIG 1.—PEN OF GRADES—FIRST EXPERIMENT.

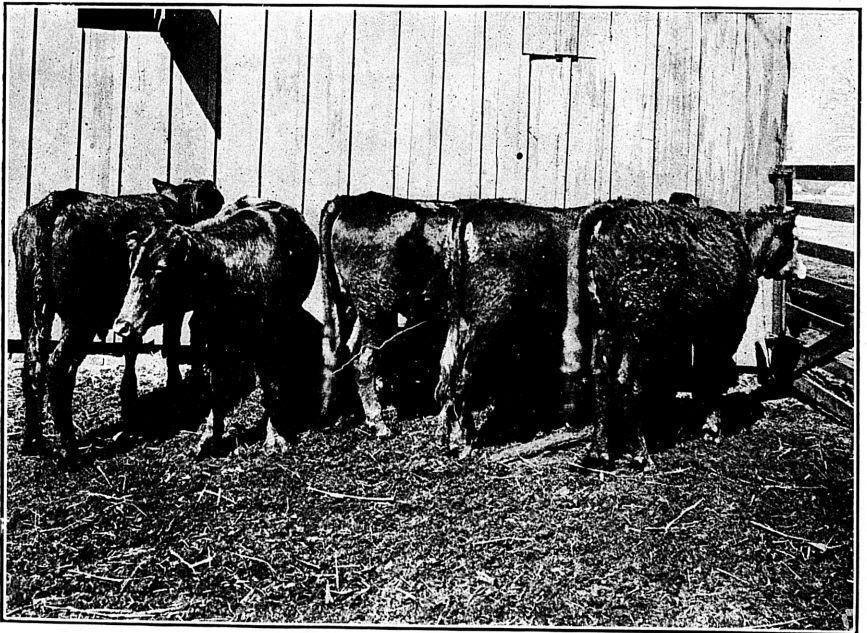


FIG. 2.—PEN OF GRADES—SECOND EXPERIMENT.

Profit or loss per steer.—Taking no account of the value of the manure and no account of the gains made by the hogs that followed the steers the first winter, we find that with cotton-seed meal at \$24 per ton, hulls at \$7 per ton, and corn at 70 cents per bushel, there was in every combination of these and other feeds a financial loss. This simply shows that such prices are too high to permit profitable feeding in such rations as those used, unless the margin between the buying and selling price of steers should be wider than it was in these experiments, namely, from about one-fourth to about three-fourths of a cent per pound. (See Table 6.)

A somewhat better financial showing is made when we figure with the more reasonable prices for the purchased feeds and the same prices as before for the home-grown stover, sorghum, and cowpea hay (p. 22). On this basis a small profit was made on all the steers that received cotton-seed hulls. On all other pens there was still a financial loss, chiefly due to the relatively high price which we have assumed for sorghum and cowpea hay in the absence of any data showing the exact cost of producing this roughage.

On the basis of prices just assumed, the greatest profit, \$1.42 per steer, was made by the scrubs, because they were bought at a lower price per pound, thus giving a larger margin (77 cents per hundred-weight), as shown in Table 6.

Comparing the financial results for the nine pens of grades, we find that the only three showing a profit rank as follows:

1. Pen 2, fed on cotton-seed meal and hulls.
2. Pen 3, fed on two-thirds cotton-seed meal and one-third corn-and-cob meal and hulls.
3. Pen 6, fed on cotton-seed meal and hulls (without shelter).

The feeding of hulls was more profitable than feeding stover at the same price (pens 2 and 4, and 3 and 7). Cotton seed was a more economical ration than corn (pens 8 and 10).

Cotton-seed meal was more economical than corn-and-cob meal as a supplementary feed with cotton seed. It was slightly more profitable to feed cotton-seed meal as the sole concentrate than to substitute for one-third of the cotton-seed meal an equal weight of corn-and-cob meal. This was true whether the roughage consisted of hulls or corn stover.

Returns received for roughage fed.—Table 5 shows the actual value in beef received as the return obtained from feeding 1 ton of the several kinds of roughage. This is based upon the difference between the selling price of the steers and the purchase price plus the cost of the concentrate fed to each pen. The figures given in the first

two columns are based upon prices of \$20 a ton for cotton-seed meal, \$12 a ton for cotton seed, and 50 cents a bushel for corn.

This table shows that on this basis the average financial return per ton of roughage, excluding the value of the manure, was as follows:

Cotton-seed hulls, \$4.64 to \$5.82 per ton.

Cut sorghum fodder alone, \$3.68 per ton.

Mixed sorghum and cowpea hay, \$5.18 to \$5.92 per ton.

Corn stover when fed with cotton-seed meal alone returned only \$1.98 per ton.

These figures suggest that under conditions prevailing in this experiment, and with cotton-seed meal at \$20 a ton a farmer could afford to give \$4.64 to \$5.82 a ton for hulls and have manure to offset labor of feeding, interest on investment, and profit. A quarter of a cent margin in addition to what was received would enable one to pay a considerably higher price for feed or greatly to increase the profit of feeding.

TABLE 5.—Actual value of roughage for feeding (average for three years).

| No. of pen. | Ration. | | Cost of all steers per pen and of grain fed. | Cost of steers per hundredweight. | Selling price per hundredweight at Auburn. ^a | Selling price per pen at Auburn. ^a | Difference, equivalent to value of roughage fed. | Roughage consumed (pounds). | Value of roughage per ton. |
|-------------|--|---|--|-----------------------------------|---|---|--|-----------------------------|----------------------------|
| | Concentrate. | Roughage. | | | | | | | |
| 1 | Cotton-seed meal..... | Cotton-seed hulls | \$103.32 | \$2.50 | \$3.27 | \$125.97 | \$22.65 | 7,778 | \$5.82 |
| 2 | do..... | do..... | 133.50 | 3.00 | 3.74 | 156.61 | 23.11 | 8,200 | 5.64 |
| 3 | $\frac{3}{4}$ cotton-seed meal, $\frac{1}{4}$ corn-and-cob meal. | do..... | 135.91 | 3.00 | 3.63 | 154.83 | 18.92 | 8,145 | 4.64 |
| 4 | Cotton-seed meal..... | Shredded corn stover. | 129.41 | 3.00 | 3.49 | 136.67 | 7.26 | 7,314 | 1.98 |
| 5 | do..... | Cut sorghum..... | 127.86 | 3.00 | 3.54 | 140.13 | 12.27 | 6,679 | 3.68 |
| 6 | do..... | Cotton-seed hulls | 130.47 | 3.00 | 3.62 | 146.92 | 16.45 | 7,855 | 4.19 |
| 7 | $\frac{3}{4}$ cotton-seed meal, $\frac{1}{4}$ corn-and-cob meal. | Shredded corn stover. | 128.74 | 3.00 | 3.28 | 127.28 | -1.46 | 6,958 | - .42 |
| 8 | $\frac{3}{4}$ cotton seed, $\frac{1}{4}$ cotton-seed meal. | $\frac{1}{2}$ pea hay, $\frac{1}{2}$ sorghum. | 124.83 | 3.00 | 3.54 | 144.20 | 19.37 | 6,538 | 5.92 |
| 9 | $\frac{3}{4}$ cotton seed, $\frac{1}{4}$ corn-and-cob meal. | do..... | 120.21 | 3.00 | 3.46 | 136.80 | 16.59 | 6,261 | 5.30 |
| 10 | $\frac{3}{4}$ corn-and-cob meal, $\frac{1}{4}$ cotton-seed meal. | do..... | 132.64 | 3.00 | 3.57 | 150.17 | 17.53 | 6,763 | 5.18 |

^a In calculating the selling price at Auburn the actual shrinkage, which was abnormally high in this experiment (see Table 4), is disregarded and the customary local 3 per cent deduction substituted therefor. The third column of figures was obtained as follows: 3 per cent for shrinkage was deducted from the sum of the final weights at Auburn. This shrunk weight was then divided into the total amount received in three years for the separate pens of steers in New Orleans, after deducting from the gross sales the expense of shipping and selling, namely, \$3.27 per steer.

Margin received and margin necessary for profit.—In Table 6 are presented average financial results for three years, each figure being the average for 15 steers. All these figures, except those in line 3, are on the basis of net prices in the feed lot at the close of the experiment.

TABLE 6.—Market values at close of experiment and margin of profit for each lot (average for three years).

| Classification of values. | Pen 1. | Pen 2. | Pen 3. | Pen 4. | Pen 5. | Pen 6. | Pen 7. | Pen 8. | Pen 9. | Pen 10. |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| Market value of steers per hundredweight in feed lot. | \$3.27 | \$3.74 | \$3.63 | \$3.49 | \$3.54 | \$3.62 | \$3.28 | \$3.54 | \$3.46 | \$3.57 |
| What each would have to sell for per hundredweight in feed lot to come out even. | 3.04 | 3.57 | 3.57 | 3.67 | 3.79 | 3.61 | 3.68 | 3.69 | 3.69 | 3.83 |
| Margin between buying price and selling price in New Orleans..... | 1.55 | 1.42 | 1.32 | 1.11 | 1.18 | 1.29 | .97 | 1.19 | 1.12 | 1.25 |
| Margin necessary between buying and selling price in feed lot to come out even..... | .54 | .57 | .57 | .67 | .79 | .61 | .68 | .69 | .69 | .83 |
| Margin per hundredweight actually received in feed lot..... | .77 | .74 | .63 | .49 | .54 | .62 | .28 | .54 | .46 | .57 |
| Net profit (+) or loss (-) per steer..... | +1.42 | +1.34 | + .53 | -1.47 | -2.00 | + .07 | -3.07 | -1.58 | -1.90 | -2.13 |

- Pen 1 (scrubs) fed cotton-seed meal and hulls.
- Pen 2 fed cotton-seed meal and cotton-seed hulls.
- Pen 3 fed two-thirds cotton-seed meal, one-third corn-and-cob meal and hulls.
- Pen 4 fed cotton-seed meal and corn stover.
- Pen 5 fed cotton-seed meal and cut sorghum.
- Pen 6 fed cotton-seed meal and hulls (no shelter).
- Pen 7 fed two-thirds cotton-seed meal, one-third corn-and-cob meal and stover.
- Pen 8 fed two-thirds cotton-seed, one-third cotton-seed meal, and one-half cowpea hay and one-half cut sorghum.
- Pen 9 fed two-thirds cotton seed, one-third corn-and-cob meal, one-half cowpea hay, and one-half cut sorghum.
- Pen 10 fed two-thirds corn-and-cob meal, one-third cotton-seed meal, and one-half hay and one-half cut sorghum.

* After making allowance for (1) shipping and selling expenses on basis of full cars of 33 head per car; (2) shrinkage in shipping, and (3) a 3 per cent shrinkage usually deducted by local buyers.

The first line shows the actual market value of the steers in the feed lot at Auburn at the end of the experiment, and shows the net prices at Auburn after deducting shipping expenses, etc., and after making allowance for a 3 per cent shrinkage.

The second line shows the price at which it would have been necessary to sell the steers in the feed lots to come out even.

The third line shows the margin received on the basis of prices in New Orleans.

The fourth line teaches the important lesson of how wide a margin is necessary under these conditions between the buying and selling prices of steers in the feed lot. It indicates that in general terms a margin of 54 to 83 cents per hundredweight in the feed lot is necessary to come out even, and that a still wider margin would be needed to afford any direct profit. In case the margin is calculated on the difference between the buying price of steers at the beginning of the experiment and the selling price after shipment, the margins indicated above would have to be increased by an amount large enough to cover expenses of shipment and sale. In these experiments the expense of shipping from Auburn to New Orleans and selling amounted to a little less than half a cent a pound, in addition to

shrinkage. Hence, on the basis of selling prices in New Orleans the margin necessary for our feeding operations to have come out even would have been the margin indicated in line 4, plus nearly 50 cents plus difference in shrinkage, or a total of from \$1.25 to \$1.51 per hundred pounds. To afford any material profit at the prices here assumed, or in case of very heavy shrinkage, the feeder should receive more than these latter figures.

Line 5 shows the margin actually received between the value of the steers at the beginning and at the end of the experiment, both calculated on the basis of prices in the feed lot at Auburn. In most cases this was too small for profitable feeding.

Line 6 shows the net profit or loss per steer, which has been previously commented on.

DAILY RATIONS AND DRY MATTER REQUIRED FOR 100 POUNDS OF GAIN.

In Table 7 are shown the average amount of roughage and concentrate fed per steer daily for the three-year period. It also shows the rations on the basis of dry matter required to make 100 pounds of gain. The amount of roughage in the daily ration was largest when hulls were fed, and least when mixed hay was fed.

The least amount of concentrate was consumed when cotton-seed meal was used alone, usually from 5.1 to 5.6 pounds per day. When corn-and-cob meal was added to the cotton-seed meal, the amount of concentrate consumed was about 1 pound per day greater. When cotton seed or corn-and-cob meal constituted the principal concentrate, the daily consumption of concentrated feed was increased to 7.2 pounds.

In dry matter consumed per 100 pounds of gain, cotton-seed meal alone and a mixture of cotton-seed meal and corn-and-cob meal were practically identical when fed with hulls, but the mixture was the more effective when fed with stover. With cotton seed the addition of cotton-seed meal as a supplement was slightly more effective than an equal weight of corn-and-cob meal. Corn-and-cob meal and cotton seed were practically equally effective as the principal concentrate.

TABLE 7.—Daily rations and dry matter per hundredweight of gain.

| No. of pen. | Daily gain per steer. | Concentrate per 100 pounds gain. | Roughage per 100 pounds gain. | Dry matter per 100 pounds gain. | Average daily ration. | |
|-------------|-----------------------|---|---|---------------------------------|-----------------------|----------------|
| | | | | | Concentrate. | Roughage. |
| | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> |
| 1 | 1.68 | 328, cotton-seed meal | 1,166, cotton-seed hulls | 1,337.7 | 5.1 | 18.5 |
| 2 | 1.55 | 366, cotton-seed meal | 1,347, cotton-seed hulls | 1,535.5 | 5.6 | 19.5 |
| 3 | 1.69 | 396, $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn-and-cob meal. | 1,191, cotton-seed hulls | 1,413.2 | 6.5 | 19.4 |
| 4 | 1.19 | 578, cotton-seed meal. | 1,847, shredded corn stover. | 2,110.2 | 5.5 | 17.4 |
| 5 | 1.39 | 423, cotton-seed meal | 1,195, cut sorghum | 1,393.3 | 5.5 | 15.9 |
| 6 | 1.47 | 386, cotton-seed meal | 1,293, cotton-seed hulls | 1,508.3 | 5.5 | 21.3 |
| 7 | 1.32 | 532, $\frac{2}{3}$ cotton-seed meal, $\frac{1}{3}$ corn-and-cob meal. | 1,380, shredded corn stover. | 1,655.4 | 6.5 | 16.6 |
| 8 | 1.68 | 439, $\frac{2}{3}$ cotton seed, $\frac{1}{3}$ cotton-seed meal. | 980, $\frac{1}{2}$ cowpea hay, $\frac{1}{2}$ sorghum. | 1,244.8 | 7.1 | 15.6 |
| 9 | 1.52 | 512, $\frac{2}{3}$ cotton seed, $\frac{1}{3}$ corn-and-cob meal. | 1,077, $\frac{1}{2}$ cowpea hay, $\frac{1}{2}$ sorghum. | 1,373.9 | 7.2 | 14.9 |
| 10 | 1.71 | 429, $\frac{2}{3}$ corn-and-cob meal, $\frac{1}{3}$ cotton-seed meal. | 966, $\frac{1}{2}$ cowpea hay, $\frac{1}{2}$ sorghum. | 1,210.8 | 7.2 | 16.1 |

Analyses of all feeds, except sorghum and shredded corn stover, taken from Henry's "Feeds and Feeding." Analyses of sorghum fodder and corn stover made by C. L. Hare, of the Alabama Experiment Station.

THE NUTRITIVE RATIO.

The nutritive ratio is the proportion between the digestible protein (or nitrogenous material) and digestible carbohydrates to which is added a sum equal to 2.25 times the digestible fat. It has been held that a nutritive ratio of about 1 to 6 is especially favorable to the fattening of cattle. A ration consisting exclusively of cotton-seed meal and cotton-seed hulls usually contains a larger proportion of nitrogen, and hence has a narrower nutritive ratio than indicated above. Apparently the nutritive ratio was not a controlling factor in the rapidity of fattening.

TABLE 8.—Nutritive ratio of rations fed.

| No. of pen. | 1904-5 | 1905-6 | 1906-7 | No. of pen. | 1904-5 | 1905-6 | 1906-7 |
|-------------|--------|--------|--------|-------------|--------|--------|--------|
| 1 | 1:5.4 | 1:3.8 | 1:5 | 6 | 1:4.7 | 1:3.9 | 1:4.8 |
| 2 | 1:4.6 | 1:4.1 | 1:5 | 7 | 1:5.7 | 1:5.3 | 1:6 |
| 3 | 1:6.3 | 1:5.8 | 1:6.1 | 8 | 1:4.5 | 1:4.4 | 1:4.5 |
| 4 | 1:4.8 | 1:4.1 | 1:4.8 | 9 | 1:6.7 | 1:6.8 | 1:6.7 |
| 5 | 1:4.2 | 1:3.5 | 1:4.2 | 10 | 1:5.2 | 1:5.1 | 1:5.2 |

NOTES.—Ether extract multiplied by 2.25 to get its equivalent in carbohydrates.

Analyses and digestibility of all feeds except sorghum and stover taken from Henry's "Feeds and Feeding." Analyses of sorghum fodder and shredded stover made by C. L. Hare, of the Alabama Experiment Station.

Digestion coefficients of corn stover taken from Henry's tables, and for sorghum from Colorado Experiment Station Bulletin 93.

Average analyses of stover and sorghum for the years 1905-6 and 1906-7 (Hare).

| | Dry matter. | Proteids. | Nitrogen-free extract. | Crude fiber. | Ether extract. |
|---------|------------------|------------------|------------------------|------------------|------------------|
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| Stover | 85.52 | 4.19 | 43.68 | 31.63 | 1.60 |
| Sorghum | 83.93 | 4.73 | 40.56 | 32.30 | 2.03 |

Digestion coefficients of sorghum and stover.

| | Dry matter. | Proteids. | Nitro- gen-free extract. | Crude fiber. | Ether extract. |
|--------------------------------------|------------------|------------------|--------------------------------|------------------|-------------------|
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| Stover (Henry)..... | 57.00 | 40.00 | 56.00 | 65.00 | 72.00 |
| Sorghum (Colo. Station Bul. 93)..... | 58.46 | 43.01 | 61.00 | 49.23 | 64.90 |

Digestible nutrients in corn stover :

$4.19 \times 0.40 = 1.68$ per cent digestible protein in stover.

$43.68 \times .56 = 24.46$ per cent digestible nitrogen-free extract.

$31.63 \times .65 = 20.56$ per cent digestible crude fiber.

45.02 per cent total digestible carbohydrates.

$1.60 \times .72 = 1.15$ per cent digestible fats.

Digestible nutrients in sorghum :

$4.73 \times 43.01 = 2.03$ per cent digestible protein in sorghum.

$40.56 \times 61.00 = 24.74$ per cent digestible nitrogen-free extract.

$32.30 \times 49.23 = 15.90$ per cent digestible fiber.

40.64 per cent total digestible carbohydrates.

$2.03 \times 64.90 = 1.32$ per cent digestible fats.

SLAUGHTER TESTS.

Through the courtesy of an abattoir company of New Orleans we were enabled to make slaughter tests of the steers butchered in New Orleans. A few of the steers were shipped out of the city to butchers in other places, and no data as to slaughter tests of such animals could be secured.

Dressed weight.—These figures are on the basis of the live weight in New Orleans. The average for three years shows that the scrubs dressed only 54.5 per cent as compared with an average of 57.2 per cent for the grades fed on the same ration. This means that in every 100 pounds gross weight there were 2.7 pounds more dressed meat in the carcasses of the grades than in those of the scrubs. The difference in selling price in New Orleans was 37 cents per hundredweight live weight in favor of the grades.

The table shows that the steers fed on cotton-seed meal and hulls dressed higher than those receiving any other ration, averaging 57.2 per cent. Next came the group of pens receiving hay with either corn or cotton seed as the principal concentrate, the hay pens falling about 1 per cent behind the hull pens. The pens receiving stover or sorghum made the poorest showing, falling about 1 per cent behind the hay pens, but dressing out better than the scrubs.

Fat on intestines and manyplies.—Not even the cotton-seed rations influenced very markedly the proportion of gut and book fat^a to the live weight, the percentage of this kind of internal fat seeming to depend largely on the individuality of the steers.

^a Book fat is the term used in New Orleans abattoirs for the fat surrounding the manyplies, or third stomach.

TABLE 9.—Percentage of dressed weight, fat, hide, blood, etc., on basis of live weight at New Orleans.

| No. of pen. | Dressed weight. | | | | Gut and book fat. | | | | Hide. | | |
|-------------|-------------------------|-------------------------|------------------------|--------------------------|-------------------------|-------------------------|-------------------------|----------------------------|------------------------|------------------------|------------------------|
| | First year. | Second year. | Third year. | Average for three years. | First year. | Second year. | Third year. | Average for three periods. | First year. | Second year. | Third year. |
| 1 | <i>Per ct.</i> b51.5 | <i>Per ct.</i> a54.5 | <i>Per ct.</i> 56.9 | <i>Per ct.</i> 54.5 | <i>Per ct.</i> b0.38 | <i>Per ct.</i> a1.28 | <i>Per ct.</i> a1.14 | <i>Per ct.</i> 0.88 | <i>Per ct.</i> b8.0 | <i>Per ct.</i> a9.2 | <i>Per ct.</i> a7.7 |
| 2 | b57.8 | 56.3 | 57.6 | 57.2 | b2.2 | 1.18 | | | 8.2 | 7.5 | |
| 3 | b56.3 | 57.2 | 58.3 | 57.3 | b1.17 | 1.11 | | | b8.1 | 7.6 | |
| 4 | 53.3 | b56.4 | 56.6 | 55.4 | 1.14 | b1.23 | b.95 | 1.03 | 8.1 | b8.9 | b7.8 |
| 5 | 53.6 | b55.5 | 56.3 | 55.1 | 1.85 | a1.19 | b1.05 | 1.42 | 8.1 | a8.3 | b8.1 |
| 6 | b56.2 | a55.8 | b59.3 | 57.2 | b1.54 | a1.22 | a1.30 | 1.37 | b7.7 | a7.4 | a7.6 |
| 7 | | b52.1 | 59.1 | | | | 1.13 | | | | b8.3 |
| 8 | | b54.9 | 57.4 | | | b1.14 | b1.19 | | | | 8.3 |
| 9 | a54.7 | b54.6 | 57.8 | 56.0 | a1.4 | a1.26 | a1.13 | 1.26 | a8.6 | a8.0 | a8.0 |
| 10 | a56.0 | a57.5 | 57.1 | 56.9 | a1.49 | | b1.10 | 1.27 | a8.2 | | a7.9 |

| No. of pen. | Blood. | | | Liver, lungs, heart, and diaphragm. | | | Paunch and intestines. | | |
|-------------|-------------------------|--------------------------|--------------------------|-------------------------------------|-------------------------|-------------------------|---------------------------|----------------------------|--------------------------|
| | First year. | Second year. | Third year. | First year. | Second year. | Third year. | First year. | Second year. | Third year. |
| 1 | <i>Per cent.</i> 2.8 | <i>Per cent.</i> 2.41 | <i>Per cent.</i> 2.71 | <i>Per cent.</i> 2.8 | <i>Per cent.</i> 3.0 | <i>Per cent.</i> 2.8 | <i>Per cent.</i> b18.5 | <i>Per cent.</i> a18.37 | <i>Per cent.</i> 15.6 |
| 2 | b2.9 | 2.56 | | b2.7 | 2.8 | | 13.2 | 16.7 | |
| 3 | b2.5 | a2.86 | b3.28 | b2.8 | a3.1 | a2.9 | b14.0 | 16.2 | |
| 4 | 2.5 | b2.86 | 2.9 | b3.0 | b2.8 | b2.8 | 15.9 | b19.6 | b16.5 |
| 5 | 2.6 | a2.84 | b2.70 | 3.0 | a3.1 | b2.6 | 13.3 | a16.9 | b16.7 |
| 6 | b2.9 | a2.83 | a2.56 | b2.9 | a2.8 | a2.8 | b12.7 | a15.33 | a16.1 |
| 7 | | | b2.96 | | | b2.8 | a16.5 | a17.1 | a17.7 |
| 8 | | b2.98 | b3.00 | | b3.1 | b2.6 | | | b18.0 |
| 9 | a2.6 | a2.68 | a2.75 | a2.9 | a2.9 | a2.7 | | b17.6 | b17.0 |
| 10 | a2.6 | | a3.00 | a3.0 | | a2.7 | a15.1 | | a17.3 |

Unmarked pens have an average of 5 steers.

^a Average of 3 steers.

^b Average of 4 steers.

SUMMARY.

The conclusions given below are based on the average of the three experiments.

1. With cotton-seed meal as the sole concentrate the average daily gains were as follows: With cotton-seed hulls, 1.55 pounds; with cut sorghum fodder, 1.39 pounds; with shredded corn stover, 1.19 pounds.

2. With mixed cowpea and sorghum hay as the roughage, and with one-third of the concentrate consisting of cotton-seed meal, the daily gain per steer from feeding cotton seed was 1.68 pounds, and from feeding an equal weight of corn-and-cob meal 1.71 pounds.

3. To produce 1-pound increase in live weight required practically equal amounts of cotton seed and of corn-and-cob meal. This shows that under the conditions of these experiments a pound of cotton seed was equally as valuable as a pound of corn-and-cob meal. Cotton seed is cheaper per pound, and hence is the more economical feed.

4. Cotton-seed meal proved more effective and economical than corn-and-cob meal when each was fed as an appetizer in connection with cotton seed.

5. When, in a ration of cotton-seed meal, one-third of the weight of the cotton-seed meal was substituted by an equal weight of corn-and-cob meal, the daily gains were slightly increased. The amount of concentrate per pound of gain was greater with the mixed ration, making this slightly less profitable than the ration containing cotton-seed meal as the sole concentrate.

6. The effect of shelter varied with the character of the winter. In two tests shelter increased the daily gains and decreased the amount of feed required per pound of gain. In the third experiment the pen fed without shelter made the larger gains and better use of its feed. The average of three years is in favor of shelter. The selling price in all three experiments was higher for the steers fed under shelter, the average difference being 13 cents per hundredweight in favor of the sheltered steers.

7. The scrub steers in two experiments made practically the same daily gains at practically the same cost as the grades. At the beginning of the other experiment the scrubs were thinner, and they gained more rapidly and economically.

8. Heavy shrinkage during shipment, due to unusual delays, greatly reduced the possible profits.

9. The average selling price of grades in New Orleans ranged between \$3.97 (for the pen fed on corn stover, cotton-seed meal, and corn-and-cob meal) and \$4.42 (for the pen fed on cotton-seed meal and hulls).

10. Of the eight rations fed the following were the most profitable at prices assumed: (1) Cotton-seed meal and hulls; (2) two-thirds cotton-seed meal, one-third corn-and-cob meal, with cotton-seed hulls as roughage. With cotton-seed meal at \$20 a ton, hulls were worth in these experiments from \$4.62 to \$5.82 per ton. Inferior sorghum fodder and corn stover were worth less than hulls.

11. A margin ranging between 0.54 and 0.83 of a cent per pound in the feed lots for the different lots would have made the feeding operations come out even. To find the corresponding margin between purchase price and selling price in New Orleans, any intending shipper can add an amount sufficient to cover expenses of shipping and selling and shrinkage.

12. The scrubs dressed out 54.3 per cent as compared with 57.2 per cent for grades fed on a similar ration.

13. In percentage of dressed weight the best showing was made by the steers fed on cotton-seed meal and hulls, and the poorest by those fed on corn stover or on sorghum fodder. The steers receiving mixed hay ranked lower in percentage of dressed weight than those fed on hulls and higher than those fed on sorghum or corn stover.