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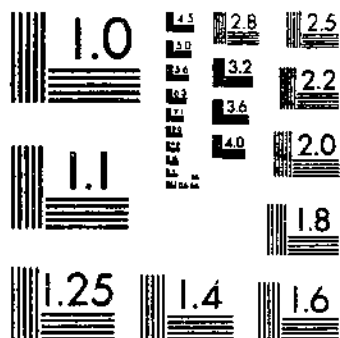
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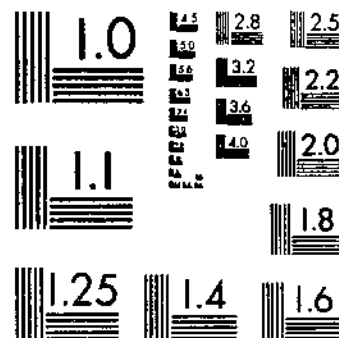
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MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

  
UNITED STATES DEPARTMENT OF AGRICULTURE  
WASHINGTON, D. C.**BEEF PRODUCTION FROM PUREBRED,  
GRADE, AND NATIVE CALVES**

By ARTHUR T. SEMPLE, *Associate Animal Husbandman, Animal Husbandry Division, Bureau of Animal Industry, United States Department of Agriculture,* and H. E. DVORACHEK, *Head of Department of Animal Industry, Agricultural Experiment Station, University of Arkansas*

In cooperation with the Arkansas Agricultural Experiment Station, and the State Agricultural and Mechanical College

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**OBJECT OF THE EXPERIMENT**

An experiment was begun in 1924 by the Arkansas Agricultural Experiment Station and the State Agricultural and Mechanical College in cooperation with the United States Department of Agriculture, in which purebred Aberdeen-Angus calves, first-cross and second-cross Aberdeen-Angus calves, and Arkansas native calves were compared as sources of beef. In conducting the experimental work, data were collected to compare the weight, height at the withers, and heart girth of calves at birth, the gains made by the calves to weaning time, the feed requirements for fattening the calves, the quantity and quality of dressed beef produced, and the financial returns for calves, ranging from purebred to native.

**PLAN OF EXPERIMENT AND DESCRIPTION OF CATTLE**

The cattle used in the experiment were kept on the farm of the State Agricultural and Mechanical College at Jonesboro, Ark., under the supervision of A. C. Cook from 1924 to 1927, and of H. W. Hollard from 1927 to 1928, members of the faculty of the college, and part-time employees of the Animal Husbandry Division, United States Department of Agriculture. William Lovard Davis, a student at the college, fed and cared for the cattle throughout most of the experiment.

The work began with the selection of 40 cows, which were divided into four lots of 10 each. The breeding of the cows was as follows: Lot 1, purebred Aberdeen-Angus; lot 2, grade Aberdeen-Angus, the sire being purebred Aberdeen-Angus and the dams of nondescript breeding common to eastern Arkansas; lot 3, Arkansas native; and lot 4, Arkansas native. Lots 1, 2, and 3 were bred to a purebred Aberdeen-Angus bull and lot 4 to an Arkansas native bull.

The 20 native cows and 1 bull which were selected in Drew County, Ark., for the experiment, were comparable to razorback hogs, the piney woods rooters of the central plains, and to longhorn cattle, in that they showed no evidence of having any immediate relationship to any improved breeds and in that they were accustomed to shift for themselves the year round in large, forested areas, with little or no harvested feed. The cattle probably had received a little feed from cornfields and cotton fields during the winter. Their type was indeed an example of the survival of the fittest, since their hardiness and prolificacy were evident. During the experiment they had much better care and feed than they had been accustomed to and responded very satisfactorily, producing strong calves and supplying them liberally with milk. The cows practically doubled their weight during the experiment while the bull quadrupled his weight. The cows appeared to be from 2 to 4 years old.

It is well known that before the Civil War a considerable number of well-bred cattle of both beef and dairy breeding were brought to the plantations of eastern Arkansas by owners who took pride in the excellence of their livestock. Those cattle undoubtedly were crossed with cattle of no particular breeding such as moved westward with the first settlers as the frontier advanced westward and northward from the Atlantic and Gulf coasts. These native cattle of southeastern Arkansas are small and have rather short horns. Some of their ancestors may have been Spanish or French cattle.

The 10 purebred cows and 1 purebred bull were taken from the herd which had been established at the State Agricultural and Mechanical College in 1916 and added to from time to time by the purchase of bulls and additional cows. The 10 grade cows were purchased in Cross County, and the 20 native cows and 1 bull were purchased in Drew County in the spring of 1924. In the selection of these cattle an effort was made to have them as nearly representative as possible of the class of animals to which they belonged. Cows from 3 to 4 years old with calves at side or apparently safe with calf were sought to avoid beginning with nonbreeders. An exception to this policy was necessary, however, in replacing the purebred cows, as funds were not always available to purchase proved breeders, and heifers were accepted. Table 1 shows the weights and gains of each of the four lots of cows during the period of the experiment of four summers and three winters. Footnotes to the table give data relative to replacements.

Because the purebred cows had been more liberally fed and were better grown and fatter than the grades and natives, they made much smaller gains during the experiment. Of the original cows in the experiments, 6 purebreds made an average gain of 133 pounds per head in three years; 8 grades, 240 pounds per head; 8 natives in lot 3, 388 pounds per head; and 10 natives in lot 4, 420 pounds per head. The bulls were kept at the barn in small paddocks and fed separately except during the breeding season, when each was turned on the

pasture with the cows which he was to breed. While on pasture the bulls had no supplemental feed. During the first summer, 1924, the Aberdeen-Angus bull was with the cows of lots 1, 2, and 3 from June 18 to July 30, when he was shipped to another State college, while the native bull was with lot 4 from June 18 to August 13. During the second summer the bulls were on pasture with their respective lots of cows from June 4 to July 22, and from July 30 to August 21. During the third year, the breeding season extended from May 20 to August 19, 1926.

TABLE 1.—Average initial and final weights, and average gains of the four lots of cows for the summer grazing and winter feeding periods, June 17, 1924—October 20, 1927

Lot	Season	Days	Cow	Weight of cows		Gain (+) or loss (-)	
				Initial	Final		
		Number	Number	Pounds	Pounds	Pounds	
1, Aberdeen-Angus	Summer, 1924	156	8	678	1,007	+129	
	Winter, 1924-25	140	10	985	1,005	+20	
	Summer, 1925	224	9	1,006	984	-22	
	Winter, 1925-26	140	10	970	1,095	+125	
	Summer, 1926	224	9	1,067	956	-111	
	Winter, 1926-27	140	10	944	903	-41	
	Summer, 1927	196	10	968	970	+2	
	Four summers		36		962	978	-4
	Three winters		30		966	1,022	+56
	2, first-cross grades	Summer, 1924	156	8	647	801	+154
Winter, 1924-25		140	10	784	843	+59	
Summer, 1925		224	10	846	855	+9	
Winter, 1925-26		140	10	855	907	+52	
Summer, 1926		224	10	907	867	-40	
Winter, 1926-27		140	10	867	847	-20	
Summer, 1927		196	10	847	879	+32	
Four summers			39		820	853	+33
Three winters			30		835	886	+51
3, natives		Summer, 1924	156	10	440	637	+197
	Winter, 1924-25	140	10	637	691	+54	
	Summer, 1925	224	9	693	795	+102	
	Winter, 1925-26	140	9	795	855	+60	
	Summer, 1926	224	8	854	745	-109	
	Winter, 1926-27	140	9	749	804	+55	
	Summer, 1927	196	10	787	809	+22	
	Four summers		37		685	745	+60
	Three winters		28		724	780	+56
	4, natives	Summer, 1924	156	10	430	616	+186
Winter, 1924-25		140	10	616	659	+43	
Summer, 1925		224	10	659	737	+78	
Winter, 1925-26		140	10	737	792	+55	
Summer, 1926		224	10	792	806	+16	
Winter, 1926-27		140	10	806	780	-26	
Summer, 1927		196	10	780	813	+33	
Four summers			40		668	744	+76
Three winters			30		720	747	+27

<sup>1</sup> There were 10 Aberdeen-Angus cows until 2 were killed by a train on Sept. 10. Two heifers purchased from Ames plantation were put with the original cows, Oct. 8, but were not included in the experimental data until Nov. 20.

<sup>2</sup> There were 10 cows until 1 died on account of buckeye poisoning Sept. 27.

<sup>3</sup> One Aberdeen-Angus cow was removed May 6 on account of being a nonbreeder.

<sup>4</sup> One cow was crippled on the second day and consequently she was not included in the experiment. Another cow was injured by a train on Sept. 10. Two new cows from the same plantation as the original ones were put with them on Oct. 8 but were not included in the experimental data until Nov. 20.

<sup>5</sup> One cow was badly cut on both front legs by barbed wire Oct. 13 and did not recover until about Dec. 17.

<sup>6</sup> As one cow was crippled by the bull on July 2 she was removed from the experiment for the summer period, but her calf was retained for winter feeding.

<sup>7</sup> Another cow was removed on June 3 because she was a nonbreeder. The herd was brought up to 10 head again when 2 cows were put with the lot on Aug. 25. They were not counted in the experiment until Nov. 18.

<sup>8</sup> Average initial and final weights are given for the 9 head which were in the experiment throughout the winter feeding period. One of the 10 with which the period was begun, died Jan. 2 of pneumonia. A substitute for the missing cow was put into the lot Feb. 10.

## METHODS OF HANDLING THE CATTLE

All the cattle were weighed on three consecutive days, June 16, 17, and 18, 1924, the average of the three weighings of each animal being used as its initial weight. Photographs such as are shown in Figures 1 to 5 were taken of each of the 40 cows and 2 bulls at the beginning of the experiment. The background consisted of a board panel painted white with vertical and horizontal heavy black lines 1 foot apart each way. With each animal the same distance in front of such a cross-section background and with the camera at the same place each time, comparable photographs of the height and length of the cattle were obtained.

The Arkansas native bull had an initial weight of 312 pounds, while his final weight June 30, 1927, practically three years later, was 1,200 pounds. After the first breeding season the Aberdeen-Angus bull

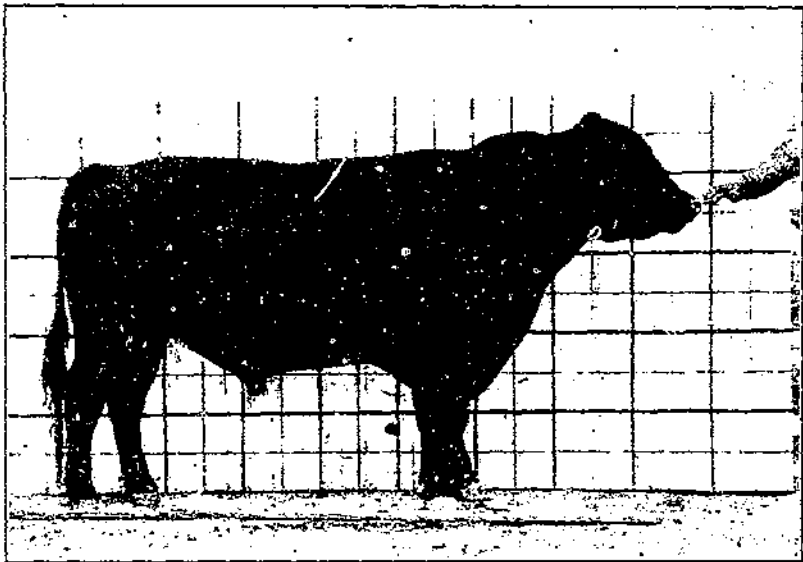


FIGURE 1.—The purebred Aberdeen-Angus bull used during the first breeding season. The bull which replaced him was smoother, more compact, and had more quality.

was replaced by one more suitable for the purebred cows. His initial weight, August 13, 1924, at  $2\frac{1}{2}$  years of age, was 1,380 pounds, while his final weight on August 25, 1927, practically three years later, was 1,325 pounds.

The four lots of cows were handled as nearly alike as possible throughout the experiment. The average initial and final weights and gains for each of the lots for each summer and winter period are given in Table 1. During the grazing periods two pastures were used. While one pasture contained 94 acres and the other contained 48 acres, their carrying capacity was similar, because the larger one was partly wooded. These pastures, the only ones available for the experimental work, were bounded by two railroads and a drainage ditch. The barbed-wire fences and water gates along the railroads were responsible for most of the losses mentioned in the footnotes of Table 1. Lots 1, 2, and 3, which were bred to the purebred bull, were kept on one

pasture, while lot 4, bred to the native bull, was kept on the other pasture. Every two weeks after the beginning of each grazing season the two groups were changed from one pasture to the other

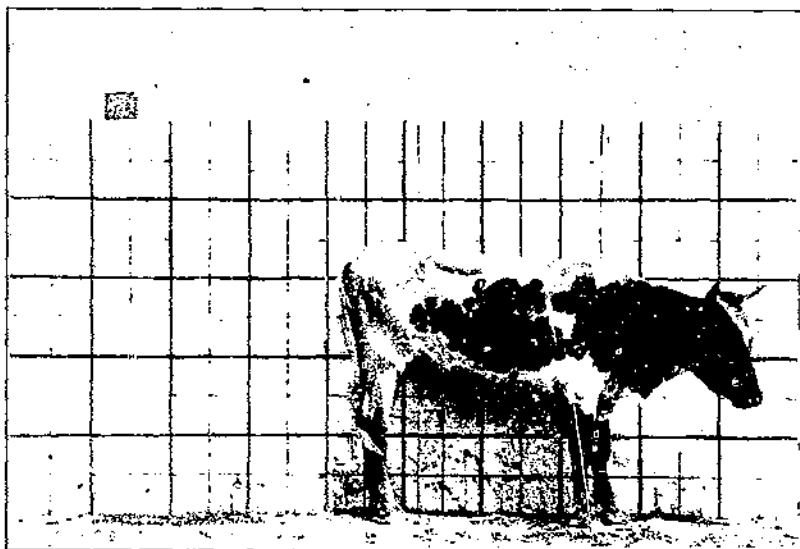


FIGURE 2.—The Arkansas native bull used throughout this experiment. This photograph was taken at the beginning of the experiment, when he weighed 312 pounds

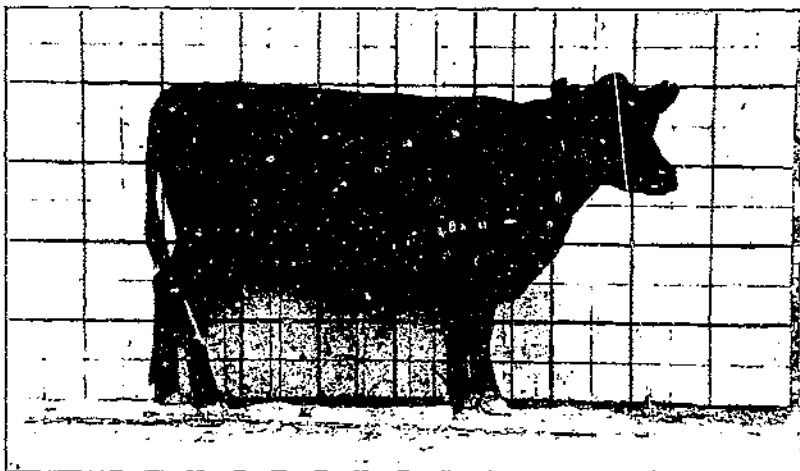


FIGURE 3.—Purebred Aberdeen-Angus cow typical of the purebreds used in the experiment

so that each group was on one of the pastures half the time and on the other pasture the other half of the time. During the winter feeding period each lot was fed practically the same quantity of feed per 1,000 pounds live weight, as shown in Table 2.



## COST OF THE WEANLING CALVES

The following prices per ton for feed have been used to calculate the cost of wintering the cows and fattening the calves: Sorgo silage, \$6; shelled corn, \$25; corn-and-cob meal, \$20; rice bran, \$20; cotton-

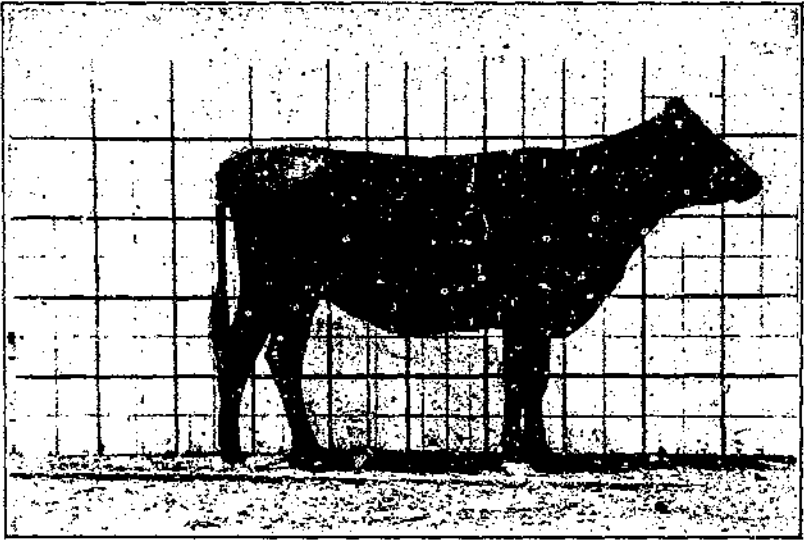


FIGURE 4.—Cow typical of the grade Aberdeen-Angus cows used in the experiment

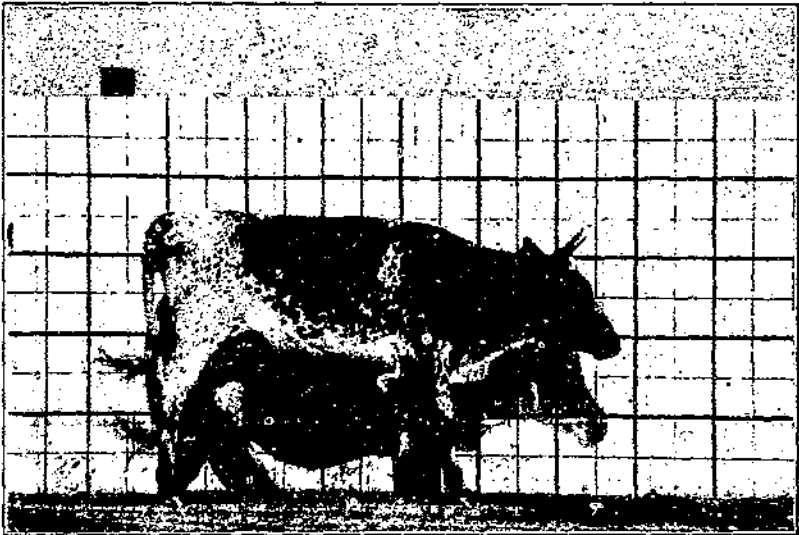


FIGURE 5.—An Arkansas native cow typical of those used in the experiment

seed meal, \$35; alfalfa hay, \$20; oat hay, \$12; and rice straw, \$8. The costs of wintering the cows and producing weanling calves for each of the four lots are given in Table 3.

TABLE 2.—Average rations of the cows per 1,000 pounds live weight during the winter feeding periods 1924-25 to 1926-27

Lot and year	Sorgo silage	Cotton- seed meal	Rice straw	Rice bran	Oat hay
	Pounds	Pounds	Pounds	Pounds	Pounds
Lot 1:					
1924-25	31.68	2.01	4.56		1.97
1925-26	32.76	.84	2.71	4.45	
1926-27	33.55	3.43	3.43		
Lot 2:					
1924-25	36.80	1.96	4.43		1.91
1925-26	34.34	.87	2.82	4.69	
1926-27	34.07	3.59	3.59		
Lot 3:					
1924-25	30.61	1.96	4.40		1.93
1925-26	33.77	.82	2.69	4.58	
1926-27	30.87	3.25	3.25		
Lot 4:					
1924-25	30.61	1.67	4.49		1.93
1925-26	33.22	.85	2.62	4.53	
1926-27	34.25	3.63	3.63		

<sup>1</sup> For 40 days there were only 9 cows in lot 3. Daily feed per 1,000 pounds live weight figured for 1,360 instead of 1,400 cow-days.

TABLE 3.—The average cost of wintering and grazing the cows per head, and of producing three crops of weanling calves, 1924-1927

Item	Lot 1, Aber- deen- Angus cows	Lot 2, grade cows	Lot 3, native cows	Lot 4, native cows
Average cost of winter feed for 140 days.....dollars	23.36	20.36	16.43	17.41
Cost of grazing 225 <sup>1</sup> days, at 5 cents a day.....do	11.25	11.25	11.25	11.25
Total feed cost per cow.....do	34.61	31.61	27.68	28.66
Actual feed cost per calf raised.....do	49.44	41.23	41.52	40.94
Average feed cost per calf (84 per cent calf crop).....do	41.20	37.63	32.95	34.12
Average weight of weanling calves.....pounds	426	441	425	430
Average feed cost of calves per 100 pounds (84 per cent calf crop).....dollars	9.67	8.53	7.75	7.93

<sup>1</sup> Each wintering period was exactly the same length, 140 days, while the summer grazing periods varied from 156 to 224 days, as indicated in Table 1, p. 3. The variations of the first and last grazing periods were due to the exigencies of beginning and ending the experiment. In order to arrive at the exact feed cost of producing the calves, the average annual cost of the winter feed is added to the cost of pasture at 5 cents per day for 225 days, making a full year of 365 days.

The greater cost per head for the purebred and grade cows is due to their greater weight, since the rations were in proportion to the live weight. The pasture is charged at the same rate per head for all lots, 5 cents a day. It is reasonable to suppose that the lighter cows ate less grass, but there was no practicable way of determining how much less.

Both the actual feed cost, and the feed cost based on the assumption that there were no significant differences in the prolificacy of the lots, are included in Table 3. Since the average calf crop for all the cows for the last two years of the experiment was practically 84 per cent, this percentage is used in determining the cost of the average calf at weaning time. The first year's calf crop of 18 calves from 40 cows is not included in determining the average calf crop because so small a calf crop was due to the short time that the bulls were with the cows, rather than to any shortcomings of the breeding stock. While the total calf crop for the lots for the last two years varied from 16 to 18 for each lot, or from 80 to 90 per cent, it seemed best to use the same percentage calf crop for all the lots for determining the cost of raising a calf to weaning age. In addition, it is reasonable to expect an 80 or 90 per cent calf crop in farm herds free from disease and carefully culled so as to eliminate nonbreeders. To compare the

profit per head for the calves when marketed, as in Table 6, it seems desirable to have their cost at the beginning of the fattening period based on the same calf crop for each lot.

Table 3 shows that while calves for each lot averaged practically the same in weight at weaning time, 426, 441, 425, and 430 pounds, respectively, the costs per 100 pounds varied considerably. The purebreds cost \$9.67 per 100 pounds, the second-cross grades \$1.14 less, the first-cross grades \$1.92 less, and the natives \$1.74 less per 100 pounds.

#### BIRTH WEIGHTS, MEASUREMENTS, AND GAINS OF CALVES

The average birth weights, heart girths, and heights of the calves at the withers and gains of the calves during the suckling period are given in Table 4. The weights and measurements of the several lines of breeding were taken to study the relation of such weights and measurements to the rate of growth and beefiness of the calves.

TABLE 4.—Average weights and measurements at birth of the calves to weaning age for the three years of the experiment

Lot No. and breeding of calves	Year	Calves	Birth weight	Height at withers	Heart girth	Age at weaning	Average daily gains to weaning time
				Centimeters	Centimeters		Pounds
1, purebred.....	1925 1926 1927	Number				Days	
		5	63.9	<sup>1</sup> 64.3	69.4	240	1.49
		7	69.7	66.7	72.9	224	1.66
	Average <sup>2</sup> .....	9	66.8	66.8	73.3	215	1.68
			66.9	66.3	72.2	226	1.59
2, second cross.....	1925 1926 1927	5	62.4	66.0	68.7	213	1.72
		9	67.5	66.7	72.0	232	1.65
		9	65.7	68.0	72.7	219	1.70
	Average <sup>2</sup> .....		65.7	67.0	71.6	223	1.68
3, first cross.....	1925 1926 1927	3	63.2	63.3	65.8	214	1.50
		9	62.8	66.2	71.9	225	1.73
		8	63.6	66.7	70.8	197	1.78
	Average <sup>2</sup> .....		61.5	66.0	70.6	212	1.71
4, native.....	1925 1926 1927	5	56.3	64.7	67.6	197	1.57
		6	63.4	68.2	73.7	223	1.64
		10	68.6	69.6	74.7	223	1.77
	Average <sup>1</sup> .....		64.2	68.0	72.7	217	1.69

<sup>1</sup> The average for 4 calves, as 1 calf's height was not measured.

<sup>2</sup> Weighted.

Each year the purebred calves weighed more at birth than the second-cross calves, and the second-cross calves weighed more than the first-cross calves. The differences between the calves of the first-cross cows of lot 2 and the native cows of lot 3 became smaller, apparently, as the native cows approached the first-cross cows in weight. (Table 1.) The surprising thing in connection with the birth weights of the calves is that each year the calves of lot 4 sired by the native bull outweighed the calves of similar cows in lot 3 sired by the purebred Aberdeen-Angus bull and that they averaged appreciably more the third year than the purebred and second-cross calves.

The correlation between the birth weights of all the calves in the four lots for three years and the weights when they were weaned is  $+0.3738 \pm 0.0629$ . The average age of the 85 calves when they were weaned was 219 days. It is probable that the correlation would have been higher had each calf been weaned at the same age. As they were

handled by lots this was not practicable. As it was, only four calves were more than 249 days old when they were weaned, and only five were less than 189 days old at weaning time.

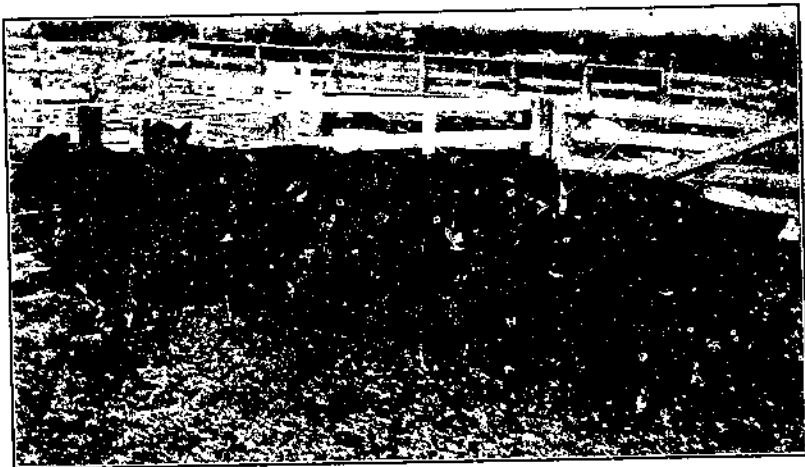


FIGURE 6.—Purebred Aberdeen-Angus calves at the end of the fattening period, April, 1923



FIGURE 7.—Calves of grade Aberdeen-Angus cows. These calves were sired by a purebred Aberdeen-Angus bull. The picture was taken at the end of the fattening period, April, 1923.

The correlation between the birth weights and weaning weights is significant. In other words, the heavier calves at birth are likely to be the heavier calves at weaning time. It does not necessarily follow, however, that the heavier calves at birth make greater gain. In fact, according to Table 4, in which the calves are divided according to their breeding, the purebreds, which weighed from 1.2 to 5.4 pounds more at birth than the grade and native calves, made the smaller daily

gains than any of the other lots each year. But, on the other hand, the correlation between the birth weights of all the calves and their total gains to weaning time is  $+0.1786$  to  $+0.0708$ . While this correlation is small, it is positive and indicates that the heavier calves at birth make slightly greater gain than the lighter calves. In conclusion,



FIG. 1.—A group of calves in a pen, showing the difference in size between the heavier and lighter calves.



FIG. 2.—A group of calves in a pen, showing the difference in size between the heavier and lighter calves.

It is not a matter that nutrition rather than birth weight determines the rate of a calf's growth. Since all the calves had the same best care, the native and grade cows either gave more milk than the purebred cows or the native and grade cattle are better adapted to the conditions of pasture than the purebreds.

The first-cross calves were shorter at the withers each year than the calves of the other lots. However, the differences are slight in comparison with the purebred and second-cross calves. As in weight, the native calves exceeded the first-cross calves in height at the withers by a considerable difference each year.

In heart girth, as in weight, the purebred calves ranked above the second-cross calves, and they, in turn, above the first-cross calves each year. However, the native calves ranked above the first-cross calves the first year and above all the lots in heart girth the second and third years, with the result that their average for the three years is higher than any of the other lots. The purebreds ranked second in heart girth.

At weaning time there was a maximum difference of two weeks in the average ages of the four lots. The purebreds were the oldest, and the first-cross calves were the youngest. At first it may seem that the age at weaning time has something to do with the average daily gains up to weaning, since the purebreds made the smallest gains and the first-cross calves made slightly the largest gains. However, the second-cross calves which were 3 days younger on the average than the purebred calves made practically as large daily gain as the first-cross calves, which were 11 days younger. Therefore, it may be concluded that the difference of as much as 2 weeks had no effect on the average daily gains. Since the purebreds were outdone in gains in every case by the grade and native calves there is good reason to believe that the native stock was better adapted to make gains on grass than the purebred stock. The same observation holds true in the case of the cows, as shown in Table 1. In each of the four grazing seasons the purebreds made the smallest gains or the greatest losses, and with two exceptions the native cows made a better showing than the first-cross cows. The difference became smaller as the natives approached the first-cross cows in weight. The writers can not say how much of this better showing of the native cows was due to their growth having been inhibited through lack of feed before their participation in the experiment.

#### FEED REQUIREMENTS FOR FATTENING THE CALVES

The average rations and daily gains and the feed required per 100 pounds' gain for each lot of calves for the fattening periods are given in Table 5, and the appearance of the various lots is shown in Figures 6 to 9. The purebreds ate just a little more, and gained appreciably more daily each year, than the second-cross and first-cross calves. The differences in feed occurred chiefly in the quantities of brewers' rice and corn which were fed. The natives in turn ate somewhat less than the grade calves, the average grain consumed daily for the three years being 1 pound less.

The average gains of the natives for the three years were one-quarter of a pound less than for the purebreds and one-sixth of a pound less than for the grades. So far as gains are concerned there was no difference between second-cross and first-cross calves.

As the daily gains and rations of the natives were considerably less than the rations and gains of the other lots, the indications are that they were the poorest feeders in the feed lot. On the other hand, the purebred calves were the best feeders.

Each year the second-cross calves required slightly more of nearly every feed than the purebreds to produce 100 pounds of gain. The chief exception was in the winter of 1927-28, when the purebreds consumed 524 pounds of grain for each 100 pounds of gain and the second-cross calves consumed only 518 pounds. The concentrates consumed per 100 pounds, gain for the second-cross and first-cross calves were practically the same, while the first-cross calves took less of silage and hay. The native calves required as much or more roughage and cottonseed meal in most cases and less grain for 100 pounds' gain than the other lots of calves. On the whole there was little difference in the feed requirements for 100 pounds' gain in the four lots, certainly none that seemed to have any relation to the differences in breeding. The same is true of the cost of 100 pounds' gain. The first year the most expensive gains were in the purebred lot, and the cheapest in the first-cross lot. The second year the most expensive gains were in the native lot and the cheapest in the purebred lot. The third year the most expensive gains were in the second-cross lot and the cheapest in the first-cross lot. For the 3-year average the second-cross calves made the most expensive gains, and the purebreds made the cheapest gains. The differences are so small, and the order of economy in respect to the four kinds of feed varies so much, that the price of one or more feeds might change the order of the lots completely, in respect to the cost of 100 pounds' gain.

TABLE 5.—The average rations, daily gains, and quantities of feed consumed for and cost of 100 pounds' gain for each lot of calves<sup>1</sup>

Breeding of calves	Sorgo silage		Alfalfa		Cottonseed meal		Carbonaceous concentrates		Gain per calf per day	Cost of 100 pounds' gain
	Ration	Feed per 100 pounds' gain	Ration	Feed per 100 pounds' gain	Ration	Feed per 100 pounds' gain	Ration	Feed per 100 pounds' gain		
Purebred:										
1925-26.....	5.0	336	0.1	304	1.0	63	4.7	283	1.67	9.28
1926-27.....	2.8	163	5.1	296	1.7	97	8.8	507	1.74	11.49
1927-28.....	2.7	150	4.5	246	2.9	156	9.6	524	1.84	10.87
Average.....	3.4	191	5.1	286	2.1	118	8.3	471	1.77	10.76
Second cross:										
1925-26.....	5.5	333	5.0	360	1.0	64	4.7	285	1.65	9.27
1926-27.....	2.8	173	5.0	306	1.7	104	8.8	540	1.83	12.15
1927-28.....	2.7	156	4.5	257	2.9	162	9.1	518	1.76	11.06
Average.....	3.3	196	5.0	296	2.0	121	8.2	483	1.69	11.14
First cross:										
1925-26.....	4.8	311	5.2	341	.9	59	4.1	288	1.53	8.43
1926-27.....	2.8	168	5.1	303	1.7	101	8.8	524	1.68	11.88
1927-28.....	2.4	137	4.1	233	2.7	153	8.7	496	1.75	10.36
Average.....	2.9	172	4.7	279	2.0	118	8.1	482	1.69	10.82
Native:										
1925-26.....	4.7	306	5.1	333	.9	58	4.0	265	1.52	8.58
1926-27.....	2.8	208	5.0	371	1.7	125	7.6	563	1.34	13.55
1927-28.....	2.3	142	4.2	287	2.5	152	8.1	502	1.62	10.07
Average.....	2.9	194	4.6	302	1.9	125	7.1	468	1.52	10.97

<sup>1</sup> The calves were fed 140, 162, and 168 days for the 3 fattening periods, respectively.

#### GRADING THE CATTLE AND CARCASSES

The second and third crops of calves, dropped in 1926 and 1927, were graded by a committee at the time of both weaning and marketing. After the carcasses had been in the cooler 48 hours they were graded by the same committee.

The committee in each instance consisted of two representatives of the United States Department of Agriculture, one each from the Bureau of Agricultural Economics and the Animal Husbandry Division of the Bureau of Animal Industry, and one representative of the State experiment stations cooperating on the national cooperative project, *A Study of the Factors which Influence the Quality and Palatability of Meat.*<sup>1</sup> The average grades for each lot are given in Table 6. The individual grades are given in Table 7.

TABLE 6.—Average feed costs of production for each lot of calves; sale weights and prices; returns over feed costs; shrinkage and dressing percentages; and feeder, slaughter, and carcass grades

Item	Purebred calves	Second-cross calves	First-cross calves	Native calves
Cost of weaning per head <sup>1</sup> .....dollars..	41.20	37.63	32.95	34.12
Feed cost to fatten per head <sup>1</sup> .....do.....	30.36	30.05	29.40	29.02
Total feed cost per head <sup>1</sup> .....do.....	71.56	67.68	62.44	60.74
Sale weight per head <sup>1</sup> .....pounds..	672.86	676.52	664.50	630.48
Net sale value per head <sup>1</sup> .....dollars..	74.62	74.08	70.17	61.96
Difference between sale value and total feed cost per head.....do.....	3.06	6.40	7.73	1.24
Net sale price per 100 pounds:				
1926.....do.....	7.91	7.41	6.91	6.66
1927.....do.....	10.49	10.49	9.99	8.74
1928.....do.....	13.22	13.22	12.47	11.72
Average.....do.....	11.09	10.95	10.56	9.83
Shrinkage in transit:				
1926.....per cent.....	4.29	6.01	6.32	5.42
1927.....do.....	1.75	1.91	.23	3.12
1928.....do.....	7.76	7.11	9.44	8.30
Average.....do.....	5.00	4.84	4.78	6.29
Cold-dressed percentages:				
1926.....do.....	54.86	56.33	54.91	55.15
1927.....do.....	60.15	60.16	58.20	57.79
1928.....do.....	58.28	58.78	58.04	57.37
Average.....do.....	58.15	58.85	57.96	57.33
Average feeder-cattle grades, 1926-27 <sup>1</sup> .....do.....	81.9	80.4	78.3	68.6
Average slaughter-cattle grades 1926-27 <sup>1</sup> .....do.....	80.9	78.3	78.9	61.1
Average carcass grades, 1926-27 <sup>1</sup> .....do.....	80.6	78.6	76.4	62.5
Average feeder-cattle grades, 1927-28 <sup>1</sup> .....do.....	82.3	83.8	80.0	70.8
Average slaughter-cattle grades 1927-28 <sup>1</sup> .....do.....	81.3	77.8	73.2	68.7
Average carcass grades, 1927-28 <sup>1</sup> .....do.....	77.9	78.4	76.0	68.0

<sup>1</sup> Average for three years.

<sup>2</sup> Values of from 86.7 to 100 represent high Selected grade feeder cattle and high Prime grade slaughter cattle and beef carcasses; 93.4 to 96.6 middle Selected feeders and middle Prime slaughter cattle and carcasses; and 90.1 to 93.3 low Selected and low Primes, respectively. Values of from 80.1 to 90, 70.1 to 80, 60.1 to 70, and 50.1 to 60 represent the ranges of the Choice, Good, Medium, and Common grades, respectively, each divided into three subgrades as in the case of the Selected and Prime grades.

#### MARKETING DATA AND GRADES OF THE CALVES

Production costs, sales weights and prices, profits, shrinkage and dressing percentages, feeder, slaughter, and carcass grades are given in Table 6.

At the end of the 1925-26 experiment, the calves were shipped to the stockyards at Kansas City, Mo., and sold by lots to a packing company. They were in transit for approximately 36 hours, but the shrinkage represents the loss in weight from the average of three days' final weights, April 7, 8, and 9, to the sale weight at noon, April 11. In slaughtering, the identification of each animal carcass

<sup>1</sup> The personnel of the grading committee varied from time to time. Those who participated in the grading of the cattle and carcasses were: L. B. Burk and D. J. Sizer, Bureau of Agricultural Economics; U. S. Department of Agriculture; A. T. Edinger, Bureau of Agricultural Economics and Bureau of Animal Industry, U. S. Department of Agriculture; A. C. Cook and H. W. Holland, State Agricultural and Mechanical College and Bureau of Animal Industry, U. S. Department of Agriculture. The cooperative arrangements and direction of the summarization of the grading records were in charge of O. G. Hankins, Bureau of Animal Industry.



was maintained. Standard rib cuts were taken from representative carcasses and shipped to the United States Animal Husbandry Experiment Farm, Beltsville, Md., for studies of the meat in accordance with the national cooperative project, A Study of Factors which Influence the Quality and Palatability of Meat.

At the end of the second and third experiments the cattle were shipped to the National Stock Yards, East St. Louis, Ill., a some-

TABLE 7.—Feeder cattle, slaughter cattle, and beef-carcass gradings of the individual animals in the 1926-27 and 1927-28 experiments

Breeding of the lots	1926-27				1927-28			
	Animal No.	Feeder-cattle grading	Slaughter-cattle grading	Beef-carcass grading	Animal No.	Feeder-cattle grading	Slaughter-cattle grading	Beef-carcass grading
Purebred		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
	21	84.1	78.0	79.8	1	78.8	79.3	73.3
	22	82.8	82.2	82.0	2	77.6	77.9	76.8
	23	75.7	75.0	78.2	3	82.8	79.0	75.0
	24	81.7	82.2	86.7	4	87.9	82.0	77.8
	25	86.4	81.8	80.9	5	85.9	81.5	81.4
	26	82.0	82.7	80.2	6	77.4	79.5	75.4
	27	83.8	80.3	76.6	7	87.6	82.4	82.4
				8	78.0	86.3	77.8	
				9	84.4	83.1	82.5	
Average		81.9	80.9	80.6		82.3	81.3	77.9
Second cross	28	76.8	71.9	74.0	11	84.8	78.6	73.3
	29	78.6	77.6	75.1	12	87.8	74.3	78.2
	30	83.1	77.9	81.9	13	83.5	76.7	81.6
	31	77.7	79.6	80.1	14	83.3	81.3	84.1
	32	85.9	80.5	78.2	15	87.2	79.6	82.2
	33	80.4	78.3	80.5	16	80.0	76.3	75.1
	34	78.7	78.9	76.1	17	83.7	80.4	79.0
	35	80.0	79.0	80.8	18	82.1	75.9	71.8
	36	83.1	80.4	80.9	20	82.0	78.8	80.2
	Average		80.4	78.3	78.6		83.8	77.8
First cross	37	79.2	79.8	73.9	22	85.5	78.5	77.2
	38	80.7	75.4	76.8	24	80.6	73.9	72.8
	39	79.4	77.2	78.0	25	78.6	72.2	77.3
	40	73.8	72.4	72.1	26	72.0	66.2	54.3
	41	79.4	78.6	77.3	27	84.5	78.1	74.1
	42	79.7	75.7	76.9	28	81.0	71.0	70.9
	43	80.9	77.7	75.7	29	81.2	76.7	77.9
	44	78.5	79.0	80.8	30	78.4	69.7	75.1
	45	80.3	76.4	76.3				
	Average		79.3	76.9	76.4		80.0	73.2
Native	46	86.2	60.8	65.1	31	74.4	69.0	72.1
	47	68.8	55.3	62.9	33	70.1	66.2	67.7
	48	70.8	64.1	69.3	34	68.7	67.6	68.2
	50	69.1	62.0	59.9	35	75.0	68.5	69.1
	51	70.7	59.8	62.8	36	71.2	68.8	61.7
	52	65.8	59.5	55.9	37	70.8	68.9	69.9
					38	73.4	71.6	66.2
				39	68.9	62.3	66.4	
				40	68.6	61.4	67.6	
Average		68.6	61.1	62.5		70.8	66.7	68.0

what shorter distance than to Kansas City, Mo. The cattle of the second experiment were weighted April 14, 15, and 16, and were shipped April 16. They were in transit 32 hours, and were sold April 18. The shrinkage covered three days' time. As the cattle of the third experiment were not shipped until the day after the taking of the last final weight, were in transit 26 hours, and were not sold until the day following their arrival, the shrinkage for them covers four days. On

each occasion the cattle were sold by lots, one packing company buying all the cattle from one experiment. After slaughter, the carcasses which had been identified with the animals from which they came were graded, and standard rib cuts were taken from representative carcasses in each lot. Then they were shipped to Beltsville, Md., for studies of the meat.

The net-sale prices are based on market weights and the net proceeds from the sale of each lot of cattle. The first year the purebred calves brought the top price, the second-cross calves 50 cents per 100 pounds less, the first-cross calves \$1 less, and the natives \$1.25 less than the purebred calves. The second and third years the purebred and second-cross calves sold equally well while the first-cross calves brought 50 cents and 75 cents less per 100 pounds, respectively. The native calves, the second and third years, sold for \$1.75 and \$1.50, respectively, less than the purebreds and second-cross calves. Consequently the average spread for the three years between the top lots was 14 cents, between the middle lots, 39 cents, and between the bottom lots, 73 cents.

In comparing the profits per head for the four lots, one should keep in mind that the cost per 100 pounds of the calves at weaning time was greatest for the purebred calves and least for the calves of the two lots of scrub cows, with the calves of the grade cows in between. The greater cost of the purebred calves was attributable to the greater weight of the cows and proportionately heavier winter rations. With very small differences in cost of gains during the fattening periods, the higher selling prices of the purebred calves were not sufficient to offset the advantage which the two lots of grade calves had in cost of production per head at weaning time. In the case of the native calves, however, the sale price was so much less that the profit per head was the smallest of the four lots.

The averages for the three years indicate that the natives lost more in shipment to market than any of the other lots. That was due, however, to the heavier shrinkage in that lot than in any of the other lots the second year. As the natives lost practically the same as the average of the other three year lots the first and third years, there is not sufficient evidence to prove that they shrink more in transit than the purebred and grade calves. On the other hand the better-bred cattle seem to have a slight advantage over the native cattle in dressing percentage. The natives ranked above the purebred and first-cross calves by a small margin the first year, but the second and third years they dressed less than any of the other lots by a margin varying from 0.41 to 2.37 per cent.

The purebred calves and their carcasses were graded "low Choice" with one slight exception. The second-cross calves and carcasses graded "high Good" with two exceptions which were "low and middle Choice." The first-cross calves and carcasses graded "top Good" with two exceptions which were "middle Good" and "low Good." The native calves and carcasses graded "top Medium" with one "low Good" and two "low Medium."

#### SUMMARY AND CONCLUSIONS

The object of this experiment was to determine the relative economy of producing market beef calves from cows carrying varying proportions of beef breeding and sired by purebred and native bulls.

Three crops of weanling calves were produced considerably more cheaply per head and per 100 pounds live weight from native Arkansas cows than from purebred Aberdeen-Angus cows, because the grade and native cows were smaller and required less feed in winter than the purebred cows. The average annual cost per calf, based on an 84 per cent calf crop, was \$34.61, \$31.61, \$27.68, and \$28.66 per head for purebred, grade, and two lots of native cows, respectively. The average cost per 100 pounds of live weight up to weaning time, based on an 84 per cent calf crop, was \$9.67, \$8.53, \$7.75, and \$7.93 for purebreds, second crosses, first crosses, and natives, respectively.

The average birth weights of the calves in the various lots were similar, being 66.9, 65.7, 61.5 and 64.2 pounds, respectively, for purebreds, second crosses, first crosses, and native calves during the three years. These weights were almost uniform for purebreds and second crosses from year to year, but increased each year with the first crosses and natives as their dams increased in size. The native calves outweighed at birth the first-cross calves each year, and during the third year outweighed the purebred and second-cross calves.

When running on pasture with their dams, without supplementary feed, grade and native calves made greater gains to weaning time than purebred calves. These average daily gains for the three years were 1.59, 1.68, 1.71 and 1.69 pounds, respectively, for purebreds, second crosses, first crosses, and native calves.

While there was practically no difference in the feed required per 100 pounds of gain for purebreds, grades, and natives fattened after they were weaned, the purebred calves ate slightly more and made somewhat greater gains than the grade or native calves. The average cost of producing 100 pounds of gain was \$10.76, \$11.14, \$10.82, and \$10.97, respectively, for purebreds, second crosses, first crosses, and natives for the three years.

The combined costs up to weaning time and of fattening were less for native calves, but the sale price of purebreds and grades was enough higher so that the sale value of purebreds and grades more than made up the difference in lower total feed costs of the natives. When the average total feed cost was taken from the average sale value for each lot, the return above feed costs was \$3.06, \$6.40, \$7.73, and \$1.24 a head for the purebred, second-cross, first-cross, and native calves, respectively. These returns indicate the value of service of a purebred sire on native cows. The first-cross calves made a return per head of more than six times as much as the native calves, or a difference of \$6.49 a head.

The dressing percentage was higher for purebred and high-grade calves than for first-cross and native calves, but the difference was not great. The average dressing percentages were 58.15, 58.85, 57.96, and 57.03, respectively.

With one slight exception, the purebreds graded highest as feeders, as slaughter cattle, and as carcasses. The second-cross calves ranked second, the first-cross calves third, and the natives fourth. The natives were from a grade to two grades below the purebreds in every case.

**END**