



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

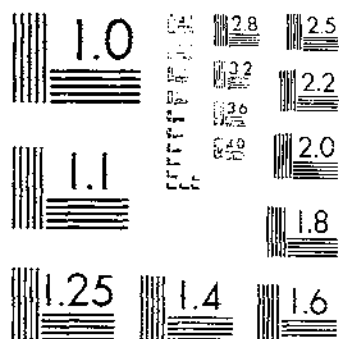
<http://ageconsearch.umn.edu>

aesearch@umn.edu

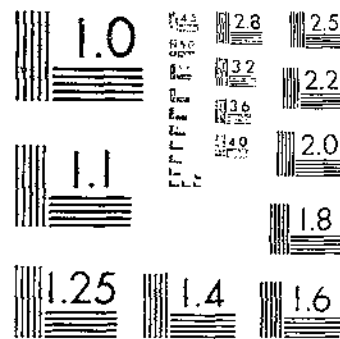
*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

7-77 TB 603-1938 USDA TECHNICAL BULLETINS - REPRODUCED FROM THE NATIONAL ARCHIVES
WINTERING BEER COWS ON THE RANGE WITH AND WITHOUT A SUPPLEMENT OF FEED
BLACK HORN COWS - QUESENBERY, T. R. - BAKER, A. L. - 1938 - 10 PAGES

START



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



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

UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

WINTERING BEEF COWS ON THE RANGE
WITH AND WITHOUT A SUPPLEMENT
OF COTTONSEED CAKE^{1 2}

By W. H. BLACK, *senior animal husbandman*, J. R. QUESENBERRY, *senior animal husbandman*, and A. L. BAKER, *assistant animal husbandman*, *United States Range Livestock Experiment Station, Animal Husbandry Division, Bureau of Animal Industry*

CONTENTS

	Page		Page
The area and its problems	1	Results of experiments:	
Scope of experiments	2	Experiment 1, 1929-30	9
Experimental procedure	3	Experiment 2, 1930-31	11
Cows used and methods of handling	3	Experiment 3, 1931-32	13
Feeds used and methods of feeding	4	Experiment 4, 1932-33	15
Range used and rate of stocking	6	Experiment 5, 1933-34	17
Weather and grazing conditions during the experiments	5	Average results	19
		Summary and conclusions	20

THE AREA AND ITS PROBLEMS

The northern Great Plains are well adapted to range beef-cattle production and have been utilized for that purpose generally since the arrival of the first trail herd from Texas into Wyoming in 1871.³ They comprise approximately 130,000,000 acres of land in central and eastern Montana, northeastern Wyoming, and western North Dakota and South Dakota. This area lies mainly in the Missouri River drainage system, is bounded on the north by Canada, and extends east and south from the base of the Rocky Mountains to the eastern boundaries of the Missouri Plateau. According to a land classification made by the United States Department of the Interior,⁴ 2 percent of the area is irrigated land, 12 percent farming, 12 percent farming-grazing, 13 percent grazing-forage, 54 percent grazing, and 7 percent national forests. The proportion of desirable farm land is relatively low. Crop failures under dryland farming are frequent because of drought, and the careful utilization of native range both for summer and winter grazing is of the utmost importance.

¹ Received for publication June 2, 1937.

² This work was carried on in cooperation with the Montana Agricultural Experiment Station. F. B. Linfield, dean and director, and C. N. Arnett (deceased), vice dean and professor of animal husbandry at the station, assisted in planning the experiments.

³ WILSON, M. L., WILCOX, H. H., KLEMMERSON, G. S., and PARR, V. V. A STUDY OF RANCH ORGANIZATION AND METHODS OF RANGE-CATTLE PRODUCTION IN THE NORTHERN GREAT PLAINS REGION. U. S. Dept. Agr. Tech. Bull. 46, 92 pp., illus. 1925.

⁴ ALBOUS, A. E., and others. LAND CLASSIFICATION OF THE NORTHERN GREAT PLAINS: MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING. U. S. Geol. Survey, 136 pp., illus. 1929. [Micrographed.]

Wintering of breeding cows constitutes one of the major problems of the beef-cattle industry in the northern Great Plains. Feeds used and methods of feeding and management vary to a great extent over the area as a whole. Some ranchers feed cows and calves together, allowing the calves to wean themselves, whereas other ranchers wean the calves late in October and feed both groups separately. Wintering on the range exclusively (fig. 1) is followed under favorable conditions. Otherwise, hay and grain supplements are fed on the range or in the feed lot for a part of the winter. In certain localities, particularly those in or adjoining the mountain areas, cows are wintered for 90 to 150 days in feed lots.

All ranchmen have the same object in view; that is, to winter breeding cows at a minimum outlay of feed and labor and still obtain a normal number of good calves. Cows that have been separated from the calves in mid-October and that have made a normal gain in weight before the arrival of cold weather may lose from 50 to 125 pounds in



FIGURE 1.—Herd of breeding cows on winter range. Under conditions as illustrated, supplemental feeding is desirable.

weight during the winter and still produce normal calves the following spring. The above-mentioned weight losses approximate those expected by stockmen whose cows are wintered on the range without supplement or in the feed lot with straw and cottonseed cake.

SCOPE OF EXPERIMENTS

The experiments reported in this bulletin were carried on from October 1929 to October 1934 for the purpose of comparing two methods of wintering beef cows in the northern Great Plains: (1) On the range with cottonseed cake as a supplement, and (2) on the range without such supplement. To prevent death losses, however, additional supplemental feeding was necessary in the winters of 1931-32 and 1932-33 because of unfavorable weather conditions.

The experiments were conducted at the United States Range Livestock Experiment Station (formerly the Fort Keogh Military Reservation) located at Miles City, Mont., near the center of the northern Great Plains. The station comprises a total of 56,300 acres, with

46,915 acres in a triangle between the junction of the Tongue and Yellowstone Rivers and 9,385 acres on the north side of the Yellowstone River. Approximately 650 acres are devoted to the production of irrigated alfalfa (fig. 2), 700 acres to the production of dry-land crops, and the remainder to winter and summer range for cattle, sheep, and horses.

EXPERIMENTAL PROCEDURE

COWS USED AND METHODS OF HANDLING

In the first two experiments, all available Hereford breeding cows at the station were used. In the remaining experiments, the registered cows were removed for other experimental work. The cows used were of desirable type and between 2 and 12 years of age. At the close of the 1929 grazing season, they were divided as uniformly as possible into two groups, one of which was to obtain its feed on winter



FIGURE 2.—Irrigated alfalfa-hay meadows at the United States Range Livestock Experiment Station, Miles City, Mont. The alfalfa hay used in the wintering experiments was produced on these meadows.

range only and the other to have range with cottonseed cake. The original cows were retained in the herds as long as they were healthy and produced satisfactory calves. Replacements were made and some heifers added throughout the years of these experiments.

Individual weights of the cows were taken at the close of the summer grazing season and at the close of the winter range season. The closing date of 1 year's experiment was the beginning date of the subsequent year. In both groups, breeding cows that had to be removed from the range to the feed lot were weighed individually in and out of the feed lot. All weights from the beginning of the experiment in October 1929 until the close of the winter range season in 1931 were taken at headquarters after the cows had been trailed 7 to 10 miles. Because of the long distance from the summer pasture to headquarters, when the calves were brought in to be weighed at weaning time (about Oct. 20) the breeding cows also were brought in for weighing. The weights obtained were recorded as the weights of the cows at the end of the summer season and at the beginning of the winter season. However, the summer pasture still had a supply of grass;

consequently, the cows were moved back to this pasture for about a month before being placed on their respective winter pastures. This method of management provided for the maximum use of summer pasture and insured a larger supply of feed in the winter pastures.

During the summer of 1931 scales were located between the winter and summer pastures at no. 2 well (fig. 3). In the three subsequent experiments, all weights of the breeding cows were taken on these scales. In two of the experiments, the animals were placed on winter pastures on the same day that weights were taken. In the remaining experiment, they were moved to winter pastures about a week after being weighed.

Calves were weighed at birth and at weaning time. The latter weights were taken each season on the scales at headquarters. Birth weights were taken on a 120-pound-capacity spring scale, swung from an arm over the saddle of the range rider (fig. 4). The calf was hog-tied (four feet tied together) and rolled in a small square canvas, having rings in the corners that were hung on the hook on the bottom of the scale. A well-trained quiet saddle horse was required for this work, but even with the best trained horse the procedure was at times difficult. The calf was ear-tagged at weighing time, and the cow's identity was determined from a duplicate numbered metal tag which had been placed in her ear before the beginning of the calving season.

The breeding season covered approximately 7 weeks, beginning July 1 to July 5 and ending on or about August 23. Accordingly, calves were born on the range through a 7-week period beginning about April 10. The two groups of cows were combined at the end of each winter and were grazed as a single herd through the spring and summer. Summer range was used as a breeding pasture for all nonregistered purebred cows, whereas groups of registered cows were separated and held in small breeding pastures with a single bull to each group. The ratio of bulls to cows in the nonregistered herds was approximately 1 to 25, and in the registered herds the ratio was 1 to from 30 to 35. Registered Hereford bulls of desirable type and conformation were used in all breeding work. By daily riding of the range throughout the breeding season, the bulls in the nonregistered herd were kept distributed throughout the herd. Calves were vaccinated against blackleg and branded. Bull calves, except those retained for breeding purposes, were castrated in May or June, just before they were taken off spring range.

FEEDS USED AND METHODS OF FEEDING

The feeding of cottonseed cake as a winter range supplement was begun as soon as practicable after the cows had been moved to the winter range and was discontinued at the close of the winter test. Weighed quantities of cake were carried to the range on a pack horse and were fed to the cows in small groups (fig. 5) wherever they happened to be located. The cake was fed on snow, on flat rocks, or on well-sodded patches of grass, with little or no waste. Nut-size cake containing not less than 43 percent of protein was used throughout the experiments. The cows were fed each day during cold weather and every other day during mild weather. The rate of feeding varied according to the weather and the condition and requirements of the cows. The maximum quantity fed at any time was 3 pounds per head per day between January 30 and February 24, 1932. The usual rate varied from 0.75 pound to 1.5 pounds per cow per feeding.

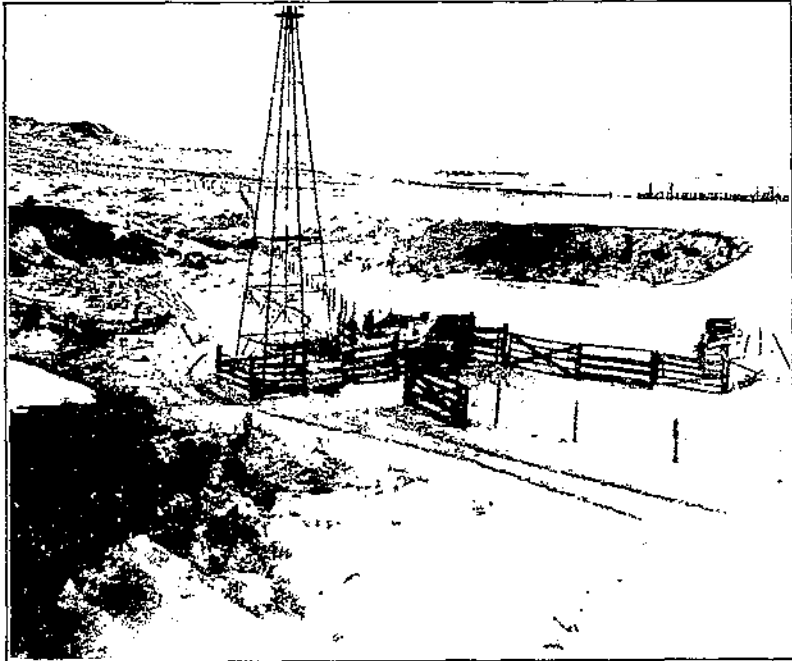


FIGURE 3.—No. 2 well, winter pasture 1B.



FIGURE 4.—Obtaining the birth weight of a calf on the range.

During the two severe winters previously mentioned, alfalfa hay was fed to extremely thin and weak cows in the dry lot and during times of heavy snowfall when it was impossible for cows to obtain any feed from the range. The alfalfa hay was produced each year on the station land and was of good quality.

RANGE USED AND RATE OF STOCKING

The most important grasses in the experimental range areas were as follows: Wheatgrass (*Agropyron smithii* and *A. tenerum*), blue grama (*Bouteloa gracilis*), buffalo grass (*Bulbilis dactyloides*), needlegrass (*Stipa comata*), junegrass, (*Koeleria cristata*), niggerwool (*Carex filifolia*), bluejoint turkeyfoot (*Andropogon furcatus*), sandgrass (*Calamovilfa longifolia*), and small feathergrass or poverty grass (*Andropogon scoparius*). Common browse species include sagebrush (*Artemisia tridentata*), greasewood (*Sarcobatus vermiculatus*), and salt



FIGURE 5.—Feeding cottonseed cake to breeding cows on winter range during the experiment. The feed is carried in a bag and scattered on the snow, grass, or bare places.

sage (*Atriplex canescens*). During the winter, the wheatgrasses, sagebrush, and greasewood were of the greatest importance. Considerable use was also obtained from the small sharp-leaved yucca during the winter season of 1931-32.

Figure 6 shows the layout of the pastures used throughout the experiments. Pastures 1A and 1B constitute the winter range and also the calving range in 1930, 1931, and 1932; pastures 2A and 2B, the summer range; and pastures 3 and 4, the calving range in 1933 and 1934.

During the first three winters pasture 1A, containing nearly 3,000 acres, was used by group 1 cows, fed cottonseed cake on the range, Pasture 1B, containing nearly 2,750 acres, was used by group 2 cows, receiving no supplement on the range. In 1932 and 1933, some of this land was made available for other experiments, and some land was added. The former pasture consisted of about 2,150 acres and the latter of a little more than 1,700 acres. This change provided a more desirable winter range in pasture 1A but a less desirable one in pasture 1B. Consequently, during the last two winters the group 1 cows were kept on pasture 1B and the group 2 cows on pasture 1A.

Water was available in these pastures at all times, tank heaters being used to keep it from freezing. However, during cold windy weather a divide which separated the cows in pasture 1A from the well prevented their coming to water as often as desirable. The maximum distance to water when range water holes were not available was

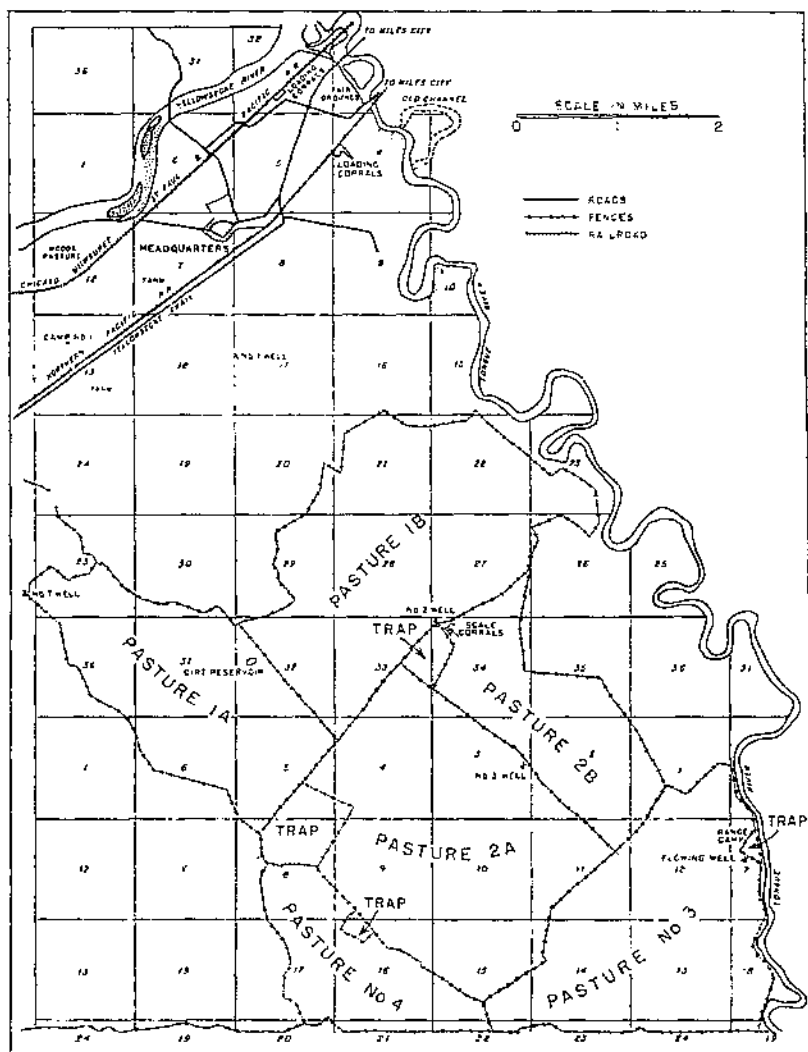


FIGURE 6. Lay-out of the pastures used during the experiments; also location of wells, fences, and corrals.

approximately 2 miles in each pasture. Salt was fed near the well in both pastures during the winter season.

Two groups of 14 to 28 head of 2-year-old steers were carried on the range with the cows during each winter season except in 1932-33, when the steers were fattened. One group of these steers was grazed with group 1 cows and fed cottonseed cake, and the other group was grazed with group 2 cows and received no supplement. This practice was not

good from either a range-management or experimental standpoint but could not be avoided as there was a shortage of satisfactory winter pastures.

The rate of stocking in the winter pastures varied from year to year, but sufficient grass for winter grazing was available in all years except those following severe summer droughts. The number of acres per head of cattle in pasture 1A ranged from 28 in 1929-30 to 19 in 1932-33 and in pasture 1B from 27 in 1933-34 to 21 in 1930-31 and 1931-32. The length of the winter grazing season varied from 4.5 to 5.5 months.

When these experiments were begun, the summer range consisted of one pasture, no. 2, containing about 7,200 acres. This pasture had a large number of natural water holes that were filled by snow water and rain during years of normal precipitation. Additional water was obtained from no. 3 and no. 2 wells, located at the north-central side of the range. In 1931, this range was divided into pastures 2A and 2B, by a fence running close to no. 3 well. As a result of this arrangement the pastures could be grazed alternately and therefore utilized more satisfactorily. Salt boxes in the summer pastures were located on or near good grazing land away from the water, in order to obtain better use of the range. The maximum distance to water during dry periods varied from 1 to 1½ miles. Pasture 2 was stocked to capacity each summer with cows and calves, yearling heifers, and dry cows. Yearling heifers were moved to other range during the breeding season and were not bred.

WEATHER AND GRAZING CONDITIONS DURING THE EXPERIMENTS

Table 1 shows a summary of the weather conditions through the five experiments. The average mean temperature during both the winter and the summer range periods was above normal through all 5 years, whereas the total yearly precipitation was below normal in all years except during the summer of 1932. The winter of 1931-32 had the lowest average temperature and the heaviest precipitation for the 5-year period. During this winter, however, the mean temperature was still slightly above normal and the precipitation was slightly below normal. The mild, dry winters resulted in a maximum amount of range use through 4 of the 5 years and was a decided advantage to wintering cows on the range without supplement.

A study of the influences of weather conditions on grazing and grass-hay yield as related to range-livestock production was made by the Montana Agricultural Experiment Station⁵ for the period 1882-1924. The following results were obtained:

"Medium" to "good" [summer] range conditions prevailed in 29 out of 43 years of record. In only 4 of the 43 years were the conditions above "medium" to "good," whereas for 10 of the 43 years a condition below "medium" to "good" was recorded. * * * The seasons of 1886 and 1887 are recorded as having been among the most critical in the ranching history of the region. The range conditions during the early season of 1886 are recorded as "failure." Summer-range conditions were recorded as "poor." The hay crop was a failure. The early range condition during the following year, 1887, was little improved over those in the former year, and the condition of the summer range and yields from grass hay showed no improvement. * * * It is further evident that no cycle of very good years or poor years in any sequence is shown by the climatological history.

Management practices have been altered to a considerable extent since the 1886 open-range days, but the fundamental principles of

⁵ WILSON, M. L., WILCOX, R. H., KLEMMEDSON, G. A., and PARR, V. V. See footnote 3.

conservative stocking for native ranges and the storage of all available forage crops in preparation for seasons of drought remain unchanged.

TABLE 1.—*Temperatures and precipitation on the ranges during the 5-year experimental period*¹

Season and month	Mean temperatures in—						Total precipitation in—					
	1929-30	1930-31	1931-32	1932-33	1933-34	1882-1924	1929-30	1930-31	1931-32	1932-33	1933-34	1882-1924
Winter season:	°F.	°F.	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches	Inches	Inches
November	31.8	34.4	31.5	34.5	38.2	30.9	0.19	0.28	0.54	0.16	0.41	0.57
December	17.7	30.4	22.1	17.0	20.4	21.0	.53	.31	.55	.51	.79	.63
January	3.6	31.0	15.2	20.4	27.6	14.5	.35	.05	.76	1.35	.12	.66
February	33.4	36.3	23.2	15.3	31.8	16.8	.36	.47	.36	.18	.05	.49
March	33.4	34.0	25.0	37.1	34.8	28.0	.29	.34	.85	.66	1.05	.86
Average or total	24.0	33.2	23.6	24.9	30.6	22.4	2.02	1.55	3.06	2.80	2.42	3.21
Summer season:												
April	53.8	48.4	49.4	44.0	50.0	44.7	1.88	.45	3.44	1.20	.40	1.12
May	55.2	57.9	59.3	55.8	66.9	56.7	1.30	.59	.72	1.60	.34	2.24
June	66.0	72.5	68.4	73.6	68.3	66.0	1.75	1.35	2.29	.80	.66	2.66
July	77.0	75.2	75.6	79.2	78.2	72.9	1.69	.77	1.37	.49	.67	1.54
August	75.6	73.5	73.0	71.7	72.3	71.5	.93	.17	2.69	1.38	.42	1.08
September	60.8	64.4	60.0	63.2	54.7	61.2	1.05	.67	.16	.80	1.04	1.04
October	42.0	49.4	42.0	48.6	52.7	46.5	.66	.23	2.32	.39	.03	.90
Average or total	61.6	63.0	61.1	62.3	63.3	59.9	8.69	4.23	12.39	6.85	3.66	10.58

¹ Data obtained from the station of the U. S. Weather Bureau at Miles City, Mont.

RESULTS OF EXPERIMENTS

EXPERIMENT 1, 1929-30

At weaning time, October 22, 1929, all available cows were weighed and divided as equally as possible into two groups according to age, weight, and condition. Both groups were then grazed together on pasture 2 until November 22, when group 1 was placed on winter pasture 1A and group 2 on pasture 1B. Cows in group 1 were fed cottonseed cake 112 days out of 119 between November 22 and the close of the winter period on March 21, and group 2 had no supplementary feeding on the range.

Weather and grazing conditions throughout the period, with the exception of January, were more favorable than usual for wintering beef cattle on the range. January was extremely cold, but most of the cattle had no trouble in obtaining adequate feed as there was little snow. The winter began to break on February 19, and the cattle made noticeable gains until the close of the experiment. Five cows in each group aborted on the range before the close of the winter period.

Ten cows in group 2, on range without supplement, were brought to the feed lot on January 22, owing to their weakened condition, and were fed a small quantity of cottonseed cake, good-quality oat straw, and low-grade alfalfa hay. One cow was later returned to the range, whereas nine had remained in the feed lot through the remainder of the winter. Seventy-eight cows in this group that wintered entirely on the range had an average weight loss of 28.3 pounds. The 10 cows brought to the feed lot had an average loss of 83.6 pounds while on the range, but in the feed lot made an average gain of 51.6 pounds.

Only the data for the 78 cows that were carried on the range all winter without supplement have been used in the summary of results of group 2 (table 2).

TABLE 2.—*Summary of experiment 1 for the winter period, Oct. 22, 1929, to Mar. 21, 1930, and for the summer period, Mar. 21 to Oct. 31, 1930*

Item	Group 1 cows (on range and fed cotton- seed cake)	Group 2 cows (on range and fed no sup- plement)
Cows in group ¹	number.....	51.....
Winter range period (150 days):		78
Average initial weight per cow.....	pounds.....	1,112.0
Average gain or loss per cow.....	do.....	+6.7
Period on range.....	percent.....	100.0
Feeds consumed per cow: Cottonseed cake.....	pounds.....	2131.5
Average feed and range cost per cow.....	dollars.....	5.12
Summer range period (214 days):		1.50
Average gain per cow.....	pounds.....	54.3
Average range cost per cow.....	dollars.....	2.14
Winter and summer period (364 days):		117.8
Average gain per cow.....	pounds.....	91.0
Average feed and range cost per cow.....	dollars.....	7.26
Calf production:		3.64
Calves weaned.....	number.....	73
Calf crop.....	percent.....	86.9
Average birth weight.....	pounds.....	74.9
Average weaning weight.....	do.....	406.8
Average age at weaning.....	days.....	174.6
Average cost of feed and range per 100 pounds of calf at weaning time.....	dollars.....	2.05
		1.11

¹ Of 89 cows in group 1 at the beginning of the experiment, 4 were removed during the winter because of injuries and 1 died on summer range. Of 91 cows in group 2, 3 heifers were removed on account of early calving and 10 cows were removed from the experiment as they were kept in the feed lot part of the winter.

² Cottonseed cake fed for 112 days within the period Nov. 22 to Mar. 21, inclusive.

³ At the following prices: Cottonseed cake \$65 per ton and range estimated at 1 cent per head per day

On March 22, after both groups of cows had been weighed, the breeding cows of group 1 were combined with those of group 2 on pasture 1B for early spring range and calving. Calving began on April 12, and cows with calves were transferred to pasture 1A as soon as the calves were old enough to travel. Cows and calves on this pasture were moved to pasture 2 beginning on May 14. The use of the winter range pasture for calving and spring range grazing was necessary on account of poor grazing conditions on the summer pasture, but this practice reduced materially the available range feed for the following winter. Cows and calves remained on pasture 2 (fig. 7) during the rest of the summer season, except for the 7-week breeding period, when the registered cows were with bulls in other pastures.

Grazing conditions from March 22 to October 21, when the experiment was terminated, were generally unfavorable, owing to hot, dry windy weather and a poor grass crop. Water holes on the range were dry at the end of March and the cattle had to be watered at the well. This condition existed throughout most of the summer. As a result, poor utilization was made of the range located at long distances from water. Pinkeye broke out among the cows and calves on May 14, persisted despite treatment, and gradually ran its course through the herd by the close of the summer season. Several cows that failed to recover normal eyesight were culled out at weaning time in the fall.

The cows fed cottonseed cake carried more flesh at the close of the winter season than did those receiving no supplement, but there was no noticeable difference in condition between the two groups at the close of the subsequent summer grazing season, as shown by table 2. Calves from the former group of cows weighed 2.5 pounds more at

birth and 19.9 pounds more at weaning time than calves from the latter group. However, the additional weight of calves in group 1 at weaning time was not sufficient to offset an increased feed charge of \$3.62. The feed and range cost per 100 pounds of calf at weaning time in group 1 was \$0.94 more than in group 2.

EXPERIMENT 2, 1930-31

The allotment of cows used in the 1929-30 experiment was used also throughout the 1930-31 experiment with the exception of cull cows that were removed. However, 64 head of bred 2-year-old heifers were added to the herd. All the cows were returned to pasture 2 for fall range after they were weighed on October 21, 1929. On November 22, they were separated into two experimental groups and moved into

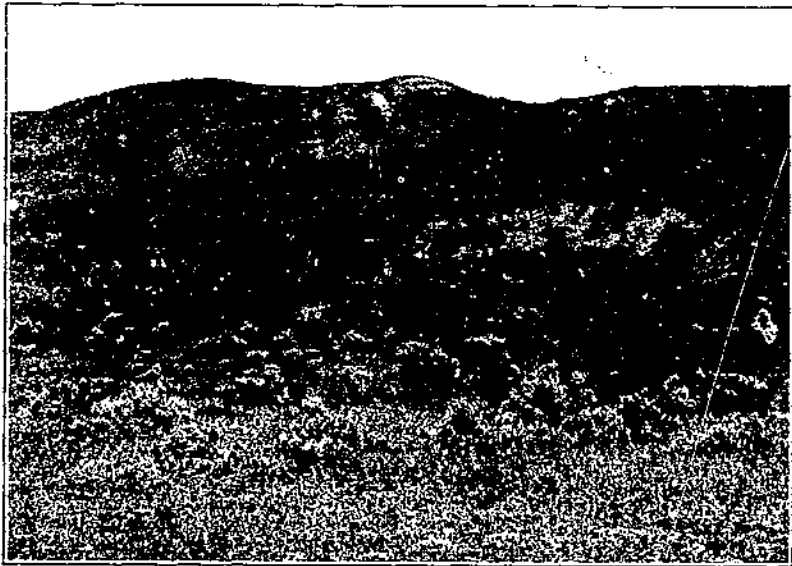


FIGURE 7.—Cows and calves around no. 3 well (pasture 2) during the breeding season.

the winter pastures. The feeding of cottonseed cake to group 1 was begun on December 1.

The weather throughout the winter of 1930-31 was unusually mild, and range conditions for this period were particularly favorable. However, the grass had made comparatively little growth during the 1930 season as these pastures had been used throughout the previous calving season. Nevertheless, since there was only a slight covering of snow on the range and that at short intervals, a good range utilization was obtained. There was little or no spring moisture, as a result of which the range was dry with no early growth of grass. Cows in both groups were able to obtain snow water on the range at irregular intervals during the winter. Water at no. 2 well was available at all times.

Cows in group 1 received 77 feedings of nut-size cottonseed cake from December 1 to March 25, inclusive. The rate of feeding averaged 0.98 pound per head per feeding. All experimental cows in both groups were on the range through the entire winter period. The cows were removed from winter range on March 25, trailed to headquarters, and

weighed on March 26, on which date the winter phase of the experiment ended. The weather was cold and disagreeable through the moving and weighing period and the cows in both lots lost heavily in weight. Cows in group 1 made a slight gain during the winter period, whereas cows in group 2, on range without supplement, suffered weight losses (table 3).

TABLE 3.—Summary of experiment 2 for the winter period, Oct. 21, 1930, to Mar. 26, 1931, and for the summer period, from Mar. 26 to Nov. 3, 1931

Item	Group 1 cows (on range and fed cotton- seed cake)	Group 2 cows (on range and fed no sup- plement)
Cows in group 1..... number	115	111
Winter range period (158 days):		
Average initial weight per cow..... pounds	1,144.5	1,139.0
Average gain or loss per cow..... do	+1.9	-26.2
Period on range..... percent	100.0	100.0
Feeds consumed per cow: Cottonseed cake..... pounds	² 75.1	
Average feed and range cost per cow ³ dollars	3.14	1.56
Summer range period (222 days):		
Average loss per cow..... pounds	82.3	79.1
Average range cost per cow..... dollars	2.22	2.22
Winter and summer period (378 days):		
Average loss per cow..... pounds	\$0.4	105.3
Average feed and range cost per cow..... dollars	5.36	3.78
Calf production:		
Calves weaned..... number	94	101
Calf crop..... percent	81.7	91.0
Average birth weight..... pounds	77.0	75.0
Average weaning weight..... do	385.5	375.6
Average age at weaning..... days	184.1	156.6
Average cost of feed and range per 100 pounds of calf at weaning time..... dollars	1.70	1.11

¹ Of the 114 cows in group 2 at the beginning of the experiment, 1 cow died in the winter, 1 in the summer, and 1 was removed for other causes.

² Cottonseed cake fed for 77 days within the period Dec. 1 to Mar. 25, inclusive.

³ At the following prices: Cottonseed cake \$41.97 per ton and range estimated at 1 cent per head per day.

Pregnant cows were moved back to the winter pasture 1B on March 28 for calving, and dry cows were trailed to a spring pasture on March 30. Calving began on April 8, and soon afterward cows and calves were moved from pasture 1B to pasture 1A and thence to pasture 2, as in the first experiment. They remained on pasture 2 from May 13, until the close of the summer except for a 7-week period, during the breeding season, when the registered cows were in other breeding pastures.

A severe drought prevailed through the entire 1931 season, and grazing conditions were generally very poor. Little or no grass grew on the ranges used by breeding cows and the chief source of forage was the 1930 grass. There was also a shortage of range moisture during the season, and most of the water had to be obtained from a central tank. Range utilization was unsatisfactory and range adjacent to water was overgrazed. The quantity of milk given by the cows was not sufficient for the best development of the calves. Bone chewing was common late in the summer, and a mineral mixture composed of 50 percent of salt and 50 percent of steamed bonemeal was fed beginning September 9. This mineral mixture reduced but did not entirely eliminate the chewing of bone.

Corrals and weighing equipment were installed near no. 2 well during the summer of 1931, thereby eliminating the necessity of trailing the herd to headquarters, a distance of 7 to 10 miles, for weighing. The herd was rounded up in pasture 2 on November 3.

The calves were then removed and trailed to headquarters and weighed, and the cows were weighed at no. 2 well.

Because of the poor summer pastures both groups of cows lost heavily in weight during this season, as shown by table 3. However, the cows in group 1, fed cottonseed cake on winter range, had on the average 24.9 pounds less loss in total weight for the year than did the cows in group 2, receiving no supplement. Calves from cows fed cottonseed cake weighed 2 pounds more at birth and 9.9 pounds more at weaning time, but the calf crop was 9.3 percent lower. Of the cows in group 1, 15.7 percent were dry as compared with 8.1 percent in group 2. Eight of the eighteen dry cows in group 1 were 3-year-old heifers added as replacements during the fall of 1931. A test for Bang's disease made on November 3 and 4, 1931, revealed the presence of 19 reactors in group 1 and 15 reactors in group 2. Only two of the dry cows in group 1 reacted, and there were no reactors among the dry cows in group 2.

The average winter and summer feed and range cost for group 1, fed cottonseed cake, was \$1.58 more per head than for group 2, fed no supplement. The feed and range cost per 100 pounds of calf at weaning time in group 2 was \$0.59 less than that in group 1. These extra returns from the use of cottonseed cake, however, did not pay for the extra cost.

EXPERIMENT 3, 1931-32

On November 3, after being weighed at no. 2 well, the cows were divided into experimental groups, and each was turned into separate winter range pastures. A number of thin cows were in each of the groups, and the general average weight was about 130 pounds less than the average weight in October 1930.

Grazing conditions through the 1931-32 winter season were generally adverse. Owing to the prevailing drought during the summer of 1931, the winter pastures in the fall of that year had less grass than in the spring at the close of the previous winter grazing. Weather conditions were generally favorable for grazing except for a 7-week period from January 1 to February 20. Rain on January 9, followed by a cold wave, resulted in a heavy crust on the snow. This condition was followed by a severe snowstorm on January 12 that drifted and closed most of the range to grazing, until the weather changed late in February. The chief source of range forage during these 7 weeks of stormy weather was the unpalatable sandgrass, greasewood, sagebrush, and yucca.

Cows in group 1, fed cottonseed cake on the range, were generally strong and all except 12 head were kept on the range all winter. These were brought to the feed lot on January 17, fed mixed hay and cottonseed cake for 43 days, and returned to the range on February 29. Cottonseed cake was fed for 111 days on the range at a daily rate of 1½ pounds. This quantity was increased to 2 pounds per head per day on January 16 and to 3 pounds on January 30 but was reduced to 2 pounds on February 24. The cows would not come to water of their own accord during the severely cold weather and depended on snow for moisture for periods ranging from 10 to 14 days at a time. On February 17 they were transferred to the winter pasture of group 2 as the range on this pasture was somewhat better. The group 2 cows, as shown later, had been moved to the feed lot. Weight losses were unusually heavy during the cold weather but were regained during the

mild weather that followed. The average daily gain per head for the winter period was 0.57 pound.

Cows in group 2, on range without supplement, suffered heavy losses in weight late in December and early in January, and 32 head were moved to the feed lot on January 8. The remainder of the group, numbering 84 head, were moved to the feed lot on January 14. The entire group was kept in the feed lot for the remainder of the winter. The average weight loss per cow on winter range was nearly offset by the gain in the feed lot, which was 64.7 pounds, there being a net loss of 5.2 pounds for the winter period. These cows were fed only mixed hay in the feed lot. Final weighing of the group was made at headquarters on March 17, and the cows were turned on range in the group 1 winter pasture on March 20 and kept there until early in April.

Calving began on April 9 in pasture 4, containing about 1,500 acres, but the breeding herd had to be removed to pasture 2 on April 11 because of the failure of the well to supply sufficient drinking water. The cows and calves were carried on pasture 2 through the remainder of summer grazing season, with the exception of the usual changes made during the 7-week breeding period.

Table 4 shows a summary of the third experiment.

TABLE 4.—Summary of experiment 3 for the winter period, group 1, Nov. 3, 1931, to Mar. 21, 1932; group 2, Nov. 3, 1931, to Mar. 17, 1932; and for the summer period, group 1, Mar. 21 to Nov. 1, 1932; group 2, Mar. 17 to Nov. 1, 1932

Item		Group 1 cows (on range and fed no cottonseed cake) ¹	Group 2 cows (on range and fed no cottonseed cake) ¹
Cows in group 2	number	112	116
Winter range period	..... days	139	135
Average initial weight per cow	..... pounds	1,016.3	1,007.6
Average gain or loss per cow	..... do.	+78.9	-5.2
Period on range	..... percent	66.7	52.1
Period in feed lot	..... do.	3.3	47.9
Feeds consumed per cow:			
Cottonseed cake	..... pounds	203.9	
Alfalfa hay ²	..... do.	187.8	2,033.3
Average feed and range cost	..... dollars	4.90	8.84
Summer range period	..... days	225	229
Average gain or loss per cow	..... pounds	-26.1	+50.1
Average range cost per cow	..... dollars	2.26	2.20
Winter and summer periods	..... days	364	364
Average gain per cow	..... pounds	52.8	44.9
Average feed and range cost per cow	..... dollars	7.15	11.13
Calf production:			
Calves weaned	..... number	80	100
Calf crop	..... percent	71.4	86.2
Average birth weight	..... pounds	74.2	70.7
Average weaning weight	..... do.	382.8	368.2
Average age at weaning	..... days	186.7	187.2
Average cost of feed and range per 100 pounds of calf at weaning time	..... dollars	2.61	3.51

¹ Because it was impossible for all the animals to obtain feed on the range during a part of the winter, 12 cows in group 1 and all the cows in group 2 were moved to the feed lot and handled as described in the text. The data for group 1 showing period on range and in feed lot have been adjusted to make them comparable with those data for group 2.

² Of the 118 cows in group 1 at the beginning of the experiment, 1 cow died from accident and 5 crippled cows were removed from the experiment. Of the 116 cows in group 2, 1 cow died on the range and 1 crippled cow was removed from the experiment.

³ At the following prices: Cottonseed cake \$27.50 per ton, alfalfa hay \$8 per ton, and range estimated at 1 cent per head per day.

Grass was slow starting in the early part of April 1932 but there was abundant moisture, and grazing conditions were generally satisfactory throughout the summer months. The water supply of the

range was good except late in July and for a short period in September. Thus, the cattle were able to graze at long distances from central water tanks during most of the summer. Little or no bone chewing was noted during the year.

Cows in group 1, fed cottonseed cake as a winter range supplement, spent 46 percent more of the winter period on the range than did those in group 2, which were carried on the range without supplement. Furthermore, the cows in group 1 made fairly good gains during this period, whereas those in group 2 failed to maintain their weights. The group 1 cows, therefore, were in better condition at calving time. However, group 2 did so much better than group 1 on summer pasture that the total gain of the former during the entire experiment was only 7.9 pounds less, on the average, than that of the latter group.

Calves from group 1 cows weighed 3.5 pounds more at birth and 14.6 pounds more at weaning time, but there were 23.2 percent of dry cows in group 1 as compared with only 12.9 percent in group 2.

At the close of the 1932 summer grazing there were 14 reactors to the Bang's disease test in group 1 and 11 reactors in group 2. The total number was nine less than in 1931. Two dry cows reacted in group 1 and one in group 2.

For the entire experiment, the average feed and range cost per cow in group 1 was \$3.98 less per head than in group 2, and the feed and range cost per 100 pounds of calf at weaning time was \$0.90 per 100 pounds less. One pound of cottonseed cake fed on the range replaced approximately 10 pounds of hay fed in the feed lot, and the use of cottonseed cake as a range supplement more than paid for its cost during this year.

EXPERIMENT 4, 1932-33

On November 18, all unregistered cows, including 15 bred 2-year-old heifers, were divided into two groups and moved to winter pastures 1A and 1B. Because of changes in these pastures, as already mentioned, group 1 was placed on pasture 1B instead of 1A, as in previous years, and group 2 on pasture 1A. When they were moved to these pastures, both groups of cows were thin owing to the very short summer and fall range. However, the average weight of the breeding cows was 40 to 50 pounds more than at the beginning of the year 1931-32.

Weather and grazing conditions through the 1932-33 winter season were about normal. Grass growth had been satisfactory during the summer of 1932, and there was more feed available on the winter range pastures than during any season since 1929-30. Weather conditions for range grazing were generally favorable with the exception of a 30-day period of extremely heavy snowfall and low temperatures from January 15 to February 15. Two of the most severe blizzards ever experienced in this locality occurred on February 6 and 8, and were accompanied with temperatures of about -30° F. All livestock suffered from this severe weather. To prevent the deaths of large numbers of animals, all cows in group 2 were fed alfalfa hay on the range from February 9 to 21, and 10 old cows in this group were fed the hay until the middle of March. Six cows in group 1 were fed alfalfa hay from February 9 to 21. All the cows of both groups were kept on the range all winter. Winter began to break during the latter part of February, and when most of the snow on the range melted, there was a general improvement in grazing conditions.

On those days on which cottonseed cake was fed the cows in group 1 received 1 pound per head daily from January 9 to February 8 and 2 pounds from February 9 to March 14. They lost in weight during this period but their losses were not unusual. At the close of the experiment, their general condition was more satisfactory than that of the group 2 cows. Cows in group 2, on range without supplement, lost a little more than 0.5 pound per head daily during the winter period, which was more than two and one-half times that of the group 1 cows.

Final winter weights of the cows in groups 1 and 2 were taken on the range scales at no. 2 well on March 17 and March 16, respectively. On March 17 the two groups were moved to pasture 3 for calving, which began on April 10. As soon as the calves were able to travel, the cows with calves were moved from pasture 3 to pasture 4, where they remained until June 6. They were then moved back to pasture 3, where more abundant grazing was available. On June 23, the usual separation of the herd was made into breeding units. All cows and calves were placed on pasture 2 on August 15, at the close of the breeding season, where they remained until the close of the summer pasture season on October 15.

Pasture 3, which contained nearly 3,000 acres, had an abundance of feed and water, and grazing conditions were very satisfactory through the calving season. There was also an abundance of old grass in pasture 4, and as a reservoir had been constructed in 1932 there was a satisfactory supply of water. However, pasture 4 contained only about 1,500 acres and the period of grazing, therefore, had to be restricted. Rainfall was below normal through July and August, water holes dried up, and the cattle were forced to graze near water tanks and reservoirs. The breeding cows maintained their condition until late in the season, but a shortage of water and feed retarded the growth of the calves. Late rains and cool weather in September and October improved grazing conditions, and both cows and calves were making satisfactory gains at the close of the season. Table 5 gives a summary of the fourth experiment.

Cows in group 1, wintered on the range with cottonseed cake as a supplement, lost on the average 48 pounds less per head than cows in group 2, wintered on the range without cottonseed cake. However, the cows in group 2 gained, on the average, 44.5 pounds more on summer range than did the group 1 cows. Thus, the average total gains for the two groups of cows for the year were approximately the same.

Calves from group 1 cows weighed 3.6 pounds more at birth and 13.9 pounds more at weaning time, but there was 17 percent of dry cows in group 1 as compared with only 9.3 percent in group 2.

At the close of the 1933 grazing season there were six abortion reactors in group 1 as compared with four in group 2. The total number was 15 less than in the fall of 1932. All the dry cows gave negative reactions.

For the entire experiment, the average feed and range cost per cow in group 1 was \$0.09 less than in group 2, whereas the feed and range cost per 100 pounds of calf at weaning time was \$0.05 more than in group 2. There was a slight advantage this winter in favor of feeding hay on the range during storms as compared with a continuous use of cottonseed cake.

TABLE 5.—Summary of experiment 4 for the winter period, group 1, Nov. 1, 1932, to Mar. 17, 1933; group 2, Nov. 1, 1932, to Mar. 16, 1933; and for the summer period, group 1, Mar. 17 to Oct. 16, 1933; group 2, Mar. 16 to Oct. 16, 1933

Item	Group 1 cows (on range and fed cotton- seed cake)	Group 2 cows (on range and fed no cotton- seed cake)
Cows in group 1	number	106
Winter range period	days	107
Average initial weight per cow	pounds	1,064.2
Average loss per cow	do	1,049.4
Period on range 1	percent	76.9
Period of supplemental feeding on range	do	100.0
Feed consumed per cow:		9.5
Cottonseed cake	pounds	58.1
Alfalfa hay	do	280.9
Average feed and range cost ² per cow	dollars	2.38
Summer range period	days	214
Average gain per cow	pounds	58.3
Average range cost per cow	dollar	2.14
Winter and summer periods (340 days):		
Average gain per cow	pounds	24.9
Average feed and range cost per cow	dollars	4.52
Calf production:		
Calves weaned	number	85
Calf crop	percent	87.9
Average birth weight	pounds	77.3
Average weaning weight	do	343.2
Average age at weaning	days	167.1
Average cost of feed and range per 100 pounds of calf at weaning time	dollars	1.61

¹ 4 group 1 cows and 3 group 2 cows died on range during the February storm; 2 group 2 cows were removed from experiment during the winter on account of weakness; 1 group 1 cow and 3 group 2 cows dead or missing on summer range.

² Of 111 cows in group 1 at the beginning of the experiment, 4 died on the range during the February storm and 1 was dead or missing on summer range. Of 115 cows in group 2, 3 died during the February storm, 2 were removed during the winter because of weakness, and 3 were dead or missing on summer range.

³ At the following prices: Cottonseed cake \$21.07 per ton, alfalfa hay \$8 per ton, and range estimated at 1 cent per head per day.

EXPERIMENT 5, 1933-34

The number of cows available for the 1933-34 winter range experiment was smaller than for the other experiments because of the closer culling of inferior cows. On October 16 the cows were divided into two groups, 22 bred 2-year-old heifers were added to each group, and the animals were moved to winter range pastures. The average weights of the cows at the beginning of this winter range experiment were slightly less than the weights at the beginning of the 1932-33 experiment.

Weather and grazing conditions through the 1933-34 winter season were more favorable than for any other year of the experiments with the exception of 1930-31. There was an adequate supply of grass in the winter pastures, temperatures were mild, and there was little or no snow on the range at any time. All cows in both groups remained on the range through the entire period. The cows in group 1 received 73 feedings of cottonseed cake from December 18 to March 17, inclusive. It was fed at the rate of 1 pound per head per day.

Final weighings for the winter period were taken at no. 2 well on March 27 for the group 1 cows and on March 29 for the group 2 cows. The weather on March 29 was stormy, as a result of which the cows in group 2 probably lost weight before the weighing operation was completed. All breeding cows were number branded at the time of weighing, after which they were moved to the calving range in pasture 3. Calving began on April 3. The cows with calves were moved from

pasture 3 to pasture 4 as soon as the calves were able to travel, as in the previous season. The water in the reservoir in pasture 4 dried up, however, and on May 8 the animals were moved back to pasture 3, where they grazed until June 11. They were then moved to pasture 2B. Pasture 2A was used during the breeding season, June 29 to August 13, and pastures 2A and 2B were used in common for the remainder of the summer. Yearling heifers were also grazed in these pastures with breeding cows after the close of the breeding season.

Drought conditions of a very severe nature began early in May and continued throughout the summer and fall. The total precipitation from January 1 to October 31 was 4.78 inches, which was 7.81 inches below normal. There was little or no growth of grass during the summer. Temperatures were high and grazing conditions were probably the worst ever experienced at the station. Table 6 shows a summary of the fifth experiment.

TABLE 6.—Summary of experiment 5 for the winter period, group 1, Oct. 16, 1933, to Mar. 27, 1934; group 2, Oct. 16, 1933, to Mar. 29, 1934; and for the summer period, group 1, Mar. 27 to Oct. 16, 1934; group 2, Mar. 29 to Oct. 16, 1934

Item	Group 1 cows (on range and fed cotton- seed cake)	Group 2 cows (on range and fed no supple- ment)
Cows in group 1.....	number..... 77	77
Winter range period.....	days..... 162	164
Average initial weight per cow.....	pounds..... 1,030.9	1,033.0
Average gain per cow.....	do..... 71.8	28.7
Period on range.....	percent..... 103.0	100.0
Feed consumed per cow: Cottonseed cake.....	pounds..... 2 69.6	-----
Average feed and range cost per cow ¹	dollars..... 2.57	1.64
Summer range period.....	days..... 203	201
Average loss per cow.....	pounds..... 119.5	73.8
Average range cost per cow.....	dollars..... 2.03	2.91
Winter and summer range periods (365 days):		
Average loss per cow.....	pounds..... 47.7	50.2
Average feed and range cost per cow.....	dollars..... 4.00	3.65
Calf production:		
Calves weaned.....	number..... 68	62
Calf crop.....	percent..... 88.3	80.5
Average birth weight.....	pounds..... 75.8	74.5
Average weaning weight.....	do..... 317.5	301.6
Average age at weaning.....	days..... 174.7	171.0
Weaned calf per cow.....	pounds..... 280.4	242.9
Average cost of feed and range per 100 pounds of calf at weaning time.....	dollars..... 1.64	1.30

¹ Of the 79 cows in group 1 at the beginning of the experiment, 2 dry cows were removed during the summer. Of the 80 cows in group 2, 2 dry cows were removed and 1 cow and calf were taken out for other cause.

² Cottonseed cake was fed 73 days within the period Dec. 18 to Mar. 17, inclusive.

³ At the following prices: Cottonseed cake at \$27.23 per ton and range estimated at 1 cent per head per day.

During the winter, the cows in group 1, fed cottonseed cake as a supplement, gained on the average 43.1 pounds more than cows in group 2, wintered on the range without supplement. Although the cows in group 2 made an average daily gain of only 0.18 pound, they appeared to be in nearly as good condition for calving at the close of the winter period as were those in group 1. During the summer the group 1 cows lost 40.7 pounds more than group 2. Average weight losses for the year were approximately the same for both groups.

Calves from group 1 cows weighed 1.3 pounds more at birth and 15.9 pounds more at weaning time than calves from group 2 cows. It is possible that the slightly better condition and weight of group 1 cows at the beginning of the summer season were responsible for the heavier calves at weaning time. Weaning weights of calves were

below normal in both groups, owing to poor grazing conditions, a shortage of water, and a limited supply of milk from their dams. There were 9.1 percent of dry cows in group 1 and 16.9 percent of dry cows in group 2.

The Bang's disease test on the herd at the close of the 1934 grazing season showed five reacting cows in group 1 and three reactors in group 2. All reacting cows in group 1 and all except one in group 2 produced calves in 1934. The total number of reactors was two less than in 1933.

For the entire experiment, the average feed and range cost in group 1 was \$0.95 more per head than in group 2. The feed and range cost per 100 pounds of calf at weaning time was \$0.14 more than in group 2. Thus the use of cottonseed cake as a range supplement was of no economic advantage during this year.

AVERAGE RESULTS

In experiments 1, 2, and 5 direct comparisons can be made between wintering on range alone and on range with cottonseed cake. Therefore, the average results of these three experiments are presented in table 7. During the winter the group 1 cows, which received the cottonseed-cake supplement, made gains, whereas the group 2 cows, which received no supplement, lost slightly in weight. During the summer both groups lost in weight, the losses by the group 1 cows being approximately twice as much as those by the group 2 cows.

TABLE 7.—Average results of experiments 1, 2, and 5, during which all cows were kept on the range all winter

Item	Group 1 cows (on range and fed cotton- seed cake)	Group 2 cows (on range and fed no sup- plement)
Cows in group.....	number 276	266
Winter range period.....	days 155.8	156.6
Average initial weight per cow.....	pounds 1,102.9	1,099.4
Average gain or loss per cow.....	do. +22.9	-10.9
Quantity of cottonseed cake consumed per cow.....	do. 99.7	
Average feed and range cost per cow ¹	dollars 3.58	1.77
Summer range period.....	days 214.3	213.6
Average loss per cow.....	pounds 42.0	21.3
Average range cost per cow.....	dollars 2.14	2.14
Winter and summer period.....	days 370.1	370.1
Average loss per cow.....	pounds 19.1	32.2
Average feed and range cost per cow.....	dollars 6.72	3.70
Calf production:		
Calves weaned.....	number 235	229
Calf crop.....	percent 85.1	86.1
Average birth weight.....	pounds 76.0	74.1
Average weaning weight.....	do. 372.4	358.8
Average age at weaning.....	days 178.4	178.8
Average cost of feed and range per 100 pounds of calf at weaning time.....	dollars 1.80	1.20

¹ At the following prices: Cottonseed cake at \$4.56 per ton and range use estimated at 1 cent per head per day.

Calves from the cows fed cottonseed cake averaged 1.9 pounds heavier at birth and 13.6 pounds heavier at weaning time than calves from the cows receiving no supplement. The difference in calf crop—about 1 percent—in favor of group 2 is too small to be considered significant.⁶

⁶ The statistical analyses of the data in this bulletin were made according to the following: FISHER, R. A. STATISTICAL METHODS FOR RESEARCH WORKERS, Ed. 5, rev. and enl., 319 pp., illus. Edinburgh and London, 1934.

In average range and feed cost for the entire experiment there was a difference of \$2.02 per cow in favor of group 2. The cost of range use was the same for both groups, and this difference of \$2.02, therefore, represents the average cost of cottonseed cake per cow. The feed and range cost per 100 pounds of calf produced shows a difference of \$0.60, which also is in favor of the group fed no supplement. This difference is significant. It is doubtful whether the smaller yearly weight loss per cow which resulted when cottonseed cake was fed on winter range would compensate for the higher feed costs just mentioned.

These results indicate that the use of cottonseed cake as a winter range supplement was unprofitable during winter periods when weather and range conditions were favorable for range grazing and a minimum amount of supplemental roughage was required. However, the winters during these three experiments were not typical of eastern Montana or of the northern Great Plains as a whole. Results obtained in experiment 3, 1931-32, when temperature and precipitation records more nearly approached the average, show that all the cows receiving no supplement on the range were forced into the feed lot on account of adverse grazing and that the majority of the cows fed cottonseed cake were satisfactorily wintered on the range. During this experiment 1 pound of cottonseed cake fed on the range replaced approximately 10 pounds of alfalfa hay fed in the feed lot and resulted in a saving of \$4.55 per head in wintering cost.

SUMMARY AND CONCLUSIONS

Experiments with Hereford breeding cows were conducted to determine the effect on winter gains, feed costs, and subsequent calf crop, of wintering cows on the range (1) without supplement and (2) with a supplement of cottonseed cake. These experiments were carried on at Miles City, Mont., from the winter of 1929 through the summer grazing season of 1934. For the most part, the winters were mild and maximum use of range grazing was made. The summers were generally hot and dry with grazing conditions below normal. The average monthly temperatures were above normal through all the winter and summer seasons, whereas the precipitation was below normal during four of the five winters and during all the summers. The period from November 1931 through October 1932 more nearly approached normal weather conditions as regards winter and summer temperatures and precipitation than any of the other four periods.

The results of these experiments indicate that cottonseed cake is a valuable supplement on native range but that for greatest economy its use should be limited to seasons in which winter range conditions are severe.

Cows fed cottonseed cake on winter range carried more flesh at the close of the winter than cows without this supplement and consistently produced heavier calves at birth and weaning time. This feed serves well as a range supplement, since it is highly concentrated and can be fed with little or no waste.

Its use provides a means of insurance against short hay crops and winters of deep snow and poor grazing. This fact was demonstrated particularly during the winter of 1931-32, as the cows in the group without supplement had to be moved from the range in January to

prevent heavy death losses, whereas all except 12 cows fed cottonseed cake were carried on the range all winter. Moreover, this group of cows maintained their weight satisfactorily when moved in the mid-winter season to the range vacated by the cows receiving no supplement on the range.

Cows fed cottonseed cake were able to subsist on sagebrush, yucca, greasewood, and other browse plants, when the grass was covered by deep snow. During the winter, 1 pound of cottonseed cake fed on the range replaced approximately 10 pounds of hay fed in the feed lot.

A summary of results from 276 cows wintered on the range with cottonseed cake as a supplement (group 1) and 266 cows wintered on the range without supplement (group 2) shows that the two groups, during the combined winter and summer period, had average weight losses of 19.1 and 32.2 pounds, respectively. During the winter, group 1 made gains in weight, whereas group 2 lost weight. During the summer both groups lost weight, although the losses made by group 1 were approximately twice as heavy as those by group 2.

Calves from cows fed cottonseed cake were, on the average, 1.9 pounds heavier at birth and 13.6 pounds heavier at weaning time than calves from cows receiving no supplement.

The average winter and summer range and feed cost, with cottonseed cake at \$44.56 per ton and range use estimated at 1 cent per head per day, was \$5.72 for group 1 and \$3.70 for group 2, with a difference of \$2.02 per cow in favor of the range without supplement.

The feed and range cost per 100 pounds of calf produced was \$1.80 for group 1 and \$1.20 for group 2, with a saving of \$0.60 per 100 pounds of calf when cottonseed cake was not fed as a winter range supplement to cows. Even though the cows in group 2 made an average yearly loss of 13 pounds more than those in group 1, the difference in their favor so far as calf production was concerned more than compensated for their greater weight losses.

In no year of the experiment was there any significant difference in numbers of cows in the two groups reacting to the test for Bang's disease. The majority of dry cows failed to react to the test.

**ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE
WHEN THIS PUBLICATION WAS LAST PRINTED**

<i>Secretary of Agriculture</i>	HENRY A. WALLACE.
<i>Under Secretary</i>	M. L. WILSON.
<i>Assistant Secretary</i>	HARRY L. BROWN.
<i>Director of Extension Work</i>	C. W. WARBERTON.
<i>Director of Finance</i>	W. A. JUMP.
<i>Director of Information</i>	M. S. EISENHOWER.
<i>Director of Personnel</i>	W. W. STOCKBERGER.
<i>Director of Research</i>	JAMES T. JARDINE.
<i>Solicitor</i>	MARTIN G. WHITE.
<i>Agricultural Adjustment Administration</i>	H. R. TOLLEY, <i>Administrator</i> .
<i>Bureau of Agricultural Economics</i>	A. G. BLACK, <i>Chief</i> .
<i>Bureau of Agricultural Engineering</i>	S. H. McCORRY, <i>Chief</i> .
<i>Bureau of Animal Industry</i>	JOHN R. MOHLER, <i>Chief</i> .
<i>Bureau of Biological Survey</i>	IRA N. GABRIELSON, <i>Chief</i> .
<i>Bureau of Chemistry and Soils</i>	HENRY G. KNIGHT, <i>Chief</i> .
<i>Commodity Exchange Administration</i>	J. W. T. DUVEL, <i>Chief</i> .
<i>Bureau of Dairy Industry</i>	O. E. REED, <i>Chief</i> .
<i>Bureau of Entomology and Plant Quarantine</i>	LEE A. STRONG, <i>Chief</i> .
<i>Office of Experimental Stations</i>	JAMES T. JARDINE, <i>Chief</i> .
<i>Farm Security Administration</i>	W. W. ALEXANDER, <i>Administrator</i> .
<i>Food and Drug Administration</i>	WALTER G. CAMPBELL, <i>Chief</i> .
<i>Forest Service</i>	FERDINAND A. SILCOX, <i>Chief</i> .
<i>Bureau of Home Economics</i>	LOUISE STANLEY, <i>Chief</i> .
<i>Library</i>	CLARABEL R. BARNETT, <i>Librarian</i> .
<i>Bureau of Plant Industry</i>	E. G. AUCHTER, <i>Chief</i> .
<i>Bureau of Public Roads</i>	THOMAS H. MACDONALD, <i>Chief</i> .
<i>Soil Conservation Service</i>	H. H. BENNETT, <i>Chief</i> .
<i>Weather Bureau</i>	WILLIS R. GREGG, <i>Chief</i> .

This bulletin is a contribution from

<i>Bureau of Animal Industry</i>	JOHN R. MOHLER, <i>Chief</i> .
<i>Animal Husbandry Division</i>	H. G. MCPHEE, <i>Principal Animal Husbandman, Chief</i> .

END