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Agricultural Research at the Antelope Range Field Station: A Progress Report

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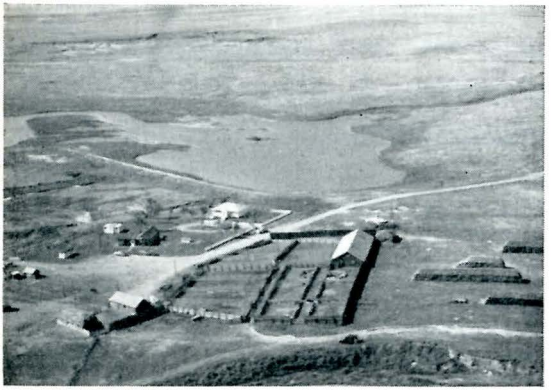
AGRICULTURAL RESEARCH AT THE

Antelope Range Field Station

A PROGRESS REPORT



AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE
BROOKINGS, SOUTH DAKOTA

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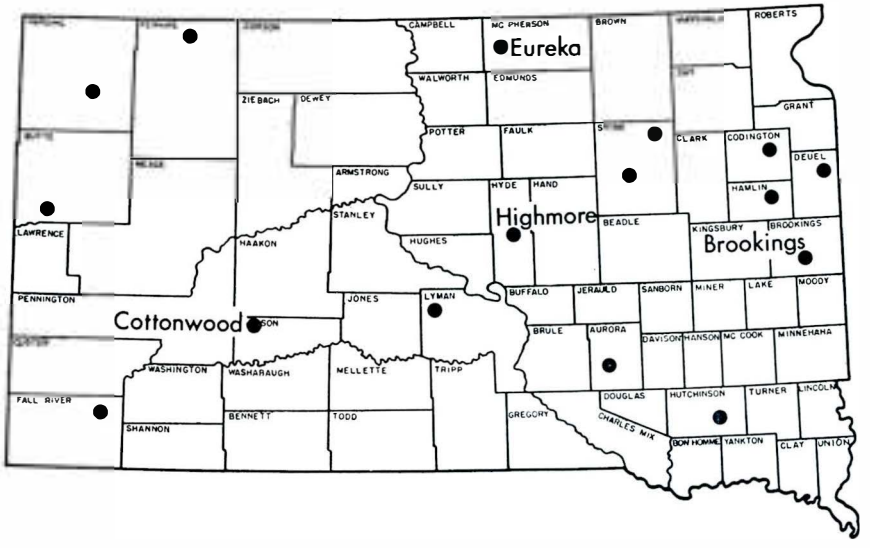
Location of research sites of the Agricultural Experiment Station.



Superintendent W. R. Trevillyan and family.

On the Cover

Here are three scenes at Antelope Range Field Station. The top picture shows the corrals and ranch headquarters. In the center are some of the cattle used in the breeding studies. Sheep used in the grazing studies are shown in the bottom picture.

A Note from the Superintendent

When I came here as Superintendent in 1953, the projects were already well established. The work was outlined for us at the station and we have done our best to carry out our part of the work.

It takes many years to obtain accurate results on these projects. In the sheep studies, for instance, the work must be repeated for several years to average out the variations caused by dry and wet years and rough and mild winters. Also, a number of years must pass in grazing studies for accumulative effects to appear. In the beef breeding work, animals have only one offspring a year which makes progress slow and the results expensive.

Nearly every year we hold a Field Day which the public is invited to attend. Project leaders of the work being done here and others from the Experiment Station Staff are present to tell about their work and their findings. We would like to see more of you attend these meetings to ask questions, to visit with us, and try to better understand what your experiment station is trying to accomplish.

We have visitors at the station from time to time and we welcome them. We like to have you stop to look over the station and the livestock. Please feel free to visit your station any time.

W. R. Trevillyan, Superintendent

History of Antelope Range Field Station

South Dakota State College research workers, with the help of the Field Station Advisory Council and the cooperation of the South Dakota Department of Game, Fish and Parks, began planning and establishing experimental projects at the Antelope Range Field Station in 1947. The Range Station consists of 7,920 acres of range land in east-central Harding County. A large part of this tract, 6,680 acres, is under the control of the state office of School and Public Lands; 1,120 acres are owned by the Department of Game, Fish and Parks; and 120 acres are privately owned by a neighbor. Prior to 1946 the preserve area was leased for grazing to private interests. The 1957 Legislature authorized the exchange of the 1,120 acres owned by the Game, Fish and Parks Department for School and Public Lands located elsewhere in the state. Negotiations to accomplish the land exchange are in progress at the time of this writing.

The station lies 2 miles south of Highway No. 8 on the west side of the Slim Buttes. The land is rolling prairie, deeply cut in some places by intermittent streams, and unsuitable for most agricultural purposes except grazing. This area was originally organized as an antelope preserve and for many years was oper-

ated as such under the control of the Game, Fish and Parks Department.

In the fall of 1946, at the request of livestock men of western South Dakota, representing the Western South Dakota Sheep Growers' Association, the Cooperative Wool Growers' of South Dakota, the Black Hills' Protective Association, Harding County Livestock Improvement Association, South Dakota Purebred Sheep Breeders Association, and the South Dakota Stockgrowers' Association, the Game, Fish and Parks Commission entered into an agreement to permit the South Dakota State College Agricultural Experiment Station to use the Antelope Range Preserve as a livestock experiment field station for range research in problems dealing with beef cattle, sheep, and antelope. Representatives of the organizations formed an advisory council to assist in developing the station and suggesting problems that needed research study.

The orginal advisory committee and the animal husbandry department research men compiled a list of 21 major problems that would be suitable for development at the Antelope Range Field Station, although not all of these could be handled at once. Actual research work was started in 1947. The first experimental livestock with which the ranch was stocked were sheep, but within the first year a cow herd was added. Of the 21 problems suggested, parasitism in sheep, stocking rate and rotational grazing studies with sheep, supplements for wintering pregnant ewes, and beef cattle breeding research were the ones undertaken and upon which sufficient data have been collected to warrant publication of the results. Many of these studies are still underway.

One of the early goals was to discover basic information on compatibility of sheep and antelope grazing on the same range in respect to carrying capacity of the range, parasites common to both species, and the host parasite interrelationships. Unfortunately this work has yielded little information because of difficulties in handling antelope either in captivity or under controlled conditions on range pastures. The other experiments have been carried forward and the results to date are reported in this bulletin.

Authors of this circular are C. A. Dinkel, associate animal husbandman; J. A. Minyard, assistant animal husbandman; F. R. Gartner, assistant animal husbandman; G. S. Harshfield, veterinarian; A. L. Musson, animal husbandman; and W. R. Trevillyan, superintendent of Antelope Range Field Station.

Weather and the Land

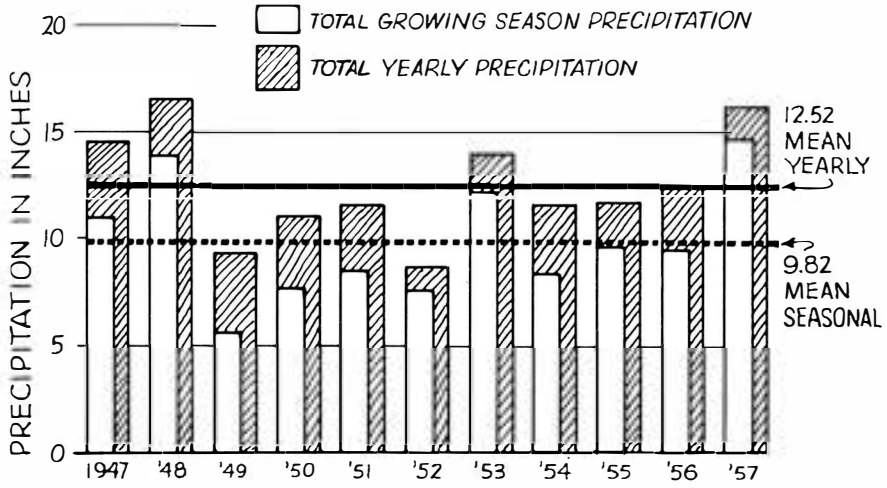
ANTELOPE RANGE Field Station is located in northwestern South Dakota in an area made up of a series of small ranges of timbered hills and isolated buttes. Because of its location in the drier part of the chestnut soil zone, precipitation has not been sufficient to leach the soils to any great depth. Because of this, an accumulation zone of lime and other carbonates has formed fairly high up in the soil profiles. Most of the soils at Antelope Range have from 1 to several inches of fine sand incorporated in their surface horizons by wind action. The soils may be grouped on the basis of topographic position under three main headings: upland soils, terrace soils, and bottomland soils.

All of the soils found on the station have developed from sedimentary rock strata. The Hell Creek member of the Lance formation seems to be the most prominent geological formation at Antelope. Beds of sandstone, shale, and clay are present in the Hell Creek and, when subject to erosion, badlands are formed.

The Field Station lies in the belt of lowest precipitation in South Dakota. Average annual precipitation is from 12 to 14 inches, but the yearly precipitation may vary several inches from normal. From 1947 through 1957 the average annual precipitation was 12.5 inches. It varied from a high of 16.5 inches in 1948 to a low of 8.8 inches in 1952 (see figure 1).

Temperatures vary as greatly as the rainfall. In January 1954 there was an unofficial 46° below zero in the area, and it is not unusual for

Figure 1. Growing season (April to September) and annual precipitation at Antelope Range.



the temperature to climb well above the 100° mark in mid-summer.

Vegetation which has developed under this climatic and soil environment is the mixed prairie type containing shortgrasses, midgrasses, and forbs. Major forage species are western wheatgrass, green needlegrass, needleandthread, blue grama, a few sedges, and numerous native forbs. Silver sagebrush is important in the area, especially on sheep ranges. In addition, numerous sandhill sites are scattered throughout this corner of South Dakota.

During years of above-normal rainfall certain tall grasses form an important part of the vegetation. Two species, little bluestem and big bluestem, become quite abundant, although the latter is restricted to draws and bottomlands. Species that are commonly found with big bluestem on lowland sites are Canada wildrye, prairie cordgrass, and lowland sedges.

The variation in climate from season to season and from year to year adds to the difficulty of analyzing the information from experimental projects. Livestock, vegetational, and soil studies must be repeated year after year to minimize these climatic variations. Repetition is important in all work of this kind but to get reliable results in an extremely variable climate, it is even more important.

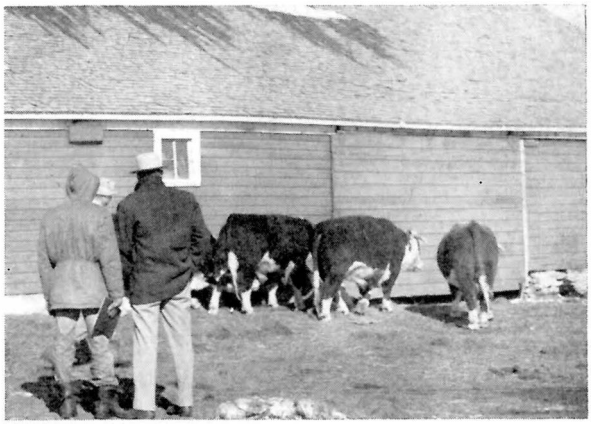
A shelterbelt was planted in the spring of 1957 for protection of the ranch buildings, and also to make possible estimates on adaptability of tree species for this area. Growth records are kept on the species represented.

Beef Cattle Breeding

Part of the cow herd at the Station is shown in this picture.

ANTELOPE RANGE Field Station forms the backbone of an extensive beef breeding project. The beef herd carried on the Station make several state-wide projects possible. Calves raised on the Station furnish data on range performance, feedlot performance, and carcass characteristics. In addition, related data are obtained from these calves on such problems as dwarfism, semen evaluation studies, pregnancy palpation studies, and various environmental adjustments necessary for the development of effective breeding programs. All of these areas of study use the data taken directly from the calves produced on the Station. Many of the same characteristics are also measured on calves produced by Experiment Station bulls in commercial herds throughout the state and in Experiment Station herds in other states.

Breeder-cooperators are shown here selecting bulls for use in the field tests.



Circular 130 of the South Dakota Agricultural Experiment Station presents the objectives of this project and experimental detail for attaining these objectives. Because this circular is available, the project will be treated only in general here.

The original cow herd for the Station was obtained by a "share the calf crop" agreement between the Experiment Station and a purebred breeder and by purchase of a small number of the original cows. The cow herd has been maintained through the years and additions were made from the herds at other stations.

Original blood lines have been preserved by close mating where sufficient cows were available to

form a closely bred group. This is true except for Line 6 which was culled because of relatively low post-weaning performance. These cows were transferred to the Reed Ranch where they are being used in studies on selenium poisoning. Cows of the original herd which did not fit into any of the closely bred groups were carried in a control line and the present day control line stems in part from these cows.

Long-Term Objectives

The long-term objectives for the cow herd involve a study of selection and inbreeding. At present there are four small inbred lines and one large control line on the Station. The use of close mating or inbreeding should provide an accurate check on the improvement brought about by selection, and, in addition, eventually will provide us with the breeding stock necessary to study hybrid vigor in beef cattle. Selection and inbreeding are being studied with regard to range performance, feed lot performance, and carcass characteristics. As more highly inbred individuals are produced, crosses between the different lines will be made to determine whether or not this is an economical method of beef production.

Beef Herd Production

Table 1 shows the weaning weights collected in the herd during the past 10 years. The first column contains overall herd averages after adjustment has been made for differences in age, sex, and age of dam. Some of the calves born in 1953 and later years were inbred and there are no corrections for this in the averages in the first column. When inbreeding was started in 1953, a control line was also initiated and the averages for this control line are given in the second column. Averages of the inbred lines after correction for inbreeding are given in the third column. These averages indicate large year to year variations. As much as 40 pounds difference in average weaning weight for the herd has been noted between years when the same bulls and the same cows have been used and managed the same way. Such large variations due to environment makes it difficult to show breeding improvement when such improvement may be only 5 to 10 pounds per year.

In 4 of the last 5 years the inbred calves have averaged heavier at weaning than the control line calves. Part of this difference can be explained as a blood line or hereditary difference. When it became apparent after the first 2 or 3 years of inbreeding that the inbred lines were producing better than the control line, it was decided to reconstitute the control line. By transferring cows from the inbred lines to the control line and using bulls from the inbred lines on unrelated cows in the control line, essentially the same blood lines are now present in

the control line that are in the individual inbred lines. Cows transferred to the control line were older and not inbred but when mated to related bulls, produced the foundation inbred calves for the lines. Calves born in 1957 were the first calves produced from this new control line. The performance of this group exceeded that of the inbred calves. The control line will be carried as a four-sire closed line with inbreeding avoided as much as possible.

The last three columns in table 1 show individual line performance for three of the inbred lines which have been closed since 1953. Average weaning weights presented are adjusted for difference in age, sex, age of dam, and inbreeding. It is hard to determine from these data what is a year effect and what is an inbreeding effect. Since the general tendency is down in all inbred lines, one might assume that the inbreeding adjustment is not satisfactorily correcting for all the decline due to inbreeding. However, comparison with the average for the control line shows that in general the same trends are present there as are present in the inbred lines. This would lead one to assume that most of the downward trend may be due to year effects rather than incomplete adjustment for inbreeding effects. As more data are collected, better estimates of the effects of inbreeding will become available and more critical analyses of these trends will be possible. The averages presented do not indicate that selection has been effective in increasing weaning weights during the course of inbreeding. However, the large year to year variations present in these averages and the possibility that the inbreeding correction is not large enough make it difficult to demonstrate an increase due to selection. Methods of analysis are available to evaluate progress by selection in such herds. However, the amount of selection actually practiced in the cow herds at this station has been so small that the extensive analysis needed will not be possible until several more years' data are available.

Table 1. Average Weaning Weights for the Antelope Range Cow Herd, 1948-57

Year	Herd Average	Control Line	Adjusted Inbred Average	Line 1	Line 2	Line 3
1948	395	—	—	—	—	—
1949	387	—	—	—	—	—
1950	437	—	—	—	—	—
1951	401	—	—	—	—	—
1952	440	—	—	—	—	—
1953	446	438	472	487	492	451
1954	406	405	432	473	460	409
1955	407	398	428	431	445	425
1956	389	406	413	394	401	379
1957	430	455	445	409	443	431

Due to the necessity of increasing the size of the herd, no selection was practiced on the heifers until the 1953 calf crop. Even then 75% of the heifers had to be saved and these heifers averaged only 10 pounds heavier at weaning than the average of the entire herd. In 1954 only 45% of the heifers needed to be saved and they averaged 47 pounds heavier than the average of the herd. These figures, along with the average weaning weights of their offspring in comparison to the offspring of the other cows in the herd are given in table 2. No calves were obtained from cows selected on the basis of their own performance until 1956. Previously, selection had been directed towards weeding out cows which weaned light calves and toward the use of bulls selected on their own performance.

Heifers selected in 1953 brought in calves in 1956 which averaged 11 pounds less than the average of the calves from all other cows in the herd. In 1957 their calves averaged the same as the other group. Heifers selected in 1954 had a 47 pound advantage over their own herd average and their calves in 1957 had a 13 pound advantage over the calves from all other cows. These figures do not take into account any improvement made by culling out older cows on the basis of the weaning weight of their calves. Selection of the older cows would tend to raise the herd average and lessen the advantage the selected heifers might have. In addition, these figures do not take into account any changes in the level of performance of the bulls in use. In general this trend should be upwards, but in individual cases for individual characteristics such as weaning weight it might actually be downward. Since bulls are selected on their rate of gain and conformation as well as weaning weight, a bull with a low weaning weight might get into the herd if he had a sufficiently high rate of gain and conformation score. Therefore, the trend caused by changing bulls cannot be estimated accurately without the extensive analysis.

Table 2. Amount of Selection Practiced on Antelope Range Cow Herd

Year Cows Were Born	Selection Differential*	% Saved	Advantage of Offspring of Selected Cows 1956	1957
1953	10	75	−11	0
1954	47	45		13
1955	9	45		
1956	21	54		

*Average of selected heifers less the average of the calf crop in which they were born.

It may be instructive to consider what might have been expected from the selection practiced on the 1954 heifers in table 2, assuming that there had not been any selection on the older cows during the period and that there have been no changes in the breeding value of the bulls used as far as weaning weight is concerned. To further simplify the example the assumption will be made that no selection was made on the bull side for weaning weight. The difference between the average weaning weight of the selected heifers and the herd average represents the selection differential or "reach" which in this case

is 47 pounds. Since inheritance is equal from sire and dam and since the assumption there is no "reach" on the bull side, one-half of the 47 pounds represents the "reach" for the next generation which in this case is 23½ pounds. Heritability estimates for weaning weight average close to 25% yielding expected gain of 25% of 23½ or about 6 pounds.

The 6 pounds represents the increase in weaning weight expected due to the selection practiced on the heifers alone. In their first year of production an increase of 13 pounds over the average of the other cows was actually obtained. There are at least three possible explanations for this. First, heritability figures can vary from herd to herd and may not fit every individual herd exactly. While this variation will usually not be large, it might be large enough to cause the small difference. Second, characteristics such as weaning weight, affected by so many variables, can by chance be thrown up or down, probably to a much greater extent than the differences here. This is one of the main reasons why several more years' data are needed before an extensive analysis can be completed. Third, it is entirely possible that there was some selection for increased weaning weights in the choice of the bulls to be used in this herd. For the purposes of this example only and not supposing that this is the actual situation, assume that the bulls which sired the 1957 calves from these selected heifers averaged 56 pounds above the average weaning weight of the calf crop in which they were born. This 56 pounds represents the "reach" on the bull side and again must be halved since inheritance is equal from sire and dam. The resulting 28 pounds multiplied by the heritability of .25 yields an expected gain on the bull side of 7 pounds. The 6 pounds gained from selecting the heifers and the 7 pounds gained from selecting the bulls would equal 13 pounds expected increase in the next genera-

The foundation herd sire for Line 1 is shown as a 7-year-old at the left. In 1956, he was replaced by his son, shown at the right as a 3-year-old.

tion. This example is used to demonstrate the theoretical means of estimating progress by selection and is not intended to explain the 13 pound increase actually obtained.

At this point the producer might be interested in what the expected "reach" might be in his herd. Inspection of table 2 indicates that in the last 4 years the average "reach" has been 22 pounds in the station herd. The table also indicates that a relatively high percentage of the heifers have had to be saved for replacement. This stems from the fact that in the early years when all the heifers were being saved in order to build up the herd many cows were saved that would ordinarily have been culled. Thus in the years since 1953 a higher proportion of heifers had to be saved to replace the poorer heifers saved in the early years. If a producer has a long established herd which has not recently undergone a similar history, the percentage of heifers saved would probably be less than those indicated in table 2 and somewhere in the neighborhood of 35 to 40%. If replacement heifers were selected entirely on the basis of weaning weight without regard to conformation, yearling weight, or other characteristics, then one might expect a "reach" of from 40 to 50 pounds. However, present reccommendations are that selections be based on conformation and where possible, yearling weight as well as weaning weight. The more characteristics on which selection is based, the less improvement that can be expected in any one characteristic, even though the overall improvement may be greater. The expected "reach" in most herds would be approximately 30 to 40 pounds if selection is practiced on conformation and yearling weight as well as weaning weight. This would mean about 5 to 10 pounds per generation increase in weaning weight. This will likely vary from year to year as it has in the Antelope Range herd but over the years it should average somewhere close to these figures.

Opportunities for improvement on the bull side are much greater than they are on the heifer side. This does not mean that one should neglect selection on the cow side. Since some improvement is possible, the highly competitive nature of the livestock business today makes it even more important to bring about improvement wherever posible. Results expected from selection on the bull's side will be treated in the next section.

Testing Inbred Lines

During their formation, the inbred lines are being tested in several different ways. A test for their ability to combine well with beef cattle in general is being carried out through a field test in cooperation with commercial breeders in the state. On-the-farm testing of bulls from these lines was initiated in 1954.

In addition to evaluating inbred lines as they are developed, field testing affords an opportunity to compare the overall performance of the Experiment Station herd

with the performance of the cattle population of South Dakota. Comparisons are being made of performance-tested bulls and non-tested bulls. In cases where more than one performance-tested bull is leased to a cooperator for the same test period, an opportunity is afforded to compare bulls with good or high performance records and bulls with fair or low performance records. Records obtained in these field tests also can be useful to the cooperating producers in their selection and culling programs.

In field testing, selected bulls are leased to interested breeders who agree to separate their cows into two breeding herds. The cow herd is divided by gate cut. One group is bred to the Experiment Station bull and the other group to the bulls owned by the breeder. Each calf is eartagged at birth and the date of birth and sire is recorded. The calves are weaned at about 6 months of age, weighed, and scored for conformation. The weights are adjusted for differences in age, sex, and age of dam. Where possible,

Table 3. Comparison of Weaning Weight and Type Score of Progeny from Performance Tested and Non-Tested Bulls

Bull No.	Ranch	Own W.W.	Dev. from Herd Average	Progeny Yr.	No.	College Ave. W.W.	College Dev.	Private Ave. W.W.	Private Dev.	Ave. Type Score*
311	1	455	+35	55	10	414	+3			2—
Own	1			55	11			408	—3	3+
334	2	497	+77	55	11	367	+10			3
Own	2			55	25			353	—4	3—
003	3	471	+119	55	12	416	+15			3+
Pooled	3			55	65			379	—2	3+
420	3	528	+115	57	26	443	+19			3+
Pooled	3			57	128			420	—4	3+
329	4	409	—11	55	27	419	+8			3+
Own	4			55	24			402	—9	3+
329	4			56	28	396	+17			2—
Own	4			56	22			358	—21	3+
54	5	390	—52	56	6	375	+8			3
Own	5			56	28			365	—2	3
522	6	407	—35	57	19	327	+2			3+
Pooled	6			57	77			324	—1	3
531	7	453	+11	57	24	375	+23			3
513	7	401	—41	57	25	335	—17			3
Own	7			57	27			348	—4	3
536	8	416	—26	57	23	426	+11			2—
Own—1	8			57	26			429	+14	3+
Own—2	8			57	21			403	—12	2—
Own—3	8			57	27			411	—4	3+
Own—4	8			57	4			360	—55	3—
Average		443	+19.2				+9.1		—9.7	

*1—Fancy; 2—Choice; 3—Good; 4—Medium; 5—Cull.

Table 4. Relation of Progeny Weaning Weight to Weaning Weight of Sire

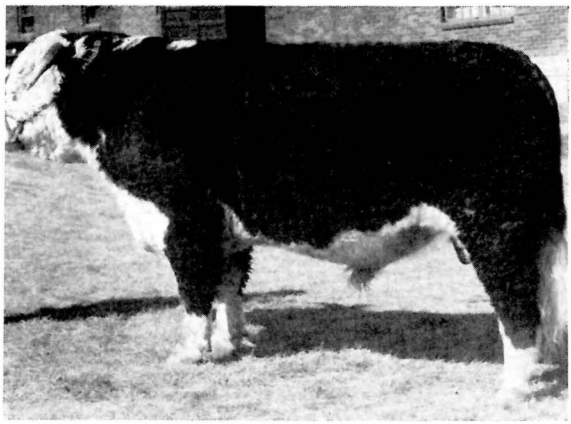
Bull No.	Ranch	Own Weaning Weight	Dev. from Herd Average	Performance of Offspring			
				Year	No. Calves	Average Weaning Weight	Dev. from Herd Average
329	4	409	—11	1957	25	392	+1
527	4	405	—37	1957	22	390	—1
540	5	463	+21	1957	13	404	+36
54	5	390	—52	1957	20	345	—23
531	7	453	+11	1957	24	375	+23
513	7	401	—41	1957	25	335	—17

additional data on rate of gain and conformation are obtained during the post-weaning period.

Since the field testing project was initiated weaning weight information has been obtained on calves from 12 Experiment Station bulls on eight farms or ranches. Post-weaning rate-of-gain and conformation records have been obtained in only three herds. The extent of post-weaning information available varies with the breeders usual method of handling his cattle but more of the current and future field tests will yield comparisons on post-weaning as well as weaning records.

A comparison of performance-tested bulls with non-tested bulls with respect to weaning weight is presented in table 3. The Experiment Station bulls are listed by number, along with their adjusted weaning weights and the deviation in pounds from the herd average. The adjusted weaning weight of the tested bulls ranged from 390 pounds, 52 pounds below the 1954 herd average, to 528 pounds, 115 pounds above the 1953 herd average, with all bulls averaging 19 pounds larger than the average of the groups from which they came. Average adjusted weaning weights of the offspring, both from the performance-tested bulls and from the non-tested private bulls, are given on the right side of the table. In general the bulls that were performance-tested and whose adjusted weaning weights were near or above the herd average produced calves that were heavier at weaning than did the bulls whose performance records were unknown. Over the three-year period at all eight farms or ranches, 211 calves from tested bulls averaged 19 pounds heavier at weaning than did 485 calves from non-tested bulls.

In 1956 two performance-tested bulls were leased to each of three cooperators affording an opportunity to make comparisons between two tested bulls. A comparison of bulls with good weaning weight records and bulls with low weaning weight records is presented in table 4. In each case the bulls with the highest weaning weight produced calves that were



This is the foundation herd sire of Line 2 as a 2-year-old.

heavier at weaning. In two herds the differences between sires in weaning weight were large; similarly the weaning performance of the offspring showed considerable differences. In the remaining herd, the sire differences were quite small and subsequently the differences in the weaning performance of the offspring were small.

Post-weaning rate-of-gain and conformation records will be obtained in five herds and weaning records will be taken in eight herds during 1958. The field testing work will be continued and each year a few bulls will be available to livestock producers who are interested and wish to cooperate on the project. The available bulls will be placed through County Extension Agents and Extension Animal Husbandmen.

In addition to the testing outlined here, the lines are being compared with inbred lines produced in other states. This year, 1958, will be the fourth year in which bulls raised at the Antelope Range Station have been used at the Fort Robinson Beef Cattle Research Station. Two bulls from Line 2 have been sent to the Nebraska station each of the first 3 years. In 1958 two bulls from Line 1 will be used at the Fort Robinson Station. These bulls, along with bulls from lines in other states, will be bred to a random group of grade cows and their offspring will be evaluated on the basis of range, feed lot, and carcass characteristics. The Ohio Agricultural Experiment Station has purchased four bulls raised at the Antelope Station to be used in a similar comparison with bulls from Oklahoma and Nebraska. From the 12 bulls originally tested, they will select two on the basis of the carcass merit of their offspring.

Two bulls at the Station are shown here using a cable-type backrubber. The backrubbers used at the Station are effective in controlling flies.

Short-Term Objectives

The dwarf problem has been studied in the Antelope Range herd and the work will continue. Dwarf calves have been produced in Line 2 and although none of the other lines have produced dwarf calves, they are not as yet considered free of the dwarf gene. Selection pressure is being applied against this characteristic, but this is an extremely slow process, compared to dispersing and replacing with pedigree clean cattle. In the meantime these cattle provide excellent opportunity to test new techniques developed to distinguish between the clean animal and the animal that carries the dwarf gene.

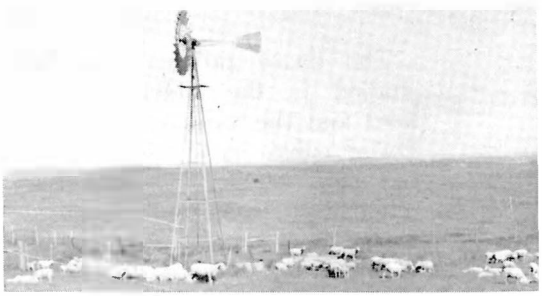
Among the shorter-term studies connected with the Antelope Range cow herd is the fertility testing phase. Semen evaluation studies have been conducted on the 1955 and 1956 bull calf crops. Pregnancy palpation of a portion of the cow herd was initiated in 1957 and if the results are satisfactory this phase will be expanded in future years. Inbreeding in plants and other animals has usually resulted in lowered fertility. These present studies should enable us to measure any lowering of fertility and determine whether there are differences between blood lines in this respect.

Another short-term project which was recently completed and published in the 1957 Fall issue of *South Dakota Farm and Home Research* was a study of the effect of color on feed lot performance of Hereford cattle. This study yielded no evidence to establish a difference in rate of gain, feed per hundred pounds of gain, or final condition among the different colored Herefords on test. Light- and dark-colored Herefords performed equally well in the feed lot test. The bull calves from the Antelope Range Station made up a large part of the cattle used in these trials.

In addition to the above studies, analyses of the data have provided information immediately useful to breeders using performance testing in their herds, whether it be on weaning weights, rate of gain, conformation, or a combination of any of these. This phase of the work is a continuing one and there are constantly more questions and problems arising than there is time to analyze the data and obtain answers. Improved methods in record of performance breeding will come from such data analyses. Since no one experiment station can possibly study all the problems involved, the new information and improvements will be accumulated through individual studies in many states and through cooperative studies between states. The beef breeding research work has been organized on a regional basis to make possible these studies, and South Dakota is cooperating with the North Central Region on methods of breeding improvement in beef cattle.

Winter Feeding and Summer Grazing

Studies With Sheep



Ewes "shading-up" around water supply during the heat of the day. The pasture is lightly grazed.

RANGE SHEEP OPERATORS in western South Dakota use various methods of protein supplementation during the winter. Seasonal and year to year changes in the nutritive content of the native forage, climatic conditions, and age and condition of the ewe are the primary considerations which control the amount and kind of protein supplement required. Furthermore, the availability and cost of protein supplements must be weighed by the ranch operator before deciding on the proper supplement to be fed during any winter season.

A study was begun in November 1951 to obtain basic data about some of the problems confronting range sheep operators in western South Dakota. Various methods of winter supplementation were combined with four types of summer grazing management to test the effects of these management practices on ewe production and on the vegetation and soils.

Four hundred range ewes of mixed breeding were allotted at random into four permanent groups of 100 ewes each for the winter feeding tests. Each of these groups was equally subdivided into four bands for the summer grazing study. Age, weight, and fleece production were considered when the ewes were allotted to the groups. In reality then, there were 16 separate groups of ewes on varied winter feeding and summer grazing treatments.

Within each group, the age of the ewes ranged from 2 to 7 years. All ewes are double ear tagged and complete records are kept of the production of each ewe. Ewes are weighed every 30 days throughout their life and at lambing, and lambs are weighed at birth and every 30 days through weaning.

Each ewe remains in its allotted group and is not removed until 7 years old or upon death. Exceptions to this rule are ewes which are culled because of serious defects such as a bad udder, rupture, broken leg, or blindness. Ewes have not been culled on type or production since these are measures of the experimental treatments.

Ewe lambs are saved from each winter-summer combination and used for replacements in the same group in which they were born and raised. They are not placed into their respective treatments until about 18 months of age.

Winter Treatments

From about November 1 through lambing the ewes are grazed as a band on a deferred winter range in excellent condition. They are cut four ways each day except Sunday (double portions are fed on Saturday) and fed the following supplements:

Lot 1—0.33 pound of 40% protein supplement winterlong (0.20 pound per head was fed in 1951-52, 1952-53, and 1953-54).

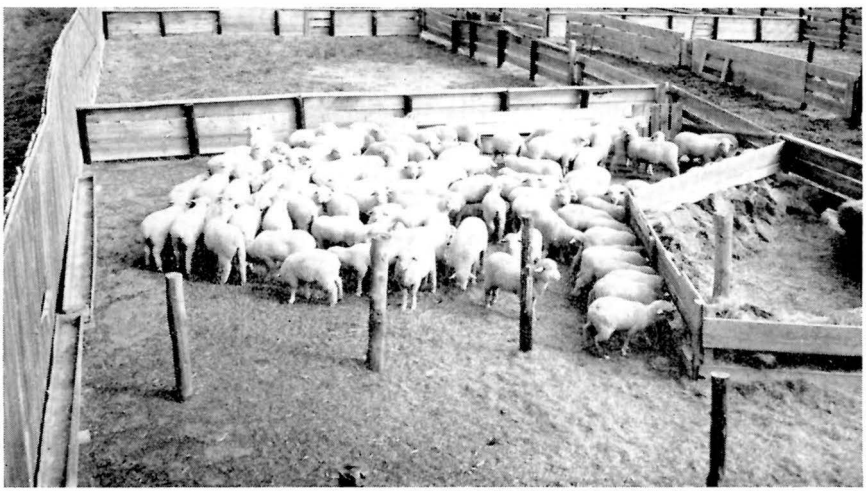
Lot 2—0.33 pound of 20% protein supplement winterlong (0.20 pound per head was fed in 1951-52, 1952-53, and 1953-54).

Lot 3—0.33 pound of 40% protein supplement the last 6 weeks of pregnancy only (0.20 pound per head was fed in 1951-52, 1952-53, and 1953-54).

Lot 4—0.66 pound of 20% protein supplement winterlong (0.40 pound per head was fed in 1951-52, 1952-53, and 1953-54).

Two and one-half pounds of prairie hay are fed per head daily to all lots when snow-cover limits grazing. Ewes are bred as a band to rather uniform polled Rambouillet rams and are shed-lambed in April. They receive no special lambing ration, but all lots are fed alike until placed in fenced summer pastures from about May 1 through November 1.

Replacement ewe lambs are shown here in October 1957. These ewes will be used in the same lots in which they were born and raised, replacing aged and cull ewes in November 1958.



Summer Treatments

Summer treatments are:

Lot 1—Light grazing season-long (0.87 acre per ewe per month).

Lot 2—Moderate grazing season-long (0.68 acre per ewe per month).

Lot 3—Heavy grazing season-long (0.42 acre per ewe per month).

Lot 4—Moderate grazing, rotated every 6 weeks in a four-unit pasture (0.68 acre per ewe per month). The moderate rotation flock was rotated weekly 1952-55. In 1956 and 1957 it was rotated in the four-unit pasture every 6 weeks.

Well water, trace-mineralized salt, and a dicalcium phosphate-salt mineral mixture are available throughout the year. Ewes are sheared in early June each year and lambs are weaned in late September.

Previous studies at other experiment stations have shown that a flushing treatment during the prebreeding (15 to 20 days before breeding) and breeding seasons results in higher conception rates, in larger lamb crop percentages, and a greater number of twins.

To test the effect of a flushing treatment in this study the 100 ewes in the moderately grazed rotation pasture were equally divided into two groups of 50 ewes in October 1956. One group received two-thirds pound ground corn and one-third pound of 40% protein supplement per head per day for 32 days prior to breeding (October 4 to November 6). The other group was used as a control and both remained on separate units of the rotation pasture. Again in 1957 the same ewes were separated and fed the same ration, but for a period of 41 days (September 26 to November 5). The flushing treatment was not continued into the breeding season because of the difficulty of cutting the ewes more than four ways after the start of the winter feeding treatment. Results from the flushing treatment will not be discussed in this publication, since sufficient data has not been obtained.

Results

Although this study has been in progress for only 6 years, some effects of the winter feeding trials and summer grazing rates are becoming evident. Results for 1953-54 and 1954-55 have been published in *South Dakota Farm and Home Research,* November 1956. Analyses for the data for all the years have not been completely summarized. The discussion that follows deals only with preliminary indications and further study is needed to definitely establish the facts.

Winter Ewe Gain

At the start of the winter feeding period in November 1954, the amount of supplement was increased in all the lots. Ewe gains from the beginning of winter feeding until 1 to 24 hours after lambing have been largely proportional to the rate of supplementation. Ewes fed the greatest amount of supplement have maintained their

weight better than ewes not fed a supplement until 6 weeks before lambing.

The ewes from the heavily-grazed summer pasture have not lost as much weight during the winter as those from the lightly- or moderately- grazed pastures because they entered the winter in poorer condition (table 1). Furthermore, they have been in poorer condition at lambing.

Summer Ewe Gain

Yearly differences, as well as seasonal differences, have resulted in varied ewe weight gains during the summer grazing period.

Ewes on the heavily-grazed pasture have made the lowest gains during the summer (table 1). In 1956, the ewes under heavy grazing gained about 8 pounds less than ewes under light grazing. In 1957 the ewes on all rates of grazing gained considerably less than in 1956, despite a good forage year. This difference in summer weight gain may be due to a high lamb mortality before May 1 in 1956 which resulted in fewer lambs on all pastures throughout the summer and at weaning. In 1956, only 368 lambs were weaned from all the summer grazing treatments, while 389 were weaned (yet fewer ewes bred) in 1957.

Fleece Weight

Fleece weights have shown a general increase since the experiment began, probably due to the improvement of the entire band through the use of high-quality rams.

Winter feeding treatment appears to have the greatest influence on fleece weights. The effect of winter treatment is shown in table 2. Lot 4 ewes, which are fed the greatest amount of supplement, have had the heaviest fleeces, while

Table 1. Effect of Summer Grazing Intensity on Ewe Weight Changes During Winter (November through Lambing) and Summer (Lambing through Weaning) 1954-57

Year		Summer Grazing Treatment			
		Light Grazing Seasonlong	Moderate Grazing Seasonlong	Heavy Grazing Seasonlong	Moderate Rotation Grazing
		Average Weight Gains and Losses, Pounds			
1954	Winter	—15.3	—17.9	—14.3	—16.4
	Summer	12.9	13.2	13.1	11.5
1955	Winter	—5.5	—5.4	—3.0	—5.2
	Summer	11.6	10.7	6.4	8.6
1956	Winter	—14.4	—1.5	—1.7	—12.1
	Summer	25.2	15.1	16.9	18.7
1957	Winter	—7.9	—5.9	—3.3	—5.7
	Summer	7.0	4.5	1.3	—1.3
Average	Winter	—10.8	—7.7	—5.6	—9.8
	Summer	14.2	10.9	9.4	9.4

Table 2. Effect of Winter Feeding Treatment on Ewe Fleece Weights, 1952-57

Year	Winter Feeding Treatment			
	Lot 1	Lot 2	Lot 3	Lot 4
	Av. Grease Fleece Wt., Lbs.			
1952	9.3	9.5	9.5	10.0
1953	9.9	10.6	10.0	10.7
1954	9.0	9.0	8.7	9.4
1955	10.1	9.9	9.4	10.7
1956	10.0	10.1	9.6	10.8
1957	11.3	11.1	10.7	12.0
Average	9.9	10.0	9.6	10.6

ewes not fed any supplement until the last 6 weeks of gestation (lot 3) have had the lightest fleeces. Summer grazing treatment has not greatly affected fleece weights, although ewes on the heavily-grazed pasture have had much dirtier fleeces than those on the other summer treatments.

Lamb Crop

A comparison of the winter treatments indicates that ewes fed the greatest amount of supplement (lot 4) have had the largest lamb crop with the best survival rate (table 3). Ewes on the lightly-grazed pasture have had a greater lamb crop born and weaned than ewes on the heavily-grazed pasture (table 4).

Birth Weight

Birth weights do not seem to be greatly influenced by summer grazing treatment, and winter feeding treatments have shown only a slight effect. Greater differences due to both summer and winter treatments may become more evident as the study continues.

Weaning Weight

The winter treatment has had a negligible effect on lamb weaning weights, whereas summer grazing treatment apparently plays a large part in determining weaning weights of lambs. Average weaning weights of lambs by summer grazing treatment are presented in table 5. Ewes on the lightly- and moderately-grazed pastures have consistently weaned heavier lambs than those from rotation or heavy grazing. In 1956, ewes on light grazing weaned lambs that weighed 88 pounds, while ewes on heavy grazing weaned lambs of only 75 pounds. In 1957, the weaning weights of lambs from the lightly- and moderately-grazed pastures were again greater than those from the heavily-grazed pasture and considerably greater than those from the moderately-grazed rotation pasture. Over the 6 years of the study, lambs from the heavily-grazed pasture have weaned 6 pounds lighter than those from the light and moderate grazing treatments, but about 3 pounds heavier than those from the moderately - grazed rotation pasture.

Weaning weights in 1957 were lighter than in 1956 in all grazing treatments. The average total and average seasonal rainfall in 1957 was considerably greater than in 1956. However, high temperatures in mid-summer of 1957 caused ewes and lambs to graze less than normal and they appeared to "shade-up" for the greater part of the day. As a result milk production probably decreased and the lambs apparently

did not gain as they should have, but they appeared to be in good condition at weaning.

In addition, other considerations must be viewed. First, there was a higher lamb mortality rate in 1956 than in 1957, especially between lambing and the start of the pasture season (about May 1). Table 4 indicates that the lamb crop weaned was higher for all grazing rates in 1957 than in 1956 despite the fact that the lamb crop born was higher in 1956. Consequently, there were fewer lambs on all grazing treatments during the 1956 pasture season. This difference has been emphasized previously with regard to its affect on ewe summer gains, but also applies to lamb weaning weights. Finally, the weaning age of the lambs in 1956 was somewhat greater than in 1957. In 1956 the lambs were not weaned until Octo-

Table 3. Effect of Winter Feeding Treatment on Lamb Crop Born and Weaned, Percent of Ewes Bred, 1954-57

Year		Winter Feeding Treatment			
		Lot 1	Lot 2	Lot 3	Lot 4
1954	Born	124.0	119.0	116.0	130.0
	Weaned	92.0	88.0	85.0	103.0
1955	Born	119.0	123.8	124.4	125.2
	Weaned	98.0	87.3	95.1	102.1
1956	Born	125.0	125.0	118.0	140.2
	Weaned	91.0	96.0	72.0	110.1
1957	Born	123.1	121.4	118.7	121.3
	Weaned	104.1	104.3	99.2	110.7
Average	Born	122.8	122.3	119.3	129.2
	Weaned	96.3	93.9	87.8	106.5

Table 4. Effect of Summer Grazing Intensity on Lamb Crop Born and Weaned, Percent of Ewes Bred, 1954-57

Year		Summer Grazing Treatment			
		Light Grazing Seasonlong	Moderate Grazing Seasonlong	Heavy Grazing Seasonlong	Moderate Rotation Grazing
1954	Born	131.0	121.0	116.0	121.0
	Weaned	100.0	86.0	95.0	87.0
1955	Born	130.0	117.0	123.0	122.4
	Weaned	104.0	87.0	94.0	97.5
1956	Born	128.3	134.0	115.0	131.0
	Weaned	85.9	97.0	87.0	99.0
1957	Born	128.6	117.2	115.2	123.0
	Weaned	108.2	101.0	105.4	101.0
Average	Born	129.5	122.3	117.3	124.3
	Weaned	99.5	92.7	95.3	96.1

This picture shows the heavy utilization of silver sagebrush on heavily-grazed pasture. Few, if any, live sagebrush plants remain in this pasture.

Although utilization of this bottom site near water is generally heavy, one grass species, prairie sandreed, is not grazed at all, showing the preference of sheep for certain grasses.

ber 4, while in 1957 they were weaned on September 25.

Production differences of ewes on the various summer grazing treatments are shown in table 6. The ewes on the light grazing treatment have produced about 5 pounds more lamb per ewe bred than the ewes on the moderate grazing treatment (lot 2) over the 6 years of the study. Moreover, the lightly-grazed pasture out-produced the heavily-grazed and moderately-grazed rotation pastures by 8 and 11 pounds, respectively, over the same period. Although all lamb weaning weights were higher in 1956 than in 1957, there were more pounds of lamb weaned per ewe bred on both the light and heavy grazing treatments in 1957. If weaning weights were adjusted to a standard age undoubtedly the lamb weight weaned per ewe bred in 1957 would surpass that of 1956.

Effects of Summer Grazing on the Vegetation

After 6 years of various grazing treatments it is evident that the heavily-grazed pasture has continually decreased in forage production. Under heavy grazing the important midgrasses have decreased in abundance and the shortgrasses and annual weeds have increased. Moreover, silver sagebrush has been almost entirely killed out due to grazing pressure. The mulch layer has also been reduced and soil erosion is evident.

Under moderate continuous grazing certain areas are decreasing in forage production, while

Table 5. Effect of Summer Grazing Intensity on Actual Weaning Weights of Lambs, 1952-57

Year	Summer Grazing Treatment			
	Light Grazing Season-long	Moderate Grazing Season-long	Heavy Grazing Season-long	Moderate Rotation Grazing
	Average Weaning Weights, Pounds			
1952	80.1	83.4	75.4	72.4
1953	75.4	76.4	73.6	71.0
1954	75.3	72.8	69.9	67.7
1955	79.2	78.0	71.2	70.1
1956	87.6	83.6	75.3	74.9
1957	74.0	76.8	69.5	63.2
Ave.	78.3	78.3	72.3	69.7

under moderate rotation grazing the range appears to be improving. In both of these pastures the mulch layer and forage cover seem adequate to prevent any appreciable erosion.

Range condition and forage production have been higher under rotation than under continuous grazing at the same stocking rates. However, lamb production from the rotation pasture has been poorer than from the continuously-grazed pasture. Lower weaning weights of lambs from the moderately-grazed rotation pasture probably have been due to reduced milk flow of the ewes caused by interrupting the grazing of regrowth vegetation.

The lightly-grazed pasture has been judged to be in excellent range condition. Certain areas in this pasture have declined in forage production due to a reduction of the more palatable forage species. Problem areas of this kind are found in the vicinity of the water tank, on a few ridges, and on one high bedground that is continually used throughout the summer. The mulch layer is quite heavy over most of this pasture and no erosion has been noticed.

Notice the good mixture of grasses and silver sagebrush on this lightly-grazed pasture.

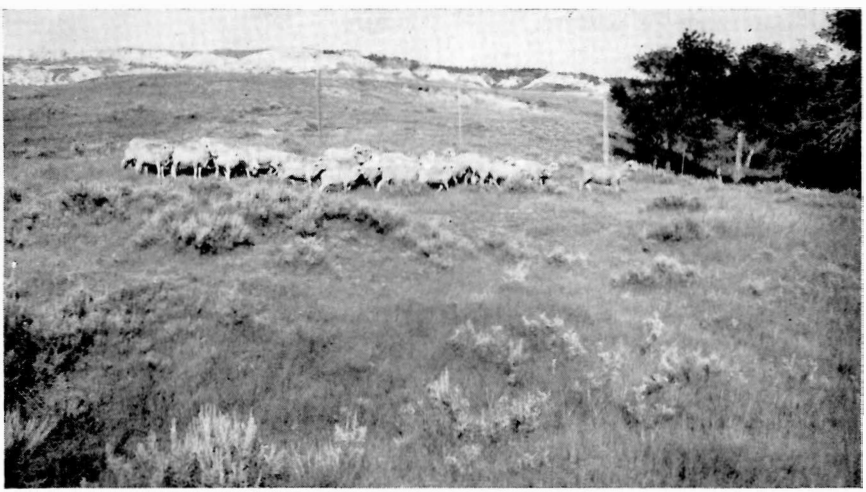


Table 6. Effect of Summer Grazing Intensity on Pounds of Lamb Weaned Per Number of Ewes Bred, 1952-57

Year	Summer Grazing Treatment			
	Light Grazing Season-long	Moderate Grazing Season-long	Heavy Grazing Season-long	Moderate Rotation Grazing
	Pounds			
1952	69.1	68.8	64.1	60.6
1953	74.7	67.3	71.4	64.6
1954	75.3	62.6	66.4	58.9
1955	82.3	67.9	67.0	68.4
1956	75.4	81.1	65.6	74.0
1957	79.2	77.5	73.1	63.6
Ave.	76.0	70.9	67.9	65.0

Problem areas, where the dominant forage plants are repeatedly grazed until they begin to disappear, are commonly found on many sheep ranges throughout Western South Dakota. Sheep are selective grazers and tend to seek out only the most palatable and choice forage. This is especially true when there is a variety and abundance of forage available, such as on a top condition range or pasture.

Sheep in the continuously-grazed pastures are "spotty grazers;" that is, they have a tendency to return to the same area to graze the regrowth rather than to graze older, more fibrous growth nearby. After grazing, grass regrowth is known to be higher in protein than ungrazed, old growth. Under rotation grazing a lower protein diet is probably consumed because of a lack of regrowth. When ewes are moved frequently under a rotation system, the disturbance of their routine may also have an effect on their production.

Intensive studies of the vegetational changes, annual and seasonal forage production, and nutritive differences in the vegetation under the various grazing systems have not been conducted. Observations and estimates have been made in most years of the study. More intensive studies of the quality and quantity of vegetation produced and consumed under the various treatments are planned for the future.

Some of the sheep on lightly-grazed pasture. Vegetation on this flat is utilized more than on other, more favorable sites in the pasture. However, notice the old trail is being revegetated, indicating improving range condition.

Parasites in Sheep

BETWEEN 1937 and 1945 many lambs were lost from diarrhea in several counties in Northwestern South Dakota. Many other lambs were light in weight and could not be sold either as market or feeder lambs. This trouble first appeared in July each year and usually continued until the lambs were removed from the range in September or October. The diarrhea did not affect the ewes. On the basis of symptoms and seasonal occurrence, sheepmen blamed internal parasites.

Field observations and studies of this problem were started in 1944 and continued in 1945 and 1946 from a temporary field laboratory at the Newell station. During this time it became evident that lamb losses were mainly associated to faulty management practices. It has long been recognized that management has an important bearing on the acquisition of internal parasites and the injury which will result from worm infestations. By 1945 the sheep population and also the incidence of the diarrhea in lambs had markedly declined.

Establishment of range studies at Antelope Range Field Station offered an opportunity to obtain information on trends in worm infestations throughout the year. From 1950 to 1954 particular attention was given to comparisons of parasite infestations acquired by sheep on different levels of grazing. A number of determinations were also made of parasites of cattle maintained at the station.

During 1947, 1948, and 1949, before pasture fences were completed, the sheep were run together as a single flock. At approximately monthly intervals, fecal samples were collected from 5 to 10% of the ewes and lambs. Examination of these specimens for parasite eggs showed certain trends in the parasite levels for different times of the year.

During the winter a low level was found in the ewes. In the spring, with the appearance of warmer weather, an increase in the worm load occurred, reaching a peak in May or June. In the next month a sharp decline had again occurred. A second but more moderate rise in the number of worm eggs developed in the ewes during the summer, followed by a decline during the fall to the low level maintained during winter months.

At the time of the peak load of parasites in ewes in the spring, the lambs had not yet acquired an infestation. The first appearance of worm eggs in specimens from lambs occurred in late June or early July. The peak was reached in July or early August, followed by a decline in later samples.

The periods of the year when highest and lowest levels of infestation were detected in ewes and lambs in this flock were the same as had been determined in private-

ly owned flocks in that area of the state.

During 1948 and 1949 fecal specimens from cattle at the station were also examined for parasite eggs at monthly intervals. No significant degree of infestation was found but the highest average number of eggs was obtained in April and May.

Starting with the 1950 grazing season, after fencing had been completed, pastures accommodating 100 ewes with their lambs provided grazing areas at three different levels:

Lot 1, low level, 580 acres
Lot 2, moderate level, 410 acres
Lot 3, high level, 254 acres

A fourth pasture containing 408 acres (lot 4) was cross fenced to provide four smaller pastures of equal size for weekly rotation. A fifth pasture of 936 acres (lot 5) was stocked with 100 ewes with their lambs and 25 cows. After 2 years lot 5 was discontinued.

The course of parasite infestations in the ewes and lambs of these lots was followed during the grazing seasons by parasite egg counts in fecal samples from 10% of the animals at 28 to 30 day intervals. A similar sampling of the cattle in lot 5 was carried out while they were included in the experiment.

Through each of the five grazing seasons from 1950 to 1954 the infestation in the ewes followed the same pattern. In 1950 and 1951 the lambs on a weekly rotation in the four small pastures reached a higher level of infestation than those of the other lots. In 1952, 1953, and 1954, the highest level of infestation was reached by the lambs in lot 3 on a high grazing level, with those of lot 4 at the next highest. The average egg counts obtained in 1952, 1953, and 1954 are shown in tables 1, 2, and 3 respectively.

No treatments for the removal of worms were given the ewes or lambs at any time during these studies. Even so, exceptionally heavy worm infestations did not develop in any of the lots. None of the lambs developed diarrhea, and there was no definite correlation between lamb weight and degree of worm infestation based on the egg counts obtained. The fact that the lambs of lot 4 on rotation at weekly intervals reached higher levels of infestation than those on free grazing on equal acreage was not surprising. A period of 21 days that any one of the small lots was vacated does not allow time for contaminating worm larvae to be destroyed by natural factors.

Samples collected from the cattle of lot 5 in 1950 and 1951 demonstrated a very low level of parasite infestation. The egg counts did not average any higher than counts in samples from cattle pastured separately from sheep at the station.

In the examination of the fecal samples, an attempt was made to identify the different kinds of worm eggs. The eggs of the common stomach worm, *Haemonchus contortus*, predominated. The eggs of tapeworms were not included in the total counts but the presence of their eggs was noted. At one or more samplings during the summer

82.6, 86.5, and 81.2% of the lambs in 1952, 1953, and 1954, respectively, were eliminating tapeworm eggs.

On the basis of these observations, recommendations can be made regarding the time that the administration of treatment to sheep for removal of worms would be most effective. Since parasite infestations are at a very low level during the winter, treatment of ewes during that period can be expected to accomplish little towards a year-round control program.

Table 1. Average Total Parasite Egg Counts of Ewes and Lambs on Different Grazing Levels, 1952

Date	Eggs per Gram Feces							
	Light Grazing Lot 1		Moderate Grazing Lot 2		Heavy Grazing Lot 3		Weekly Rotation Lot 4	
(1952)	Ewes	Lambs	Ewes	Lambs	Ewes	Lambs	Ewes	Lambs
6-5	1160	7	1100	95	1025	207	820	32
7-1	950	57	1213	38	1059	12	1150	12
7-29	743	290	272	181	251	290	530	205
8-26	506	262	201	293	389	448	455	239
9-23	414	226	208	257	136	230	213	263

Table 2. Average Total Parasite Egg Counts of Ewes and Lambs on Different Grazing Levels, 1953

Date	Eggs per Gram Feces							
	Light Grazing Lot 1		Moderate Grazing Lot 2		Heavy Grazing Lot 3		Weekly Rotation Lot 4	
(1953)	Ewes	Lambs	Ewes	Lambs	Ewes	Lambs	Ewes	Lambs
6-2	1067		1856		1161		1180	
7-14	243	471	123	1013	402	1831	188	709
8-4	82	1131	80	1063	237	1941	544	1480
9-1	90	545	59	953	91	561	101	582

Table 3. Average Total Parasite Egg Counts of Ewes and Lambs on Different Grazing Levels, 1954

Date	Eggs per Gram Feces							
	Light Grazing Lot 1		Moderate Grazing Lot 2		Heavy Grazing Lot 3		Weekly Rotation Lot 4	
(1954)	Ewes	Lambs	Ewes	Lambs	Ewes	Lambs	Ewes	Lambs
5-3	993		1038		1794		1041	
6-3	1111		1246		2873		1667	
7-6	56	36	98	26	97	141	371	266
8-3	503	948	636	1242	354	1035	795	1455
9-1	196	700	386	658	289	1606	468	1165
9-20	294	722	746	973	297	1783	418	840

Because of the increased infestation in spring months, individual treatment of ewes just prior to turning to summer range should greatly reduce pasture contamination. If the flock has been kept off summer range during winter and spring, pastures should then be relatively clean for the start of grazing. With sufficient summer range so that it is not overgrazed, infestations in lambs would generally not develop to a degree requiring treatment.

Should factors such as limitation of range, failure to treat the ewes, or spring contamination of range occur, it may become necessary to treat the flock during the summer. The time of that treatment should be during the rapid rise in the infestation of the lambs in early July.

While rainfall, plant growth, and perhaps other factors vary from year to year, the observations reported here indicate that at least 4 acres of native pasture to the ewe and lamb are necessary for summer range in the region of this station. With less acreage, the chances of harmful worm infestations are increased.

A representative group of ewes that were used in the grazing level trials at Antelope Range Field Station. These ewes are being weighed and fecal specimens collected.