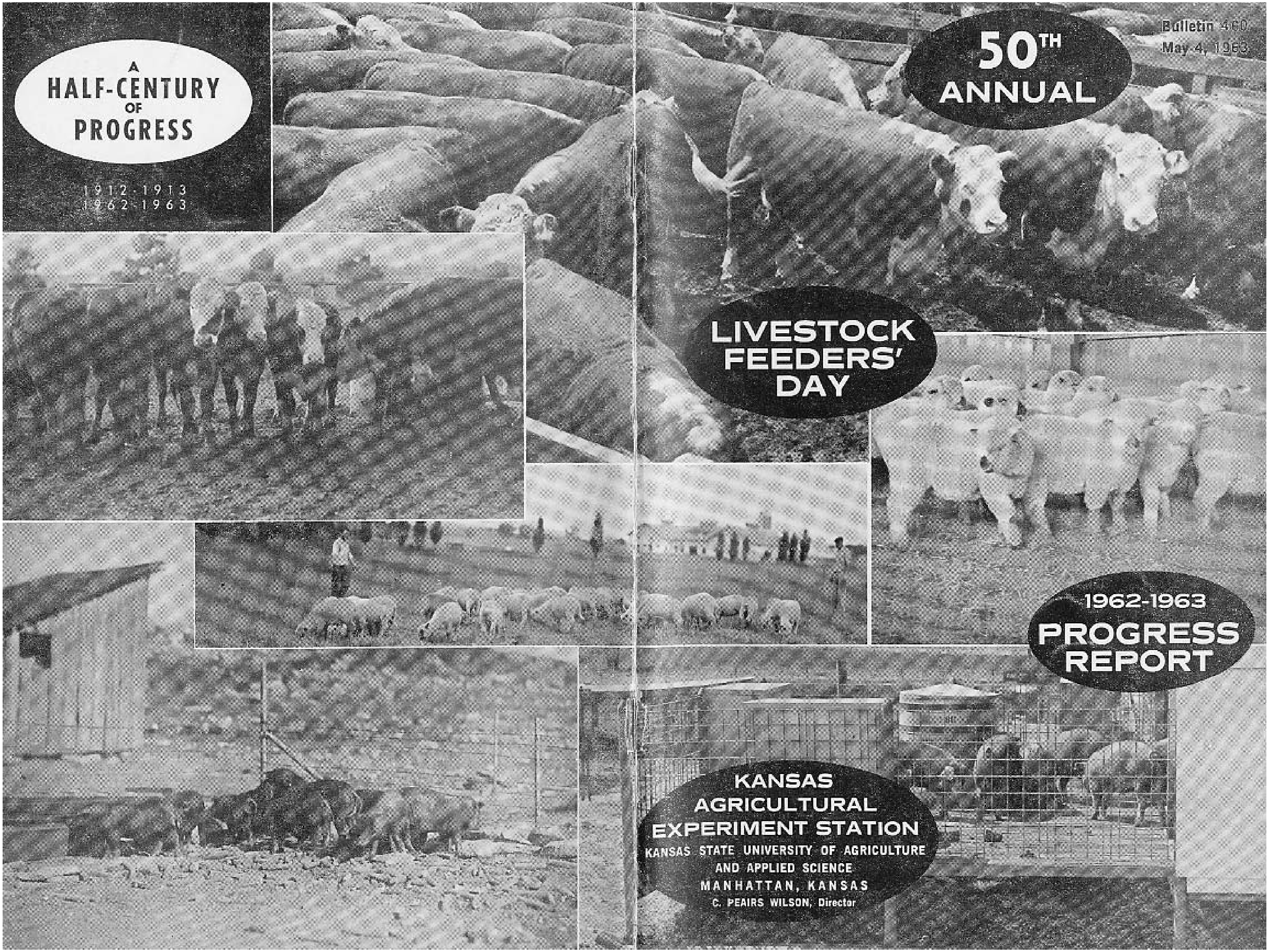

A HALF-CENTURY OF PROGRESS

1912-1913
1962-1963

Bulletin 460
May 4, 1963

50TH ANNUAL

LIVESTOCK FEEDERS' DAY

1962-1963 PROGRESS REPORT

KANSAS AGRICULTURAL EXPERIMENT STATION
KANSAS STATE UNIVERSITY OF AGRICULTURE AND APPLIED SCIENCE
MANHATTAN, KANSAS
C. PEAIRS WILSON, Director

CONTENTS

(HALF CENTURY OF PROGRESS)

50th Annual Livestock Feeders' Day

KANSAS STATE UNIVERSITY
MANHATTAN, KANSAS

Saturday, May 4, 1963

8:00 a.m.—Livestock in arena for visitors' inspection and comparison.

10:00 a.m.—Animal Husbandry Arena, Announcements, R. F. Cox.
Presiding—Taylor Jones, Garden City, President, Kansas Livestock Association.

10:00 a.m.—Contributions of Research to the Livestock Industry, Dr. Arthur D. Weber, Vice President, Kansas State University.

Summaries of Fifty Years of Livestock Research

Staff—Animal Husbandry Department, Kansas State University.

10:30 a.m.—Animal Breeding, Walter H. Smith

10:50 a.m.—Meats, D. L. Mackintosh

11:20 a.m.—Animal Nutrition, D. Richardson

12:00 noon—Lunch, Arena

1:30 p.m.—Awards to Livestock Producers.
Tommy Benton, Agricultural Commissioner, Chamber of Commerce, Kansas City; and Extension Animal Husbandry staff.

1:50 p.m.—Livestock Management, 50-year Summaries (Continued), Animal Husbandry staff
Swine—Berl A. Koch
Sheep—Carl S. Menzies
Type Selection—Don L. Good
Beef Cattle—Ed F. Smith and Fred W. Boren

3:00 p.m.—Adjournment

6:30 p.m.—Banquet for visiting stockmen and ladies, Kansas State Union, by Block and Bridle Club

Honoring—James B. Hollinger
Johnson Workman (Deceased)

KANSAS STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
MANHATTAN
C. PEAIRS WILSON, Director

FOR THE LADIES

Friday, May 3, 1963

6:30 p.m.—Dinner, Gillett Hotel. (Make reservations with Mrs. R. F. Cox, 421 Edgerton, Manhattan.)

Presiding—Mrs. N. V. Hudelson, Pomona, President, Kansas Cow Belles.

Saturday, May 4, 1963

9:00 a.m.—Coffee, Justin Hall (Home Economics Building) Animal Husbandry Ladies

10:30 a.m.—Food Preparation Demonstrations, Foods and Nutrition Class in Principles of Food Demonstration. School of Home Economics, Kansas State University.

12:00 noon—Lunch, Animal Husbandry Arena.

6:30 p.m.—Block and Bridle Banquet (see general program).

*From 8-10 a.m.—Livestock will be in pens in the arena for visitors' inspection and comparison.

PROGRESS IN ANIMAL NUTRITION

D. Richardson

Not one nutrient has been created, yet tremendous progress has been made in the relatively new field of animal nutrition, primarily by scientific investigations that have more clearly defined nutrient needs and interrelationships in the animal body and more knowledge of nutrient content and availability in various feedstuffs. Contributions also have been made by improved feedstuff preparation, animal breeding, management, and disease control.

Modern systems of livestock production tend to remove animals from nature's environment and place them in man-made environment to obtain greater economic returns. This necessitates greater care in formulating rations to meet nutrient requirements.

Feed is stored nutrients. By the process of digestion, feed is broken down to its constituent nutrients such as amino acids, simple sugars, fatty acids, minerals, and vitamins, to be absorbed and used in the body. Best ration formulation is accomplished by knowing the nutrient needs of the animal, the availability of nutrients in feedstuffs and combining feedstuffs so they supply the required nutrients. Meeting the nutrient needs of animals efficiently results in greater economic returns.

A great step forward was made when it was recognized that not all diseases and health problems are caused by infectious organisms. We now know that many disease problems are brought on by nutrient deficiency and some by excessive amounts of certain nutrients. In fact, a properly fed animal may be less susceptible to infectious diseases or at least more likely to make a normal recovery.

Most of the early work with livestock rations was concerned with protein, fat, and fiber. Later, the importance of minerals was recognized. Many deficiencies were observed. Eventually, vitamins and their importance in nutrition were recognized. We now have additives that are not nutrients but exert influences that are normally classed under nutrition.

Protein

Everyone who reads this recognizes the importance of sufficient protein in an animal's ration. However, 25 to 35 years ago a tremendous amount of experimental work was done to convince livestock producers that protein concentrates were needed in swine, poultry, cattle, and sheep rations.

Once the value of protein was established, many probably fed more than was needed. It soon became apparent that the "extra protein" was supplying other nutrients such as minerals and vitamins. With increasing knowledge as to how to "balance a ration," the tendency was to reduce the amount of protein fed. That it cost more than other ingredients was a factor also. The writer feels that the tendency at present is to feed too little protein in many cases.

We recognize that protein is made up of about 24 amino acids. We know that certain amino acids must be supplied for simple-stomached animals like man, pig, and poultry. Those amino acids are the ones that cannot be synthesized in the digestive tract or body in sufficient quantity to meet the normal needs of the animal. The term "essential" amino acids has come to mean the amino acids that must be supplied in the feed. Protein supplying a good quantity of "essential" amino acids is said to have good quality.

Ruminants (cattle, sheep) are not concerned with quality of protein so long as there is sufficient in the ration. Regardless of the kind of

Contribution No. 293, Department of Animal Husbandry; No. 111, Department of Agricultural Engineering; No. 37, Department of Biochemistry; No. 3, Mound Valley Branch Experiment Station; No. 17, Colby Branch Experiment Station; No. 66, Garden City Branch Experiment Station, and No. 831, Department of Agronomy, Kansas Agricultural Experiment Station, Kansas State University, Manhattan.

NOTE: When trade names are used in Kansas State University publications, no endorsement nor criticism of them or of similar products not named is intended.

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protein fed, most of it will be converted to microbial protein in the paunch and then digested in the true stomach and small intestine of ruminants. It is important to recognize that there are nutrients other than protein in ingredients that supply protein. Therefore, one ingredient or supplement that supplies protein may or may not be better than another. The overall nutrient content of a supplement and what is needed must be considered before you decide which one might be best.

Oilseed meals, animal and milk by-products, and legumes are all good sources of protein. The best single ingredient from the standpoint of quality protein is soybean oil meal.

Protein substitutes such as urea and ammonia can be used by cattle and sheep to synthesize protein in the rumen (paunch). This is accomplished by microorganisms (microscopic plants). They use the nitrogen plus readily available energy from grain (plus probably other nutrients) to grow. Protein is produced in their bodies. Later they are digested and make amino acids available to the animal.

Urea should be used only with rations containing 4 pounds or more of grain per day per animal. It is not protein but can be used as a substitute and lower supplement cost if used properly. There is no difference in its value whether used in dry or liquid form.

Fat

It is desirable to have 3 to 3.5% fat in livestock rations. In addition to being an excellent source of energy, fat must be present for best utilization of the fat-soluble vitamins, A, D, E, and K. Most grains contain around 3% fat. Solvent-processed oilseed meals contain very little fat and are less valuable than "old process" meals for feed.

Fats and oils can be added to feed when price does not exceed two or three times the cost of grain. In addition to the energy value, they tend to lubricate machinery, preserve fat-soluble vitamins, reduce dust, and increase palatability, unless the fat is rancid.

Minerals

Minerals have two general functions:

1. Structural: build bones, teeth, and soft tissue like muscle and blood.
2. Regulatory: soluble salts in blood and other tissues affect irritability of nerve and muscle, catalysts, form enzymes, hormones, etc.

Minerals are usually classified as (1) macro (used in greatest amounts): calcium, phosphorus, sodium and chlorine, and (2) micro or trace (used in very small amounts): potassium, sulfur, manganese, magnesium, iron, copper, cobalt, zinc, iodine, etc.

In plants, the forage portion is usually a good source of calcium but not phosphorus. The seed portion is a good source of phosphorus but practically no calcium.

Normal rations generally provide all micro minerals needed. In abnormal rations, like all-concentrate for cattle, probably most of the micro minerals should be added. Small amounts of good-quality legume roughage, like dehydrated alfalfa meal, will take care of micro or trace element needs.

Excess minerals could prove harmful. An example is excess calcium causing parakeratosis in swine.

Vitamins

Vitamins are the latest nutrient discovery. We did not have the word "vitamin" until 1911-12. Yet, much in ancient literature indicates that man and livestock have always been faced with troubles caused by vitamin deficiencies.

Vitamins are classified as (1) fat soluble (A, D, E, and K) and (2) water soluble (C, Thiamine, Riboflavin, Niacin, Pantothenic Acid, Pyridoxine, Inosital, Biotin, Folic Acid, Choline and B_{12}). Perhaps there are other undiscovered vitamins. Vitamins function primarily in the enzyme system.

Vitamin A or its precursor must be fed to all animals. Carotene from

green plants and harvested roughages has been, and still is the main source of vitamin A for livestock. Carotene is converted to vitamin A in the wall of the small intestine. Synthetic vitamin A is now available. Any ration deficient in vitamin A should have additional carotene or vitamin A added to meet the needs of the animal.

Vitamin D aids mineral metabolism and helps prevent rickets. There should be no deficiency so long as animals are exposed to sunlight. Vitamins E and K are supplied in sufficient amounts in the normal ration or are synthesized in the digestive tract.

Ruminants synthesize a bountiful supply of the water-soluble vitamins in the paunch, so there is no reason to supply them. Care must be taken to formulate swine rations to supply these vitamins or add them to the ration.

Additives

Additives are not nutrients but substances added to rations to increase rate of gain, feed efficiency, or in some way aid in more economical production. Some are worth while but some are not worth the space they occupy in a sack of feed. The feed additive business amounts to about $120 million per year.

Stilbestrol. When fed at the rate of 10 milligrams per head daily or implanted at 12 to 36 milligrams, stilbestrol normally increases rate of gain and feed efficiency significantly with steers on a fattening ration. It has little or no value for heifers. Implants for steers on pasture increase gains about 25 to 35 pounds per season. Fattening lambs can be fed 2 milligrams per head daily or implanted with 3 milligrams. Never implant more than 6 milligrams. No breeding animal or swine should receive stilbestrol.

Antibiotics. Certain antibiotics have proved beneficial in livestock rations. The benefit seems to be associated with level of disease present. Aureomycin, Terramycin, or Penicillin fed at the rate of 5 to 10 milligrams per pound of feed in swine-fattening rations has generally increased rate of gain and feed efficiency. Aureomycin and Terramycin at the rate of 15 to 25 milligrams per head daily in lamb-fattening rations tend to prevent overeating. The recommended level of Aureomycin or Terramycin for calves or cattle is 10 milligrams per 100 pounds body weight; however, normally 70 milligrams per head daily are fed. Use of greater amounts would become therapeutic doses and should be supervised by a veterinarian.

Arsenicals. Arsenicals help control certain scours. Follow recommendations on labels closely.

Tranquilizers. Tranquilizers are of no value in livestock rations.

Chemobiotic. Dynafac has produced variable results. Its benefit in rations is doubtful.

Rumen factors. This is a rather vague and somewhat misleading term. Products now on the market are of very doubtful value.

Enzymes. Enzymes are organic catalysts that help break down food in the digestive tract. Theoretically, added enzymes should be of value; however, enzyme preparations available to date have not been consistently of value.

Yeast. Yeast is a good source of water-soluble vitamins for swine and poultry, and the protein has some value. Adding yeast to cattle rations has no value. In fact, it has been harmful in some cases.

Summary

The improvement in practical feeding of livestock today is based on facts obtained from scientific investigations. Further improvement will depend on present and future research.

CHANGES IN TYPE SINCE 1900

Don Good

Beef Cattle

America owes a great deal to the founders of the Hereford, Angus, and Shorthorn breeds of beef cattle, the dominant U.S. beef breeds. Early Scotch and English breeders in developing the beef breeds aimed to breed cattle with superior beef quality. This, by necessity, had to be done under, in many instances, vigorous environmental conditions.

Purebred beef bulls have tremendously influenced improvement of beef cattle over the past 50 to 60 years. They have been primarily responsible for the change from the "Longhorn" to the present-day, prime beef steer.

The Shorthorn breed was the first to be used to improve Longhorn range cattle. Captain King took Shorthorn bulls to Texas when he established King Ranch and the Mormons moved Shorthorn cattle with them when they migrated to Utah from Missouri. These first two attempts to improve range cattle occurred from 1890 to 1900. Later, Hereford cattle were used extensively and played the major role in range cattle improvement. Still later, Angus cattle came to the range country and all three breeds are presently being used to improve market cattle. Now, instead of marketing four- to five-year-old, 1400- to 1800-pound slaughter cattle, we market 800- to 1100-pound choice to prime cattle at the age of 12 to 20 months.

This drastic change altered size and type of cattle from larger, rangier, growthier, rougher, more angular cattle to today's smaller, shorter legged, more compact, higher qualitied, smoother, earlier maturing cattle. Shamrock, the 1902 International Grand Champion Angus steer, weighed 1790 pounds, was three years old and sold for 56¢ a pound. Wood's Principal, a Hereford steer, was Grand Champion at Chicago in 1901.

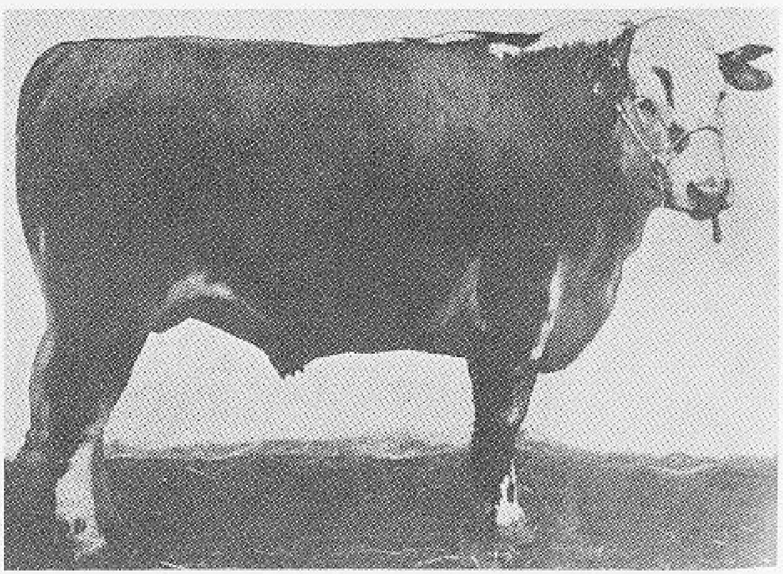

Fig. 1. Champion Hereford Angus crossbred steer, 1903; age, almost 3 years; weight, 1730 pounds. (No carcass information.)

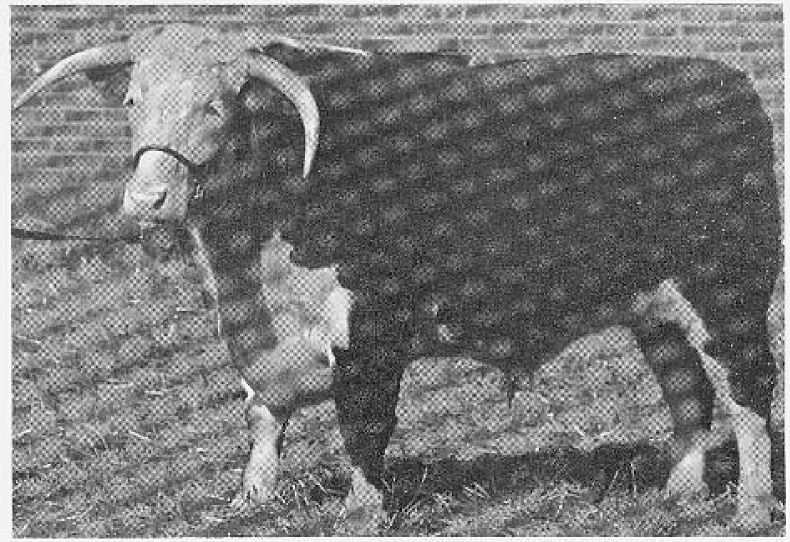

Fig. 2. Champion at many shows, 2-year-old Hereford steer, 1919; weight, 1575 pounds. (No carcass information.)

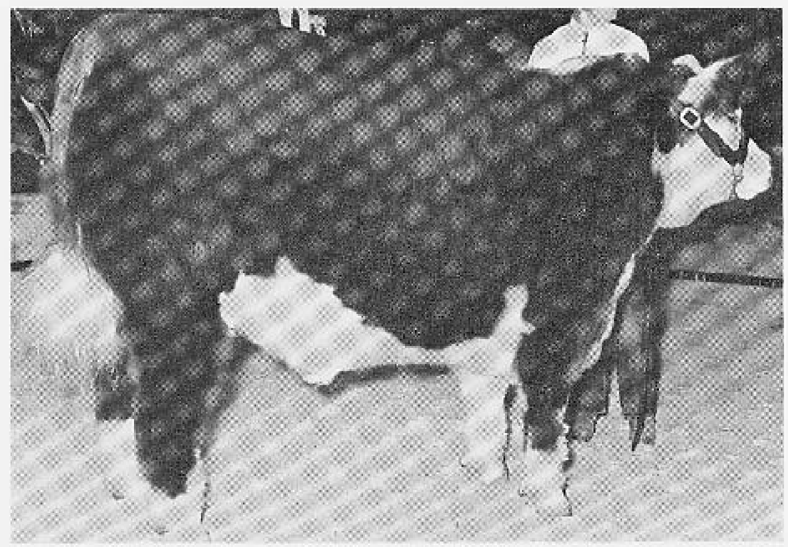

Fig. 3. Champion Hereford steer, 1963; weight, 975 pounds; age, 13 months; yield, 67.3%; rib eye area, 12.9 sq. in.; carcass weight per day of age, 1.68 pounds; grade, top choice.

He was two years old, weighed 1645 pounds and sold for 50¢ a pound. Since then, gradually younger, lighter weight, smoother cattle have been winning the shows and have received a premium at the market.

Consumer demand brought about the change. Homemakers have very definite ideas about the dimensions of roasts and steaks they buy. As a general rule they want a definite number of servings for the money they expect to spend. They don't want three steaks for four people. They want a separate steak for each member of the family or for each guest. When a homemaker buys a steak, she want it thick enough to be pleasing and she isn't keen about cutting one steak for two servings. This demand for smaller cuts and higher quality beef has pressured the market into paying a premium for early-maturing, high-quality, well-finished cattle that weigh 800 to 1100 pounds.

The two great forces influencing changes in type are livestock shows and relative prices paid by markets. From the commercial standpoint, the market value has produced the principal effect. Therefore, the future trend in breeding can be determined by analyzing what brings price premiums on the markets.

In 1935, P. C. Burns, head cattle buyer of Armour and Company, outlined the history of price premiums paid for beef cattle. The first premium was for improved fattening qualities, especially the amount of fat the animal carried and the amount of marbling in the carcass. This brought greater flavor and tenderer meat. The second-price premiums were paid for reducing carcass waste. The packer could afford to pay more for animals lacking patches and rolls of fat, and so the demand for smoothness was reflected through prices and became a great factor in improving beef type and quality. The third-price premium was for animals that would grow and fatten at the same time, to reach market finish younger and lighter. This was called early maturity, and breeders selected bulls that would sire this trait in their offspring.

The market now is starting to pay premiums for heavy-muscled, cor-

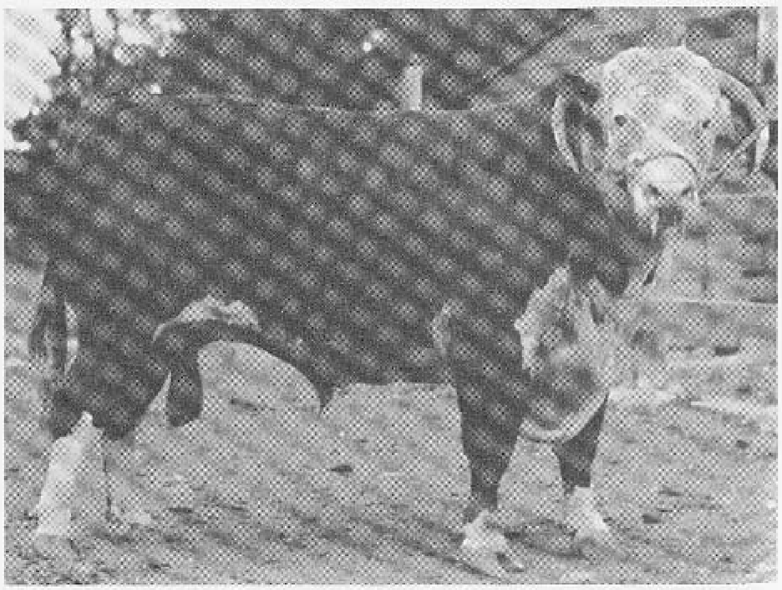

Fig. 4. Hereford bull, considered very good bull in his day, 1926.

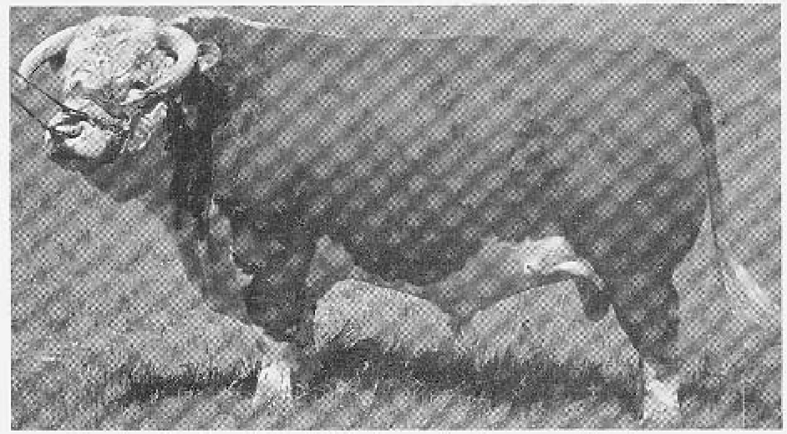

Fig. 5. Hereford bull, 1962; the modern type most breeders are selecting to attain.

rectly finished, handy-weight cattle. The machine and space age has brought about shorter working hours and less physical labor, and Americans are more weight conscious; so there is demand for less fat on meat servings. This demand must be supplied without sacrificing quality.

When the trend to smaller and more compact cattle became evident, some commercial and purebred breeders tried a short cut. They used extreme type compressed and compact bulls in breeding to make their cattle smaller and more compact. The stock shows also changed their standards and smaller cattle began to win. For a time some breeders went to the extreme and produced cattle that were too small and too compact for utility. Many winners at livestock shows from 1940 to the early 1950's were extremely small, very compact, squatty-type cattle that were not useful. This we now know was wrong, and it has been corrected. Larger, sounder, more useful cattle are winning today.

Beef cattle numbers per capita have been declining through the years, yet we are eating more beef per capita than ever before and the quality of the beef is better. This, in itself, indicates how far we have come in selecting cattle for economical beef production. Chain stores and supermarkets retail about 80% of the beef that is consumed in this country. The bulk of their demand calls for cuts from choice-quality cattle that weigh from 800 to 1000 pounds.

During the past decade much standardization of type has taken place. We see more of the middle of the road type cattle and very few extremes such as the large, plain, rough cattle or the very small, dumpy, compressed type. Classes at the shows are evener and of much better quality now than 10 years ago. We have improved the bone structure of our cattle in recent years, but still have a long way to go in improving muscling and decreasing fat cover while maintaining marbling in the meat.

Future changes in type should be gradual, not revolutionary, as a gradual change is more likely to be sound and lasting. Single births plus a long-generation interval makes progress in cattle breeding slow. It is vitally important not to go on wild tangents in beef cattle selection.

Swine

When early American settlers moved west into the fertile soils of what is now called the Eastern Corn Belt, their agricultural production soon exceeded their needs, and surpluses of grain were available for

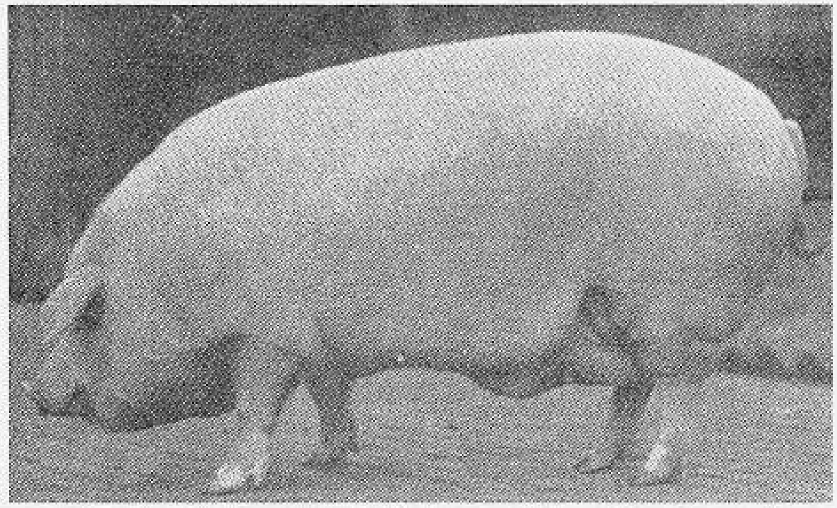

Fig. 6. Champion Chester White barrow, 1918; weight, 625 pounds; age, 18 months (No Carcass Information)

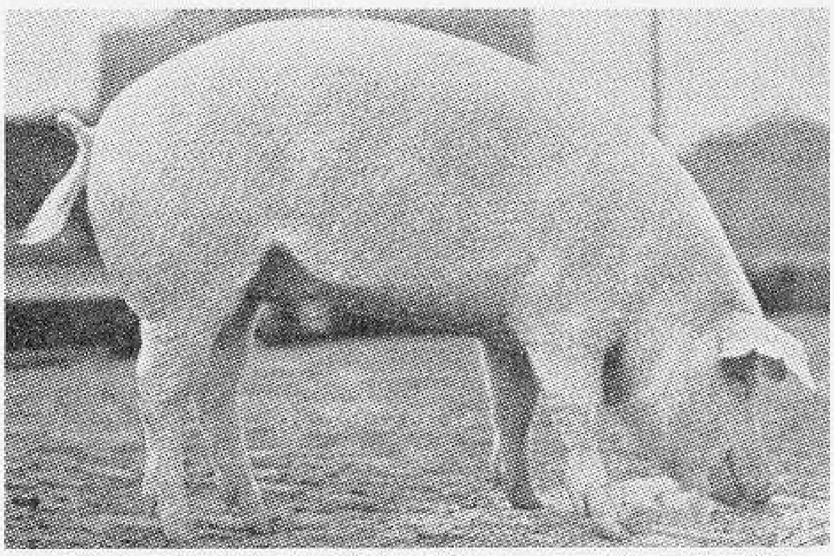

Fig. 7. 1934 Champion Chester White barrow, 1934; weight, 250 pounds; age, 7 months (No Carcass Information)

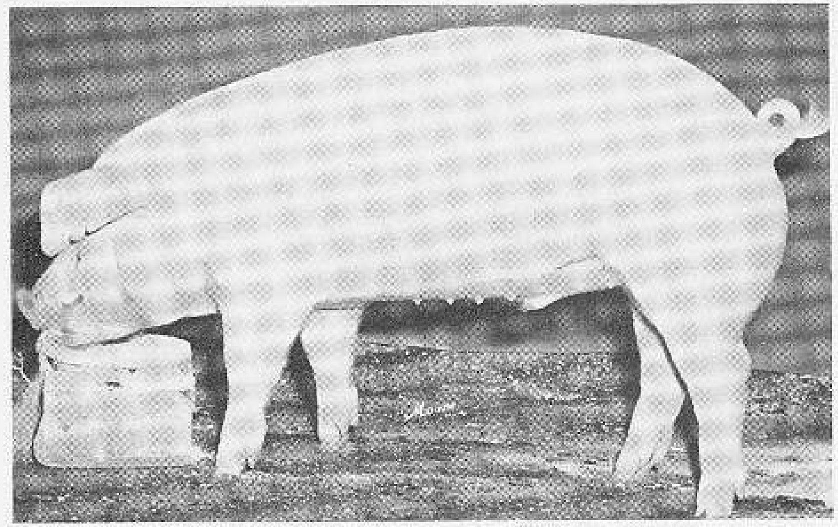

Fig. 8. Champion Chester White barrow, 1960; weight, 208 pounds; age, 160 days; length of carcass, 29.8 inches; backfat thickness, 1.13 inches; loin eye area, 6.07 square inches.

livestock consumption. Swine breeds were developed to consume the surplus corn and convert it into meat for human consumption.

The two main types of swine were "lard" and "bacon." The two bacon breeds were Yorkshire and Tamworth, both developed in England. The Berkshire is the only lard breed developed in England. The other lard breeds were developed in the United States. In early 1900, lard was at a premium and we bred hogs to yield large quantities of lard. Barrows were marketed at 500 and 600 pounds. In 1923, the United States produced 2,871 million pounds of lard and exported to Central European countries 1,060 million pounds. For many years lard was a very important export. In 1923, the per capita consumption of lard was 11.3 pounds. The price of lard through the years has strongly influenced type and weight of hogs produced.

With the advent of vegetable oil production, demand for lard decreased. With swine as cattle, machines replaced human labor and resulted in less consumption of fat and less demand for fat hogs. The quickest way to get rid of fat is to market hogs at lighter weights. This was done and, in addition, hogs were selected to yield a higher proportion of lean to fat. With emphasis on musclng and meatiness, the term lard type began to disappear. Beginning about 1948, all breeders were trying to produce meat-type hogs. Meat type is now the production goal of all swine breeders in the United States.

Multiple births and short gestation periods make it easy to change type in hogs through selection. From 1900 to 1915 the type was very short, "chuffy" and lardy. The hogs were very short legged and dumpy. Type began to change and breeders tried to produce big, long-legged hogs that would obtain tremendous size. This period lasted from 1915 to 1925. Some sows then weighed more than 1000 pounds and boars reached 1500 to 1800 pounds. Such hogs were long, tall, very heavy boned, and coarse. Names like Giant, Big Sammie, Giant Buster, Big Annie, Big Jack, and Big Bone Maid were given registered swine during that period.

The next shift in type was to a long, lean, meatless hog with very little muscle, and no constitution or vigor. This change was short lived, and breeders started to produce more of a meat-type hog with less fat and more muscle. Carcass studies of progeny have helped breeders greatly in selecting lines of breeding stock that produce heavy-muscled hogs with less backfat. Barrow shows and carcass contests have played, and are now playing, an important role in selecting the modern meat-type hog.

Sheep

There are basically two general types in sheep, wool and mutton. The wool type are bred to produce heavy-shearing, high-grading fleeces; the mutton type, to produce excellent lamb and mutton carcasses.

During the past 50 years mutton type has not changed greatly. We have gradually changed from marketing older, heavier weight lambs to lighter weight, younger lambs with less fat and more muscle. From 1900 to about 1950 the fattest lamb usually was placed at the top of the class. Many judges used amount of finish as the main guide in placing market lambs, and some coaches of college livestock judging teams instructed the students always to place the fattest lambs at the top of the class.

Since finish is no longer an important factor in grading lamb carcasses, judges have been selecting heavy-muscled lambs with enough finish to obtain marbling.

The International Livestock Exposition showed one and under two-year wethers and lambs until 1940, then the one and under two class was dropped and only wether lambs were shown. In 1953, wether lambs

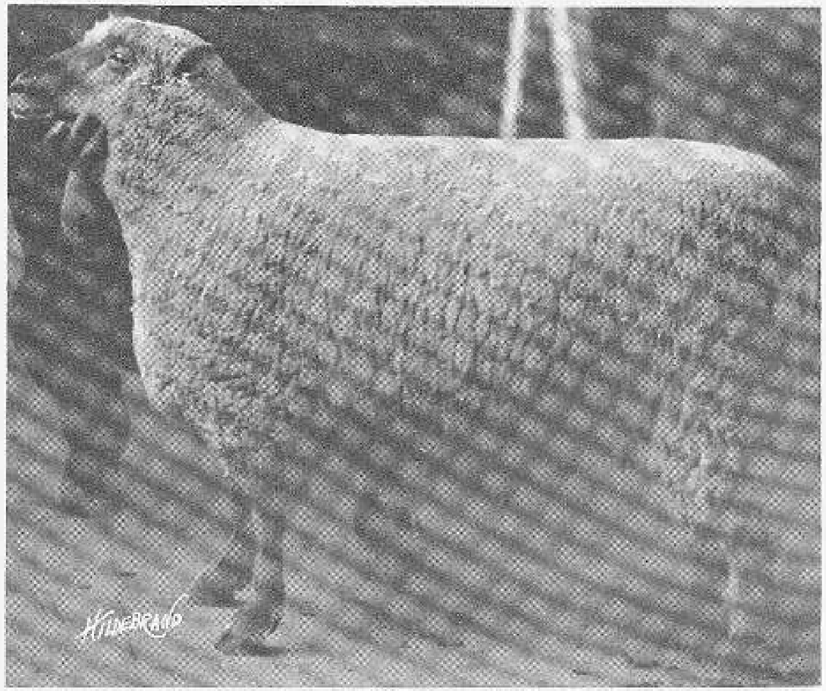

Fig. 9. Champion Crossbred wether, 1917 International.

were divided into two weights, under 95 pounds and 95 to 115 pounds. Now they are considering accepting a heavier weight market lamb which producers feel would be an advantage in commercial sheep production. The market has been very strong in imposing price cuts on lambs that weigh over 110 to 115 pounds. If the markets continue this practice, breeders that produce fast-growing lambs with excellent carcasses will be at a disadvantage.

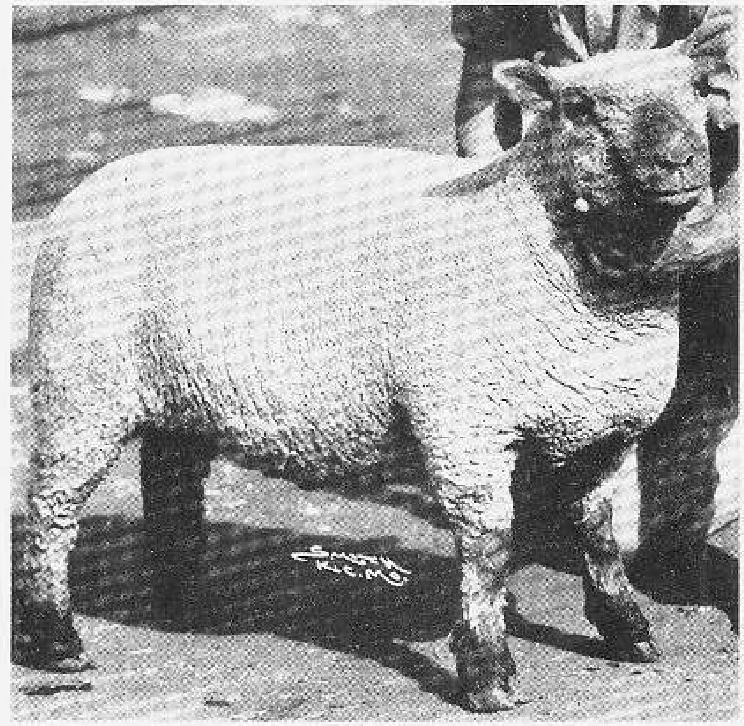

Fig. 10. Champion Southdown wether at a recent American Royal livestock show.

FIFTY YEARS OF PROGRESS IN BEEF CATTLE PRODUCTION

Ed F. Smith and Fred W. Boren

Nutrient Requirements

Determination of nutrient requirements extends back 100 years and was reviewed and summarized in 1917 by H. P. Armsby in his classic book, "The Nutrition of Farm Animals."

In 1917 the National Research Council, through cooperative investigations, established protein requirements for growth of cattle.

Samuel Brody and co-workers compiled their work in the book, "Bioenergetics and Growth," which was published in 1945.

F. B. Morrison, beginning work in about 1910, developed the "Total Digestible Nutrient Values" and feeding standards which are used universally.

The National Research Council published "Recommended Nutrient Allowances for Beef Cattle" in 1945, revised 1958, which states the quantitative allowances of beef cattle for all recognized nutrients.

Vitamins

The discovery of vitamins has occurred largely since about 1911.

The symptoms of vitamin A deficiency were recorded long before it was known that the vitamin existed. It wasn't until 1930 that the common troubles associated with feeding cottonseed hulls and meal to cattle were established as being due to a deficiency of vitamin A.

Fortunately, sunlight is an effective source of vitamin D for cattle and since most cattle are exposed to the sun most of their life they are seldom deficient. Vitamin D was discovered in 1922.

The B-complex vitamins are supplied to the ruminant through the activities of the microorganism in the rumen. The feeding of yeast products and other sources of the B-complex vitamins to ruminants has never been shown to be necessary.

Proteins

It has long been known that animals needed some source of protein in the diet. The most recent advances in this field date from about 1930.

In the rumen of cattle there is a large amount of bacterial action; these bacteria are able to build protein of high quality which is used by the animal. Urea has been shown to be a satisfactory source of nitrogen for these bacteria to build proteins from, and its use in rations containing adequate energy and other nutrients is common today.

Minerals

The gross composition of mature animals in a good state of nutrition was first established in 1859.

Mineral elements and their distribution in animals appeared in Missouri Agr. Expt. Sta. Bulletin 107 in 1927.

Nutritional significance of minerals as known today has been established since 1930.

It has only been about 35 years ago that calcium and/or phosphorus deficiency, commonly called "creeps" and "sweeny" in cattle, was produced experimentally and could be corrected by feeding bone meal or dicalcium phosphate.

A phosphorus content of 0.11 to 0.13% and a calcium content of 0.23% are the minimum amounts of these elements in the dry matter of the vegetation required by range cattle.

Roughages, in general, are much better as a source of calcium than phosphorus, since they rarely fall below 0.23% calcium.

Calcium deficiency is comparatively rare when the principal feed is roughage.

High concentrate, low roughage fattening rations are likely to be deficient in calcium.

Extensive work in Kansas has shown that fattening cattle receiving

less than 2 pounds of good legume hay per head daily should receive 0.1 pound of calcium supplement.

Relatively few trace element deficiencies are recorded for beef cattle. Copper deficiency has been reported only in Florida, cobalt deficiency in Florida, eastern Atlantic states, and the Great Lakes states. Trace mineral requirements have not been established.

Roughages

Problems arising from the feeding of roughages are in direct relation to the quality of the roughage. As protein content of prairie hay increases, total digestible nutrients, crude fiber, and protein digestibility increase.

Low-quality roughages are high in fiber, low in nitrogen-free extract and low in protein, calcium, phosphorus and carotene, and must be supplemented accordingly if they are to be utilized effectively.

The value of sorghum silage as a cattle feed is equal to corn silage and the value of either is directly related to the dry matter of the silage. In order to produce good gains, the dry matter should be over 25%.

Pelleted roughages fed to beef cattle have produced satisfactory response. Average daily gains have increased markedly, mainly as the result of a 30 to 40% increase in dry matter consumption.

Hay wafers have been successfully fed to cattle with results equal to conventional hay.

Grain

Sorghum grain production has increased consistently and has become the chief source of energy in many areas of the country. We now depend more on grain as a source of other nutrients than formerly. Grain protein content is an important item in meeting the protein requirement of the animal. With high concentrate rations some grains are depended on as a source of fiber in the ration. In the late 1950's it was demonstrated that fattening cattle would perform well on rations made up entirely of concentrates when properly supplemented with needed nutrients. Work in the last few years has demonstrated that high moisture grain (20-30% moisture) can be stored and efficiently utilized by cattle.

Feed Additives

Feed additives and hormonelike drugs have received more attention in recent years than many other fields of research. There seems to be no question of the growth-stimulating effect of diethylstilbestrol. Some undesirable effects have been noted especially at high levels; low level administration has reduced some of the objection to its use. Its use dates from 1954.

The degree of response obtained from the use of antibiotics may be related to feedlot and disease conditions. Their use dates from about 1949. A great deal of research with both of those materials has been conducted at the Kansas station.

Management

There has been a consistent trend in increasing the size of the beef cattle enterprise which has brought about many mechanical innovations in the feeding of animals. Large cattle feeding operations (several thousand head) are possible with the labor of only one or two men. Under range conditions the use of salt-meal mixtures and protein blocks has been a move in the same direction. The comfort of cattle in hot climates has become recognized as being an important management factor. Research in the 1950's demonstrated the value of shade and other cooling measures in hot weather.

Marketing and Transportation

Cattle were marketed nearly completely through large central markets at the beginning of the century. Since then there has been an increase in marketing at local markets. Livestock auction markets have increased in the United States from about 200 in 1930 to a peak of 2500 in 1952.

Transportation by truck of livestock to central markets began about

1911. It has been estimated that more than 85% of cattle now arrive at market by truck transport.

Systems of Production

Systems of production have consistently been altered to include animals at younger age and heavier weights. The utilization of grass has become confined largely to cows and yearling animals. Steer receipts at markets are largely made up of animals weighing under 1100 pounds grading choice and good.

The deferred feeding of beef cattle was developed by Kansas producers, which is a step toward the use of younger more efficient animals in converting roughage and grain into beef.

PROGRESS IN ANIMAL BREEDING

Walter H. Smith

The Trend of the Purebred Livestock Industry.

The purebred livestock industry was well established in the United States 50 years ago. Breed registries were active in promoting breeds and maintaining pedigree records then. Livestock shows were well established in the early 1900's and have continued, with breeders relying on placings made in shows for guidance in livestock selection. More recently, livestock carcass class competition has been introduced and the discrimination has increased against excess external carcass fat as appraised in both live slaughter animals and their carcasses.

During the last 50 years the purebred segment of the United States livestock industry has increased proportionately and considerable "grading up" has been accomplished in the larger commercial cattle herds and sheep flocks. Many type changes have taken place, particularly in cattle and swine, and some breed comparisons have been made. It appears that the major objective of all purebred meat animal breeding has become more closely devoted to efficient production of meat with quality appeal to the consumer. Many of the major livestock breed associations recently have adopted herd-breeding programs based on the measurement of production traits, including carcasses. It appears that breeders have received and applied those plans with sufficient interest to assure future effort in that direction.

Developing New Breeds.

Some new breeds of livestock devoted to meat production have been established. In the main, they have been developed from breed and species crosses. It appears that the main objectives of this effort have involved improved environmental adaptability and increased productivity, commonly measured in terms of growth rate, in our existing livestock. Many of the new breeds have survived commercial preference well; however, only scant evaluative research has been accomplished to date. Many of the general purposes and genetic principles involved do not differ widely from the fundamentals of crossbreeding.

Applying Genetics to Animal Breeding.

The principles of Mendelian genetics were rediscovered at the beginning of of the 20th century. Applying genetic principles to animal breeding has been slow but progressive. Most of the early effort devoted to research on animal genetics concerned the simply inherited qualitative traits including color markings and abnormalities such as lethals and sublethals. Considerable work has continued in this area as circumstances have required, as dwarfism in beef cattle recently. The area of qualitative inheritance is certainly not closed to research; however, the main effort devoted to animal genetics research is in quantitative inheritance, which includes the conventional production traits of farm livestock.

Methods of measuring the genetic relationship between animals and the degree of inbreeding possessed by individual animals were discovered in the 1920's. Statistical techniques to analyze quantitative inheritance were formulated during the 1930's. Methods to measure performance traits in livestock were evaluated during those periods. Those areas of research provided the basis of livestock selection procedures, which have been progressively developed since about 1940.

Studies of Animal Breeding Plans.

Basically there are two animal breeding plans, outcrossing and inbreeding. Outcrossing by crossbreeding has been widely adopted in the commercial swine and sheep industry. The practice is not new; however, research on the subject is fairly recent. Some heterosis or hybrid vigor has been observed with regard to most production traits (the crossbred tends to be superior to the parental average); however, fewer losses of the new born and increased reproductive efficiency seem to be the most important advantages. Studies devoted to research on outcrossing in beef cattle are in progress but findings to date are preliminary and inconclusive. It appears that outcrossing will play an important role in the production of future meat animals.

Technical research studies on the effects and feasibility of the use of inbreeding have been in progress since the 1930's. The development of inbred lines of livestock is expensive and time consuming. Limited commercial use of inbred swine, cattle, or sheep has been made to date; nevertheless, research to evaluate the feasibility of the development and use of inbred lines of livestock will continue.

Studies on the Inheritance of Performance Traits.

Numerous estimates of heritability values for nearly all the production traits of meat animals have been reported by research workers during the last 20 years. Heritability is generally defined as the proportion of the differences measured or observed between animals that is transmitted to their offspring. Single estimates of heritability are subject to considerable error. Enough information is available now to justify reference to average heritability values for production traits in farm livestock selection procedures.

Research has also been done on genetic and phenotypic relationships between production traits. Many research selection projects are currently in progress to further evaluate that area of animal genetics.

Selecting Meat Animals.

Selection in meat animals is complicated by numerous production traits. The traits of high economic value and heritability should be emphasized in selection programs. Selection indices that give two or more production traits for the various meat-producing species need to be developed. Additional information regarding heritability values and phenotypic correlations and genetic correlations for production is needed. Simple ways to measure some production traits, especially those involving the animal carcass, should be developed. Most of the factual information available on these problems has been reported in the last 10 years, so this is still a very active area of animal breeding research.

Considerable research has been accomplished on aids to selection. Progeny testing appears to be an important technique in genetic improvement of carcass traits and other production traits of meat animals that are economically important but low in heritability.

FIFTY YEARS OF PROGRESS IN SHEEP PRODUCTION

Carl Menzies

Research has provided the basis for improving production of quantity and quality of lamb and wool. Knowledge obtained concerning improved breeding, feeding, management and disease control practices has been used to increase profits through more efficient production of quality lamb and wool.

Following are a few areas where major change and improvement have been accomplished.

Types of sheep produced. The sheep industry has matured from a frontier-type industry with wool as the major source of income to making lambs the major product. Consumer preference for meaty, high-quality lamb has decreased market age, weight and finish. This trend has resulted in using more mutton-type rams in crossbreeding, in a considerable improvement in mutton characteristics of fine-wool breeds, and has even caused formation of new breeds of sheep such as the Columbia. The Kansas fall lambing program, with 90- to 100-pound, 5-month-old choice and prime crossbred lambs being sold in the spring, is one result of this trend.

Sheep nutrition. Considerable basic research on mineral, protein, and vitamin requirements for sheep has been conducted in the past 50 years. This has been important; however, much applied research concerning the value of feeds, combination of feeds and methods of feed preparation and feeding has contributed considerably to the sheep industry. Probably one of the most valuable has been the development of pelleted rations. Pelleting complete mixed roughage-concentrate rations has decreased death loss from overeating, increased feed consumption (particularly low-quality roughages), increased gains, improved feed efficiency, and reduced labor involved in feeding. Cost of pelleting should become more reasonable as better pelleting equipment is developed and as pelleting becomes commoner.

Fattening feeder lambs. Much research has been conducted with feeder lambs, since this practice has developed largely during the past 50 years. Self-feeding ground-mixed or pelleted rations has increased gains and mechanized feeding. Many lambs have been fattened on wheat pasture in western Kansas. Research has indicated that no supplement other than salt is needed for fattening lambs on wheat pasture. Implanting or feeding diethylstilbestrol has improved feed efficiency and gains of feeder lambs. Antibiotics, vaccination for enterotoxemia, and management practices have been used to control death loss from overeating disease.

Breeding. Sheep producers have largely practiced mating the best to the best, "best" being determined by visual selection. Recent interest in using performance records in connection with type scores in selection should increase rate of economic improvement.

Attempts to control out-of-season breeding of sheep have not been successful. The newly developed oral, effective progesterone-like compounds, reported effective in synchronizing the estrous cycle, may have real practical value. This points to a need for research on storing ram semen for artificial insemination.

Environmental factors such as level of nutrition and temperature have been shown to affect number of lambs produced. Consequently practices such as flushing ewes and shearing rams in hot weather are recommended for increasing lambing percentages.

Parasite control. New anthelmintics have helped control internal parasites, which are a serious problem.

Sheep production is a minor industry compared with beef cattle and hogs. However, there is no surplus of lamb or wool in this country. All the lamb produced in the United States is eaten (actually about 10% of the lamb and mutton consumed is imported). About 50% of the apparel wool plus all the carpet wool used in the United States is imported. So sheep producers have a demand for increased production of quality lamb and wool in the future. Continued research and increased promotion of these products should result in continued progress.

FIFTY YEARS OF SWINE PRODUCTION

B. A. Koch

Changes in methods of feeding, breeding, and managing swine have been almost revolutionary the past 50 years. Consumer preference, disease control, new knowledge concerning nutrition, new and more adaptable equipment, new structural methods, improved breeding techniques and specialized management all have contributed to the changes in swine production.

Housing and Management:

1910's—Open shed, dirt floor, dirty lots.
1920's—Portable housing, pasture—McLean County System of sanitation.
1930's—Legume pasture, central farrowing, vaccination.
1940's—Limited pasture, concrete, blood testing.
1950's—Pig hatcheries, pig parlors, confinement.
1960's—Slotted floors, manure lagoons, automation.

Feeds and Feeding:

1910's—Skim milk, ear corn, 450 pounds of feed per 100 pounds gain.
1920's—Water gruel, corn, tankage and bonemeal, 400 pounds of feed per 100 pounds gain.
1930's—Dry feed, self fed, full fed, vitamins and minerals added, 350 pounds of feed per 100 pounds gain.
1940's—Commercial rations, trace minerals, B-complex vitamins, plant protein, 330 pounds of feed per 100 pounds gain.
1950's—Antibiotics, nitroflurans, arsenicals, hormones, pelleted feeds, 320 pounds of feed per 100 pounds gain.
1960's—Limited feed for finishing, automation, linear programming, 300 pounds of feed per 100 pounds gain.

Feeding Standards:

1910's—Henry
1920's—Morrison
1930's—Morrison
1940's—Morrison, Schneider
1950's—Morrison—National Research Council
1960's—National Research Council—Morrison

Experimental Methods:

1910's—Feeding trials.
1920's—Feeding trials, paired feeding.
1930's—Metabolism studies, carcass analysis, breeding studies.
1940's—Factorial design, carcass quality.
1950's—Testing stations, breed certification.
1960's—On-the-farm testing, breed certification, testing stations.

Market Animal Produced:

1910's—300 lbs., very fat, 12 months old.
1920's—300 lbs., rangy, fat, 12 months old.
1930's—275 lbs., fat, 9 months old.
1940's—250 lbs., fat, 8 months old.
1950's—230 lbs., less fat, more meat, 6 months old.
1960's—210 lbs., lean, meaty, 5 months old.

Beef Cattle

The Effect of Added Calcium and Phosphorus with and without Added Protein in the Ration of Steers on Bluestem Pasture (Project 253-1).

C. L. Drake, E. F. Smith, D. Richardson and W. S. Tsien

This experiment was designed to evaluate the desirability of supplementing bluestem pasture as indicated in the title.

Forty Hereford steer calves were divided into four lots of 10 each and fed the following experimental rations per head daily:

Lot 1. Two pounds of dehydrated molasses (a molasses product dried on soybean hulls).

Lot 2. Two pounds of dehydrated molasses and 39.1 grams of dicalcium phosphate.

Lot 3. One pound of dehydrated molasses and 1 pound of 41% corn gluten meal.

Lot 4. One pound of dehydrated molasses and 1 pound of 41% corn gluten meal plus 29.6 grams of dicalcium phosphate.

The trial was started February 18, 1961, with steers weighing about 445 pounds each. They were all pastured together on a 190-acre bluestem pasture, gathered each morning, divided into different lots and fed. This procedure was continued until October 5, 1961, when they were fed three times per week instead of every day. The ration was increased so three feedings provided the same ration as the previous seven. The experimental ration was discontinued August 21, 1962, and the cattle were started on feed consisting of ground sorghum grain, soybean meal and hay. September 7, 1962, the steers were moved into drylot and put on full feed until November 28, 1962.

The cattle were weighed every 28 days, and a blood sample was obtained from the jugular vein of each animal, and analyzed for calcium and phosphorus as soon as possible after collection. Hematocrit values were also determined.

At the beginning of the trial a bone sample was obtained from the coccygeal vertebra and a tooth was extracted to determine the effects of added mineral on the amount deposited in the bone and teeth. The procedure was repeated at the completion of the third and sixth months and at slaughter. These samples were placed in a sharp freeze and are being analyzed now.

The chemical analysis of the ration is presented in Table 1.

The approximate quantity of calcium and phosphorus received per day per 700-pound steer is shown in Table 2. Grass consumption was calculated on the basis of 2 pounds dry matter intake per 100 pounds live weight.

Blood calcium, phosphorus and hematocrit values for 17 months are shown in Table 3.

Table 1
Chemical analysis of ration ingredients.

Feeds	% Protein	% Calcium	% Phosphorus
Corn gluten meal	43.63	0.05	0.98
Molasses product	6.25	0.73	0.16
Little bluestem	5.32*	0.43	0.09
Dicalcium phosphate	......	22.33	20.56

* During the winter months % protein was 2.80.

Table 2
Daily calcium and phosphorus allowance and ratios.

Lot	Calcium (gms.)	Phosphorus (gms.)	Ca-P-Ratio
1	33.95	7.17	4.7 – 1
2	42.69	15.21	2.8 – 1
3	30.87	10.89	2.8 – 1
4	37.47	16.97	2.2 – 1

The blood calcium and phosphorus varied, depending on the season of the year. Serum calcium reached a peak during April and declined during May, June and July. Then it slowly increased to another peak in October and November, and then declined to a low during January, February and March. Supplemental calcium had no apparent effect on serum calcium.

Blood phosphorus reached a peak during March and April and little fluctuation appeared until June and July, when the blood level declined to a low in October and November, followed by a gradual increase to a peak the following March and April. In contrast to calcium, blood phosphorus supplementation tended to increase blood phosphorus.

Table 3
Calcium, phosphorus and hematocrit values.
(Blood values in mgs./100 mls. blood)

Lot	Calcium	Phosphorus	Hematocrit
1	10.48	5.64	36.02
2	10.29	6.82	34.35
3	10.40	6.33	35.51
4	10.34	6.45	37.15

Carcass grades were very uniform, with no apparent treatment differences. None of the steers graded choice, while 32 graded good and eight, standard. The standard grade was uniformly distributed among lots.

Average weights and daily gains are shown in Table 4. Adding protein to Lots 3 and 4 gave a highly significant increase in gain over Lots 1 and 2 for the entire period. Gain differences between Lots 1 and 2 or between Lots 3 and 4 were not significant.

Table 4
Weight gain as affected by added calcium and phosphorus on steers with and without added protein on bluestem pasture.

Lots	Starting wt. 2/18/61	Weight 8/21/62	Av. daily gain 2/18/61 8/21/62	Av. daily gain* 8/21/62 11/28/62	Av. daily gain 2/18/61 11/28/62
1	438	820	.69	2.15	.93
2	455	822	.67	2.19	.86
3	441	917	.87	2.13	1.08
4	457	922	.85	1.90	1.02

* Represents average daily gain while in drylot on feed.

Dicalcium Phosphate and Vitamin A for Calves on Winter Bluestem Pasture, 1962-63 (Project 253).

E. F. Smith, D. Richardson, F. W. Boren and C. L. Drake

The 40 steer calves, 10 per lot, used in this experiment were good to choice Herefords from near Fort Davis, Texas, and were assigned on a random-weight basis to their treatments. They were pastured together in a 190-acre bluestem pasture, penned three times weekly, divided into treatment groups and fed the experimental diets shown in Table 5. The lots receiving dicalcium phosphate (0.1 pound per steer daily) and vitamin A (10,000 I.U. daily) received it mixed with the soybean meal.

The results of the trial to date are reported in Table 6. Apparently dicalcium phosphate, Vitamin A or a combination of the two had no effect.

Table 5

Dicalcium phosphate and vitamin A for calves on winter bluestem pasture.

December 8, 1962, to April 1, 1963—114 days.

Lot no.	12A	12B	12C	12D
Treatment	Control	Dicalcium phosphate	Vitamin A	Dicalcium phosphate and vitamin A
No. of steers	10	10	10	10
Initial wt., lbs.	372	378	375	382
Daily gain per steer	.30	.23	.23	.23
Daily ration per steer, lbs.:				
Soybean meal	1.0	1.0	1.0	1.0
Ground sorghum grain	1.0	1.0	1.0	1.0
Dicalcium phosphate	.....	0.1	.....	0.1
Vitamin A, 10,000 I.U. daily	.....	.....	Yes	Yes
Bluestem pasture	Free choice			
Salt	Free choice			

The Value of Dicalcium Phosphate, Vitamin A, and Grinding Sorghum Grain for Calves Fed Prairie Hay, 1962-63 (Projects 253-4 and 253-6).

E. F. Smith, F. W. Boren, D. Richardson and J. E. Kramer

The 60 steer and heifer calves, six steers and four heifers per lot, used in this experiment, were good to choice grade Herefords from near Fort Davis, Texas, and were assigned on a random-weight basis to their treatments. All lots received all the prairie hay they would consume, 4 pounds of sorghum grain, and 1 pound of soybean meal per head daily. Where vitamin A (10,000 I.U. daily) and dicalcium phosphate (0.1 pound per head daily) were fed they were mixed with the soybean meal. In the lots fed ground sorghum grain, it was ground medium fine.

The results of trial to date are reported in Table 6. Grinding the sorghum grain fed to Lots 19, 21 and 23 increased gains on an average of 0.21 pound per animal daily, dicalcium phosphate increased gains about half this amount but vitamin A had no effect. Feed efficiency was directly related to rate of gain. The phosphorus and carotene content of the feeds used is reported in Table 6. The phosphorus content of the basic ration without dicalcium phosphate was estimated at about 12 grams daily and the carotene content of the basic ration without vitamin A added at about 115 mgs. of carotene; both equal or exceed the requirements published by the National Research Council.

Table 6

The value of dicalcium phosphate, vitamin A, and grinding sorghum grain for calves fed prairie hay,

December 7, 1962, to March 29, 1963—112 days.

Lot no.	18	19	20	21	22	23
Treatment	Whole grain dical vitamin A	Ground grain dical vitamin A	Whole grain dical	Ground grain dical	Whole grain	Ground grain
Animals per lot	10	10	10	10	10	10
Initial wt., lbs.	528	526	525	527	529	528
Daily gain, lbs.	1.01	1.15	.96	1.19	.84	1.11
Daily ration per calf, lbs.:						
Sorghum grain	4.0	4.0	4.0	4.0	4.0	4.0
Soybean meal	1.0	1.0	1.0	1.0	1.0	1.0
Prairie hay	12.4	12.3	12.6	12.5	12.4	12.5
Dicalcium phosphate	0.10	0.10	0.10	0.10	.....	.....
Vitamin A, 10,000 I.U. daily	Yes	Yes				
Salt	Free choice					
Feed per cwt. gain, lbs.:						
Sorghum grain	392	343	414	333	471	357
Soybean meal	99	87	105	84	119	90
Prairie hay	1226	1068	1317	1048	1483	1126

A Comparison of Four Native Bluestem Pastures, 1961-62 (Project 253-4).

E. F. Smith, D. Richardson, F. W. Boren, and H. W. Westmeyer

This test compares steer weight gains on four bluestem pastures to determine whether differences among the pastures might influence steer performance. Other than being in different pastures, all steers were treated and fed alike. The supplemental feed during the winter period was offered free choice and depended on either salt or urea or a combination of the two to limit consumption to under 2 pounds of supplemental feed per steer daily. Only salt was supplied during the summer.

Yearling Hereford steers with an average USDA feeder grade of about high good were used. The steers came from near Thermopolis, Wyoming, were received at the Kansas station in March, 1961, and were used in summer grazing studies preceding this test.

All weights were after an overnight stand in drylot without feed or water.

The following 60-acre bluestem pastures were used in the test.

Pasture 7A. A hilltop bluestem pasture typical of many Flint Hills pastures with a large proportion of big and little bluestem and Indian grass with very few trees, and very little winter protection. A road is in this pasture. Water was supplied by an automatic waterer, heated in winter.

Pasture 7B. A hilltop bluestem pasture with more northern slopes than pasture 7A and a moderate-size timbered draw through it running north and south. This pasture is west and north of pasture 7A with similar vegetation, but perhaps slightly more cool-season grasses, such as Kentucky bluegrass, than 7A has. Steers in 7A and 7B received water from the same automatic waterer.

Pasture 13. This was primarily a bottomland pasture with a timbered creek running its entire length east and west and offering a source of open spring-fed water all winter and summer. The vegetation was similar to that in the other pastures, but a larger proportion of cool-season grasses (winter annuals and Kentucky bluegrass) was present.

Pasture 15. This pasture was a combination of hilltops and lowland areas, sloping primarily south. The vegetation was very similar to 7B and perhaps 7A. Two draws crossed the pasture, one running north and south, the other running south and east with a few trees along it. Water was supplied by an automatic waterer, heated in winter.

None of the pastures had been burned for about 10 years. Grass was abundant in all pastures.

Observations

Results are reported in Tables 7 and 8. (Table 8 on page 26)

The steers in all pastures lost weight during winter; largest weight losses in all pastures occurred during March. Performance of the steers in Pastures 13 and 15 during winter was superior to that of the steers in Pastures 7A and 7B. Gains during April seemed to account for most of the difference.

Only small differences in gain occurred during summer. The largest yearly gain was obtained in Pasture 13.

Table 7
A comparison of four native bluestem pastures.

Wintering—December 5, 1961, to May 1, 1962—147 days.[1]

Pasture no.	7A	7B	13	15
No. steers	10	10	10	10
Initial wt., lbs.	581	594	591	592
Gain per steer, lbs.	−36	−46	−14*	−13*
Daily gain per steer, lbs.	−0.25	−0.31	−0.10	−0.09
Daily ration per steer, self-fed:[2]				
Salt, lbs.	.271	.220	.208	.297
Urea, lbs.	.158	.150	.154	.150
Dicalcium phosphate, lbs.	.047	.045	.045	.047
Defluorinated phos., lbs.	.028	.028	.026	.026
Phenothiazine, lbs.	.007	.006	.006	.006
Dehydrated alfalfa, lbs.	.056	.056	.052	.052
Soybean oil meal, lbs.	.317	.317	.303	.310
Ground sorghum grain, lbs.	.881	.831	.872	.846
Total	1.765	1.663	1.670	1.734
Bluestem pasture	Free choice			
Grazing—May 1, 1962, to November 1, 1962—184 days.				
Initial wt., lbs.	545	548	577	579
Gain per steer, lbs.	288	319	311	299
Daily gain per steer, lbs.	1.57	1.73	1.69	1.63
Summary—December 5, 1961, to November 1, 1962—331 days.				
Final wt., lbs.	833	867	888	878
Gain per steer, lbs.	252	273	297	286
Daily gain per steer, lbs.	0.76	0.83	0.90	0.86

* Gains significantly different from those in Pastures 7A and 7B, .05 level of significance.

1. This was the total wintering period, but supplement was added to the ration December 12, so the daily ration is figured on 138 days.

2. Five different mixtures were offered free choice to the steers: a 20% salt, 5% urea, 5% dicalcium phosphate, 30% soybean oil meal, and 40% sorghum grain mixture were fed the first 17 days; a 10% salt, 12% urea, 5% defluorinated phosphorus, 10% soybean oil meal, 10% dehydrated alfalfa, and 53% sorghum grain the next 13 days; a 5% salt, 12% urea, 5% defluorinated phosphorus, 30% soybean oil meal, 10% dehydrated alfalfa, and 38% sorghum grain the next 28 days; a 5% salt, 12% urea, 5% dicalcium phosphate, and 78% sorghum grain the next 35 days; a 5% salt, 12% urea, 82.6% sorghum grain, and .4% phenothiazine the last 15 days. Additional salt was added in some instances to control consumption.

Table 8

Monthly gain (pounds per head) of steers on four native bluestem pastures.
December 5, 1961, to November 1, 1962—331 days.

Lot no.	7A		7B		13		15	
	Monthly gain	Accumulative gain	Monthly gain	Accumulative gain	Monthly gain	Accumulative gain	Monthly gain	Accumulative gain
December	5	5	—22	—22	—4	—4	—4	—4
January	—10	—5	—12	—34	—17	—21	—8	—12
February	—14	—19	9	—25	3	—18	7	—5
March	—27	—46	—39	—64	—19	—40	—42	—47
April	10	—36	18	—46	26	—14	34	—13
May	107	71	120	74	127	113	115	102
June	52	123	39	113	32	145	32	134
July	64	187	58	171	74	219	73	207
August	52	239	64	235	36	255	42	249
September	42	281	23	258	44	299	50	299
October	—29	252	15	273	—2	297	—13	286

Different Methods of Managing Bluestem Pastures, 1962 (Projects 253-3 and 253-5).

E. F. Smith, K. L. Anderson, F. W. Boren, and C. L. Drake

This experiment was designed to determine the effect of different stocking rates, of deferred grazing, and of pasture burning on cattle performance, productivity of pastures, and range condition as determined by plant population changes. In addition to the yearly report, a summary of cattle gains for the past 13 years of the study is included.

Experimental Procedure

Yearling Hereford steers with an average USDA feeder grade of about high good were used in 1962. The steers came from near Fort Davis, Texas, and were wintered at the Manhattan Station on prairie hay and alfalfa hay the winter preceding the grazing season. Due to a shortage of yearlings to stock the pastures, some two-year-old steers were assigned to each pasture to increase the stocking rate. Their weight gains are not reported.

The experimental treatment for each pasture was:

Pasture 1. Moderate stocking rate, 3.3 acres per steer.

Pasture 2. Overstocked, 1.8 acres per steer.

Pasture 3. Understocked, 4.6 acres per steer.

Pastures 4, 5, and 6. Deferred grazing at the moderate stocking rate, 3.3 acres per steer. The steers were grazed on Pastures 5 and 6 from May 2 to July 2. They were then moved to Pasture 4 where they remained until September 15, when all were allowed to graze in all three pastures until October 3, close of trial.

Pasture 9. Burned March 19, 1962, moderate rate of stocking.

Pasture 10. Burned April 10, 1962, moderate rate of stocking.

Pasture 11. Burned May 2, 1962, moderate rate of stocking.

The steers were gathered about 2 p.m., held over night without feed or water and weighed the following morning, about 8 a.m. The starting and final weights were obtained after putting all the steers together and weighing them in random order.

Observations

The results are reported in Tables 9, 10, and 11.

Steer gains appeared to be lowered by all treatments, especially deferred grazing and overstocking. This is the second consecutive year and the only two years when the weight gain on the nonburned Pasture 1 exceeded the gain made by steers on the mid- and late-spring-burned pastures. Forage was sufficient only on Pasture 9 among the burned pastures to permit the entire pasture to be burned. This is two consecutive years the entire early-spring-burned pasture has burned. Only about three fourths of the mid-spring-burned pasture burned and very little of the late-spring-burned pasture was burned; only on the slopes was there sufficient forage to permit burning; new growth was apparent on over half of the pasture by May 2, which hampered burning where little old growth was available to carry the fire.

Yields of vegetation were approximately equal to those of the previous year, but range condition has declined slightly under burning and heavy grazing. This appears to contribute to the somewhat lower yields of beef under those treatments.

Table 9
Yearly account of summer steer gains under different methods of grazing pastures; 13-year summary, 1950-62. Average gain per steer in pounds for the summer season of approximately 150 days.

Pasture no.	1	2	3	4, 5, 6	9	10	11
Management	Moderately-stocked	Over-stocked	Under-stocked	Deferred rotated	Early-spring-burned	Mid-spring-burned	Late-spring-burned
1950	221	210	214	205	216	254	230
1951	242	256	290	234	243	265	254
1952	246	209	228	197	251	278	283
1953	226	194	233	197	205	217	234
1954	261	237	236	214	270	271	306
1955	270	224	253	213	282	305	307
1956	179	184	168	154	212	234	216
1957	243	236	244	209	261	256	279
1958	208	207	207	198	222	270	253
1959	252	241	262	203	254	275	295
1960	267	242	255	235	299	289	314
1961	255	217	227	187	243	245	237
1962	232	177	215	167	201	205	212
Average	239	218	233	201	243	259	263

Table 10
A comparison of different methods of managing bluestem pastures.
May 2, 1962, to October 2, 1962—153 days.

Pasture no.	1	2	3	4, 5, 6	9	10	11
Management	Moderately-stocked	Over-stocked	Under-stocked	Deferred	Early-spring-burned	Mid-spring-burned	Late-spring-burned
No. steers per pasture	18	33	13	54	14	14	14
Yearling steers	16	28	12	48	12	12	12
Two-year-old steers[1]	2	5	1	6	2	2	2
Acres in pasture	60	60	60	3—60[2]	44	44	44
Acres per head	3.3	1.8	4.6	3.3	3.1	3.1	3.1
Initial wt. per steer, lbs.	473	481	479	487	485	483	485
Final wt. per steer, lbs.	705	658	694	654	686	688	697
Gain per steer, lbs.	232	177	215	167	201	205	212
Daily gain per steer, lbs.	1.52	1.16	1.41	1.09	1.31	1.34	1.39
Gain per acre	62	79	43	45	55	56	58

1. Acres per head include two-year-olds but all gain data are on yearling steers only.
2. Three 60-acre pastures.

Table 11

Production and disappearance of forage, weeds, and mulch in 1962, yields given as pounds air-dry weight per acre.

Pasture no.		1	2	3	4, 5, & 6 (av.)	9	10	11
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Ordinary uplands—	Forage	3,470	3,104	4,310	4,364	2,163	3,005	2,959
	Weeds	456	558	139	192	333	267	170
	Mulch	2,919	1,823	3,682	2,761	(a)	(a)	(a)
Limestone breaks—	Forage	2,643	1,984	2,890	3,150	1,922	2,670	1,960
	Weeds	386	388	176	348	675	712	143
	Mulch	1,605	849	2,280	3,189	(a)	(a)	(a)
Disappearance (an index of grazing use)								
Ordinary uplands—	Forage	1,528	1,903	955	1,887	1,060	1,417	1,402
	Weeds	300	258	(b)	(b)	139	139	90
	Mulch	992	406	126	571	(a)	(a)	(a)
Limestone breaks—	Forage	867	961	179	833	891	754	631
	Weeds	82	134	53	226	205	509	(b)
	Mulch	287	(b)	(b)	279	(a)	(a)	(a)
Remainder (amount left as cover at close of grazing season)								
Ordinary uplands—	Forage	1,942	1,201	3,355	2,477	1,103	1,594	1,557
	Weeds	156	300	139	192	194	128	80
	Mulch	1,927	1,417	3,556	2,190	(a)	(a)	(a)
Limestone breaks—	Forage	1,776	1,023	2,711	2,317	1,031	1,916	1,329
	Weeds	304	254	123	122	470	203	143
	Mulch	1,318	349	2,280	2,910	(a)	(a)	(a)
Grass decreasers and grass increasers given as % of total population, and estimated range condition given as %								
Ordinary uplands—	Grass decreasers	46	36	45	47	39	63	65
	Grass increasers	35	36	32	36	31	18	19
	Range condition	54	42	50	51	50	75	80
Limestone breaks—	Grass decreasers	58	49	65	60	15	68	74
	Grass increasers	24	29	24	23	70	21	18
	Range condition	75	69	84	78	57	87	91

a. No mulch in burned pastures.
b. No measurable disappearance.

The Value of Supplemental Cobalt for Heifers on Fattening Rations, 1961-62 (Project 253-6).

E. F. Smith, F. W. Boren, D. Richardson and C. L. Drake

The 40 heifer calves, 10 per lot, used in this experiment were good to choice Herefords from near Fort Davis, Texas, and were assigned on a random weight basis to their treatments.

All lots received all the prairie hay they would consume; ground shelled corn was gradually increased until they were on full feed; then the ground corn was self-fed. Soybean oil meal was fed once daily in a separate bunk, ground limestone was added to the soybean oil meal to supply 1/10 pound daily per head, and vitamin A concentrate was added to the soybean oil meal to supply 10,000 I.U. daily per head. Cobalt sulfate was added to the soybean oil meal of two of the lots to supply 1 mg. of cobalt daily per head.

Results of the trial are reported in Table 12. There were no significant differences among the lots, although a small increase in gain and carcass weight occurred in the cobalt-supplemented lots.

Table 12

The value of supplemental cobalt[1] in the ration of fattening heifers.

December 4, 1961, to October 11, 1962—311 days.

Lot no.	19	20	21	22
Treatment	Control	Control	Cobalt	Cobalt
No. heifers per lot	10	10	10	10
Initial wt. per heifer, lbs.	379	379	378	381
Daily gain per heifer, lbs.	1.77	1.84	1.94	1.91
Daily ration per heifer, lbs.:				
Ground corn, self-fed	10.98	11.23	11.69	11.99
Soybean meal[2]	1.53	1.54	1.53	1.58
Prairie hay	4.05	4.14	4.31	4.28
Salt, free choice				
Feed per cwt. gain, lbs.:				
Ground corn	618.70	610.70	602.70	626.94
Soybean meal	86.27	83.65	79.07	82.40
Prairie hay	228.35	224.90	222.47	223.85
Feed cost per cwt. gain[3]	$18.54	$18.25	$17.88	$18.53
Carcass data:				
Average carcass wt., lbs.	597	594	627	619
Average packer yield, %	64.1	62.5	64	63.4
Average USDA grade[4]	13.7	13.6	14.2	13.2
Average yield grade[5]	4.6	4.6	4	3.9
Average marbling score[6]	5.1	5.3	4	5.2

1. Cobalt was mixed with the soybean meal fed to lots 21 and 22 in the form of $CoSo_4 \cdot 7H_2O$ at the rate of 1 mg. of cobalt daily.

2. The soybean meal of all lots was fortified to furnish per head daily a tenth of a pound of ground limestone and 10,000 I.U. of vitamin A.

3. Feed prices may be found on inside back cover.

4. Average grade determined as follows: High choice, 15; average choice, 14; low choice, 13; high good, 12.

5. Score from 1 to 6 on basis of yield, with 1 being the highest yield in closely trimmed boneless retail cuts.

6. Average marbling determined as follows: Moderately abundant, 3; slightly abundant, 4; moderate, 5; modest amount, 6.

Factors Affecting the Feeding Value of Sorghum Silage, 1962-63 (Project 623).

F. W. Boren, E. F. Smith, D. Richardson and G. E. Fairbanks

This is the third year of an experiment designed to investigate factors that affect the feeding value of sorghum silage. Data reported in Circular 383, 1960-61, indicated that almost without exception, average daily gain, silage dry matter consumption, and silage dry matter percent were positively correlated. Pounds of silage dry matter required to produce a pound of gain were negatively correlated with average daily gain, silage dry matter and daily dry matter consumption. Winter gains also ranked in the same order as the percentage of grain in the silage, i.e., the higher the grain content, the greater the gain. However, digestion coefficients, using steer calves, were lower with the high-grain silage, suggesting the possibility of appreciable nutrient loss in undigested grain.

In Bulletin 447, 1961-62, data were reported on the effects of silage dry matter, stage of maturity, grain versus no grain, and ground-heads silage on winter gains. Gains were directly related to silage dry matter and daily silage dry matter consumption and also to the grain content of the silage. Grain on the silage crop increased gain approximately 32%. Forage sorghum cut at 10 days past full bloom and having only 20% dry matter produced unsatisfactory gains. It appears that silage with less than 25% dry matter will not produce satisfactory gains in the type beef calves used in these tests. Grinding the heads did not improve gains; however, it appeared that silage dry matter and silage consumption affected average daily gain.

Experimental Procedure

The 1962-63 experiment was designed to study further the value of grinding heads of forage sorghum for silage. It appeared from previous experiments that this practice might be beneficial. Two forage sorghum varieties, DeKalb FSIA and White Sourless, were used. DeKalb FSIA is described as nonjuicy, nonsweet, heavily grained, and mid-season maturity. White Sourless is very sweet, very juicy, lightly to moderately grained, and mid-season maturity.

This experimental design was used.

Lot no.	Variety	Silage treatment
1	DeKalb FSIA	Heads removed at medium to hard-dough stage of maturity, ground in a hammermill and combined with chopped forage at a uniform rate and ensiled.
2	DeKalb FSIA	Conventional silage made at same maturity as Lot 1.
3	White Sourless	Same as Lot 1.
4	White Sourless	Same as Lot 2.

Upright, 50-ton concrete stave silos were used to ensile the forage sorghum. They were provided through the courtesy of Salina Concrete Products, Inc., Salina, Kansas.

Forty head of choice-quality Hereford heifer calves, weighing about 350 pounds each, were randomly allotted, 10 head to a lot, and randomly assigned to each of the four types of silage. Silage was fed free choice and 1.25 pounds of soybean oil meal were fed per head daily. Dicalcium phosphate was fed daily in the soybean oil meal. Salt was kept before the calves at all times.

Observations

The performance of the calves is shown in Table 13. Average daily gains made by the heifers were not significantly different. As in previous experiments, gains increased as dry matter consumption increased. Grinding the heads of DeKalb FSIA increased gain about 10%, whereas there was no benefit from grinding the heads of White Sourless sorghum.

Table 13
Factors affecting the feeding value of sorghum silage (progress report).
November 20, 1962, to March 14, 1963—114-day wintering period.

Lot no.	3	4	5	6
No. heifers per lot	10	10	10	10
Silage variety	DeKalb FSIA		White Sourless	
Silage treatment	Ground heads	Control	Ground heads	Control
Silage dry matter content, %	32.8	32.4	28.1	29.6
Initial wt. per heifer, lbs.	350	351	354	348
Av. gain per heifer, lbs.	140	134	131	152
Final wt. per heifer, lbs.	490	485	485	500
Av. daily gain per heifer, lbs.	1.23	1.18	1.15	1.33
Av. daily ration, lbs., as-fed basis:				
Silage	27.44	27.38	30.10	30.37
Soybean oil meal	1.25	1.25	1.25	1.25
Av. daily ration, lbs., dry-matter basis:				
Silage	9.00	8.87	8.46	8.99
Soybean oil meal, 90% dry matter	1.13	1.13	1.13	1.13
Total dry matter consumed daily, lbs.	10.13	10.00	9.69	10.12
Lbs. dry matter per cwt. gain	823.6	847.5	842.6	760.9
Feed cost per cwt. gain,[1] as-fed basis:				
Silage	$ 7.81	$ 8.12	$ 9.16	$ 7.99
Soybean oil meal	$ 3.88	$ 4.02	$ 4.14	$ 3.57
Total feed cost per cwt. gain	$11.69	$12.14	$13.30	$11.56

1. Feed prices: Silage, $7 per ton; soybean oil meal, $3.80 per cwt.

The Effects of Adding Protein to Dry-rolled Sorghum Grain Fattening Rations, 1961 (Project 370).

F. W. Boren, E. F. Smith, D. Richardson, R. F. Cox

Previous work (Bulletin 447) indicated that sorghum grain fattening rations supplemented with 0.5 pound per head per day of soybean oil meal produced gains minimal in efficiency and carcasses equal to those from heifers fed 1 pound of protein per head daily. With each increase of 0.5 pound of protein (0, 0.5, 1.0) came a 0.20-pound increase in average daily gain, an increase in feed efficiency, and an increase in profit over feed cost.

This experiment repeated a portion of the previous experiment with modifications, as shown below, for a 140-day fattening period:

Lot 13. One half pound of soybean oil meal per head daily.

Lot 14. One pound of soybean meal per head daily.

Lot 15. One and one half pounds of soybean meal per head daily.

Lot 16. One half pound of soybean meal per head daily for the first 28 days, then increasing one half pound each 28 days for the 140 days.

Lot 17. Two and one half pounds of soybean meal per head daily for the first 28 days, then decreasing one half pound each 28 days for 140 days.

Table 14

The effects of adding protein to dry-rolled sorghum grain fattening rations.

March 9, 1962, to July 27, 1962—140 days.

Lot no.	13	14	15	16	17
Protein feeding:					
Lbs. per head daily	0.5	1.0	1.5	0.5 plus	2.5 minus
Method of feeding	Constant	Constant	Constant	0.5 lb. each 28 days	0.5 lb. each 28 days
No. heifers per lot	10	10	10	10	10
Av. initial wt., lbs.	541	545	546	547	547
Total gain, lbs.	206	231	251	227	229
Av. final wt., lbs.	747	776	796	774	776
Av. daily gain per head, lbs.	1.47	1.65	1.79	1.62	1.64
Av. daily ration, lbs.:[1]					
Sorghum grain	14.72	14.63	14.12	13.21	13.05
Soybean oil meal	0.5	1.0	1.50	1.50	1.50
Prairie hay	4.78	4.65	4.99	4.56	4.54
Feed required per cwt. gain, lbs.:					
Sorghum grain	1001	887	794	815	796
Soybean oil meal	33	61	84	93	91
Prairie hay	325	282	279	281	277
Total	1359	1230	1157	1189	1164
Feed cost per cwt. gain:[2]					
Sorghum grain	$18.02	$15.97	$14.29	$14.67	$14.33
Soybean oil meal	1.25	2.32	3.19	3.53	3.46
Prairie hay	2.60	2.26	2.23	2.25	2.22
Total	21.87	20.55	19.71	20.45	20.01
Initial cost per head[3]	$129.84	$130.80	$131.04	$131.28	$131.28
Cost of feed[4]	45.05	47.47	49.47	46.42	45.82
Total cost, animal + feed	174.89	178.27	180.51	177.70	177.10
Av. carcass value per head[5]	183.30	199.66	198.88	200.02	196.48
Profit over feed cost per head	8.41	21.39	18.37	22.32	19.38
Carcass data					
Av. area ribeye, sq. in.	8.96	8.79	8.88	8.80	8.87
Av. fat thickness at 12th rib	0.59	0.81	0.75	0.75	0.72
Av. carcass grade:[5]	18.3	18.9	19.0	19.1	18.8
Choice + = 21				1	1
Choice = 20		1	4	2	1
Choice − = 19	4	7	2	4	3
Good + = 18	5	2	4	3	4
Good = 17	1				1
Good − = 16					

1. Each lot supplemented with 10,000 I.U. vitamin A and 30 gms. calcium carbonate per head daily; salt fed free choice; none of these included in cost of feed.

2. Feed costs used are on page 72.

3. Initial live wt. x $24 per cwt.

4. Feed cost per cwt. gain x total gain.

5. Carcass weight x carcass grade price: Choice, $42.25; good, $39.50.

Observations

Data collected from this experiment appear in Table 14. Average daily gain increased 0.18 and 0.14 pound, respectively, as daily soybean meal intake increased from 0.5 to 1.5 pounds. However, a daily intake of 1.5 pounds of protein fed in a decreasing or increasing manner seemed to depress gain.

Feed efficiency increased markedly as the protein intake increased from 0.5 to 1.5 pounds daily. Feed efficiency was essentially the same for Lots 15, 16, and 17 which received 1.5 pounds of protein per head daily.

Table 15 shows data collected from another feeding trial with the same objectives. Feeding methods were the same except sorghum silage instead of prairie hay was used as a roughage.

Average daily gain was materially increased when daily protein intake was increased from 0.5 to 1.0 pound but no increase occurred with 1.5 pounds of protein. Decreasing or increasing the protein during the fattening period did not affect average daily gain.

In both experiments the heifers from the lots receiving 1.5 pounds of protein constantly throughout the fattening period had larger rib eyes and higher carcass grades.

Table 15

Effects of adding protein to dry-rolled sorghum grain fattening rations.

May 10, 1962, to September 27, 1962—140-day fattening period.

Lot no.	7	8	9	10	11
Protein:					
Lbs. per head daily	0.50	1.0	1.5	0.5 plus 0.5 lb. each 28 days	2.5 minus 0.5 lb. each 28 days
No. heifers per lot	10	10	10	10	10
Av. initial wt., lbs.	626	620	625	618	624
Total gain, lbs.	231	279	278	272	276
Av. final wt., lbs.	857	899	903	890	891
Av. daily gain per head, lbs.	1.65	1.99	1.99	1.94	1.97
Av. daily ration, lbs.:[1]					
Sorghum grain	14.0	14.1	14.0	14.0	14.0
Soybean oil meal	0.5	1.0	1.5	1.5	1.5
Sorghum silage	18.7	18.8	18.8	18.4	18.7
Feed required per cwt. gain, lbs.:					
Sorghum grain	848	709	704	722	711
Soybean oil meal	30	50	75	77	76
Sorghum silage	1133	945	945	948	949
Total	2011	1704	1724	1747	1736
Feed cost per cwt. gain:[2]					
Sorghum grain	$15.26	$12.76	$12.67	$13.00	$12.80
Soybean oil meal	1.14	1.90	2.85	2.93	2.89
Sorghum silage	3.97	3.31	3.31	3.32	3.32
Total	20.37	17.97	18.83	19.25	19.01
Initial cost per head[3]	$150.24	$148.80	$150.00	$148.32	$149.76
Cost of feed[4]	47.05	50.14	52.35	52.36	52.49
Total cost, animal + feed	197.29	198.94	202.35	200.68	202.23
Av. carcass value per head[5]	212.49	220.37	233.90	230.52	228.04
Profit over feed cost per head	15.20	21.43	31.55	29.84	25.81

Table 15 (Continued)

Carcass data

Av. area ribeye, sq. in.	9.01	9.65	9.70	9.83	9.51
Av. fat thickness at 12th rib, in.	0.88	0.83	0.90	0.83	0.93
Av. carcass grade:[1]	18.4	17.8	19.2	18.5	18.4
Choice + = 21	1		2		
Choice = 20		1	2	2	2
Choice − = 19	2	1	2	4	1
Good + = 18	6	4	4	1	6
Good = 17	1	3		3	1
Good − = 16		1			

1. Each lot supplemented with 10,000 I.U. vitamin A and 30 gms. calcium carbonate per head daily. Salt fed free choice; none of these included in feed cost.

2. Feed costs are on page 72.

3. Initial wt. x $24 per cwt.

4. Feed cost per cwt. gain x total gain.

5. Carcass wt. x carcass grade price: Choice, $43.25; good, $40.50.

Effects of Field-conditioned Alfalfa Hay on the Winter Performance of Weaned Heifer Calves, 1962-63 (Project 370).

F. W. Boren, E. F. Smith, D. Richardson, G. E. Fairbanks

This feeding trial was to determine the effects of various field-conditioned alfalfa hays on the winter performance of heifer calves.

Second-cutting alfalfa was field-conditioned or processed as follows:

1. Control—mowed, raked, baled.
2. Crushed—mowed, crushed with one smooth steel roll and a spiral-grooved rubber roll, raked and baled.

Table 16

Winter performance of weaned heifer calves fed alfalfa hay field-cured by various methods.

December 12, 1962, to March 8, 1963—93-day wintering period.

Lot no.	13	14	15	16	17
No. heifers per lot	10	10	10	10	10
Hay-conditioning method	Control	Crushed	Rotary cut	Swathed, crimped	Wafered
Initial wt. per heifer, lbs.	438	441	442	443	442
Av. gain per heifer, lbs.	102	110	98	121	119
Final wt. per heifer, lbs.	540	551	540	564	561
Av. daily gain per heifer, lbs.	1.10	1.18	1.05	1.30	1.28
Av. daily ration, lbs.:					
Alfalfa hay	11.8	13.1	11.3	11.9	13.0
Ground sorghum grain, lbs.	3.5	3.5	3.5	3.5	3.5
Lbs. feed per cwt. gain:					
Alfalfa hay	1072.7	1110.2	1076.2	915.4	1015.6
Ground sorghum grain, lbs.	318.2	296.6	333.3	269.2	273.4
Total lbs. feed required per cwt. gain	1390.9	1406.8	1409.5	1184.6	1289.0
Feed cost per cwt. gain[1]	$16.46	$16.44	$16.76	$14.00	$15.08

1. Feed costs on page 72.

3. Rotary cut—a 12-foot, trail-behind, twin-rotor rotary mower that cut, lacerated, and windrowed the hay in one operation, baled.
4. Swathed, crimped—a 12-foot, self-propelled windrower with a crusher-crimper attachment, baled.
5. Wafered—Alfalfa cut with a flail-type cutter, field dried to about 15% moisture in windrows, wafered with a Massey-Ferguson wafering machine.

Fifty head of choice Hereford heifer calves were used in this study, allotted 10 head per lot, and fed alfalfa free choice, plus 3.5 pounds of rolled sorghum grain per head per day. Salt was available at all times.

Observations

Data are given in Table 16. There was no apparent reason for the difference in average daily gain of heifers in the various lots. Calves fed wafers rapidly adjusted to that type of hay-package and were apparently satisfied with wafers as a source of roughage.

Vitamin A and Dehydrated Alfalfa Fed Individually and in Combination with and without Aureomycin in a Steer Fattening Ration (Project 567).

D. Richardson, E. F. Smith, F. W. Boren and Keith Kingsley

Hereford yearling steers in this test were used in a previous bluestem pasture grazing test. After the grazing test was completed, they were assigned to six lots of 10 animals each on the basis of weight and uniformity to compare the value of dehydrated alfalfa as a source of vitamin A with preformed vitamin A, both individually and in combination with and without Aureomycin. The supplements supplied the same amount of protein, calcium and phosphorus in each lot. Vitamin A value of carotene was figured on the dehydrated alfalfa at 400 I.U. per milligram of carotene; 10,000 I.U. of vitamin A per head was fed daily for the first 84 days and 15,000 I.U. units for the remainder of the test; 70 milligrams of Aureomycin was fed per head daily. After the steers were on feed, silage was limited to 20 pounds per head daily; however, grain was fed **ad lib.**

Results and Observations

The results of this test are presented in Table 17.

(1) Dehydrated alfalfa produced greater gains than preformed vitamin A (compare Lots 7 and 9).

(2) A combination of dehydrated alfalfa and vitamin A was no better than either alone (compare Lot 11 with 7 and 9).

(3) Aureomycin apparently was beneficial with a combination of dehydrated alfalfa and vitamin A but not when used with each individually (compare Lot 12 with 8 and 10). We have no satisfactory explanation for these results.

(4) Liver storage of vitamin A was greatest with animals fed preformed vitamin A; however, there was no relationship between liver storage of vitamin A and gains of individual animals.

(5) No deficiency symptoms or differences in appearance attributed to vitamin A were observed.

(6) Feed cost and efficiency favored lots making the greatest rate of gain.

(7) There were no significant differences in dressing percentage, carcass grade or carcass characteristics.

The following is a 114-day progress report on a repeat of this test, except 15,000 I.U. of vitamin A per head daily has been used throughout the test.

Lot no.	7	8	9	10	11	12
Av. starting wt., lbs.	862	860	860	856	862	857
Av. daily gain, lbs.	2.86	2.96	3.00	3.02	2.88	3.19

Table 17

Vitamin A and dehydrated alfalfa fed individually and in combination with and without Aureomycin.
November 30, 1961, to July 7, 1962—220 days.

Lot no.	7	8	9	10	11	12
No. steers per lot	10	10	10	10	10	10
Av. initial wt., lbs.	708	708	708	708	710	708
Av. final wt., lbs.	1206	1179	1233	1180	1208	1235
Av. daily gain, lbs.	2.26	2.14	2.39	2.14	2.26	2.40
Av. daily ration, lbs:						
Sorghum silage	20.4	19.6	20.4	19.8	20.9	20.0
Sorghum grain	18.1	18.1	18.7	18.7	18.8	18.7
Supplement	1.3	1.3	1.7	1.7	1.7	1.7
Dehyd. alfalfa[1]	No	No	Yes	Yes	Yes	Yes
Vitamin A[2]	Yes	Yes	No	No	Yes	Yes
Aureomycin[3]	No	Yes	No	Yes	No	Yes
Feed per cwt. gain, lbs:						
Sorghum silage	902	917	853	926	926	836
Sorghum grain	799	846	786	874	833	782
Supplement	58	61	72	81	76	72
Feed cost per cwt. gain	$19.54	$20.82	$19.17	$21.44	$20.46	$19.38
Dressing %, feedlot wt.	62.3	62.4	62.3	62.7	61.8	62.2
Av. hot carcass wt., lbs.	752	736	769	740	747	769
Est. kidney knob, % carcass	3.9	3.3	3.4	3.8	3.4	3.5
Av. finish:						
Fat thickness 12th rib, in.	.71	.76	.69	.70	.77	.62
Distribution[4]	2.7	2.7	2.3	2.6	2.9	3.1
Degree marbling[5]	6.0	6.3	5.9	5.4	6.1	5.2
Degree firmness[6]	2.3	3.1	2.5	2.2	2.7	2.8
Fat color[7]	2.6	2.6	2.0	2.2	2.4	2.7
Size ribeye, sq. in.	11.8	11.6	12.2	12.1	11.5	12.2
Carcass grades:						
Low prime	..	..	..	1	..	..
Top choice	..	..	..	1	1	4
Av. choice	2	..	1	3	2	2
Low choice	6	6	6	3	3	2
Top good	1	4	2	2	2	2
Av. good	..	..	1	..	2	..
Low good	1	..	..	..	..	..
Yield grades:						
3	3	2	4	3	5	4
4	6	8	4	5	3	6
5	1	..	2	2	2	..
Vitamin A per gram liver, I.U.	32	24	13	12	26	21

1. 0.4 lb. first 84 days; 0.6 lb. thereafter.
2. 10,000 I.U. first 84 days; 15,000 I.U. thereafter.
3. 70 milligrams per head daily.
4. 2 = uniform, 3 = moderately uniform, 4 = modestly uniform.
5. 5 = moderate amount, 6 = modest amount, 7 = small amount.
6. 1 = very firm, 2 = firm, 3 = moderately firm.
7. 1 = white, 2 = creamy white, 3 = creamy, 4 = slightly yellow.

Table 18
Feedlot results for wintering phase.
November 21, 1962, to March 19, 1963—118 days.

Location	Colby		Garden City		Manhattan		Mound Valley	
Lot no.	1	2	1	2	1	2	1	2
No. steers per lot	6	6	6	6	6	6	6	6
Av. initial wt., lbs.	448	448	449	448	449	449	449	448
Av. final wt., lbs.	585.8	567.5	588.3	584.8	581.7	592.5	611	611
Av. daily gain, lbs.	1.17	1.01	1.18	1.16	1.12	1.21	1.37	1.38
Av. daily ration, lbs.:								
Sorghum silage	24	24	22	22	23	23	30	29
Alfalfa hay	5	5	5	5	5	5	5	5
Feed per cwt. gain, lbs.:								
Sorghum silage	2,082	2,376	1,853	1,873	2,045	1,895	2,187	2,135
Alfalfa hay	418	490	422	430	445	412	365	363
Dry matter per cwt. gain, lbs.:								
Sorghum silage	618	706	584	590	644	597	538	525
Alfalfa hay	397	465	401	408	423	391	347	345
Total dry matter per cwt. gain, lbs.	1,015	1,171	985	998	1,067	988	885	870

Table 19
Feedstuff analysis.

	Moisture %	Dry matter %	Protein %	Ash %	Crude fiber %	Ether extract %	N.F.E. %	Carotene mgs./lb.
Colby:								
Sorghum silage	71.80	28.20	1.82	2.61	5.07	0.84	17.86	8
Alfalfa hay	5.00	95.00	15.50	6.41	33.32	1.40	38.37	14
Garden City:								
Sorghum silage	68.56	31.44	1.33	2.00	3.17	0.48	24.46	1
Alfalfa hay	5.00	95.00	14.28	9.19	29.97	1.62	39.94	38
Manhattan:								
Sorghum silage	68.49	31.51	1.95	1.54	7.38	0.75	19.89	2
Alfalfa hay	5.00	95.00	11.98	3.11	35.67	1.19	43.05	10
Mound Valley:								
Sorghum silage	75.96	24.04	1.80	1.61	3.95	0.39	16.29	2
Alfalfa hay	5.00	95.00	13.67	5.79	31.01	1.41	43.12	7

Nutritive Value of Forages As Affected by Soil and Climatic Differences (Project 430).

D. Richardson, E. E. Banbury,[1] A. B. Erhart,[2] F. E. Davidson,[2] Grady Williams,[3] E. F. Smith, F. W. Boren and R. F. Cox

Some persons think performance of cattle may differ in various parts of the state due to location, soil, climate, rainfall and/or feed produced. This test is an attempt to determine whether such differences exist and, if so, to measure them.

Forty-eight Hereford steer calves from the same herd and averaging 448 pounds were divided as uniformly as possible into four lots of 12 animals. One lot was assigned to each of four locations: Colby, Garden City, Manhattan, and Mound Valley. Uniform-size concrete lots with sheds are being used at each location. The animals were subdivided into two groups of six animals. The ration consisted of sorghum silage fed to limit of appetite and 5 pounds of second-cutting alfalfa hay per head daily. Salt was the only mineral supplied and water was available in automatic electrically heated waterers.

Results of the wintering phase are shown in Table 18 and feedstuff analyses in Table 19. Silage has been removed from the ration and replaced by a full feed of sorghum grain. Final results will be obtained at time of slaughter—probably September.

1. Colby Experiment Station.
2. Garden City Experiment Station.
3. Mound Valley Experiment Station.

Quantitative Determination of the Amino Acid Content of Rumen Fluid from Twin Steers Fed Soybean Oil Meal or Urea (Project 596).

D. Richardson and W. S. Tsien

Crude protein, or protein as the term is commonly used, represents all nitrogen-containing compounds in the feed. True protein is that portion of the protein which has been formed by the combining of amino acids. The value of any protein supplement is determined by its amino acid content plus the ability of the animal to synthesize true protein in the digestive tract from nonprotein-nitrogen sources. The purpose of this test was to determine the amino acid content of rumen fluid of steers fed soybean oil meal or urea.

Two pairs of fistulated identical twin steers were fed the same daily ration of 1 pound alfalfa hay, 4 pounds prairie hay and 5 pounds cracked corn. One of the steers in each pair was supplemented with 1 pound of soybean oil meal; the other, with 60 grams of urea and an additional pound of corn. One-half of the ration was fed at 7 a.m. and the other half at 5 p.m. Samples of rumen contents were taken after the steers were maintained on these rations for 63 days. Four 200-ml. strained samples were taken at 7 a.m. before feeding, 10 a.m., 1 p.m., and 4 p.m. The 800-ml. combined sample was dried at about 90° C. and ground in a Wiley Mill preparatory for analysis.

The technique of sampling in this experiment should have eliminated the time factor in protein synthesis because the samples were withdrawn at selected intervals during the day. Hereditary differences were considered to have been eliminated from the comparisons by using identical twins. The adjustment period of 63 days should have eliminated any carryover effect from the previous ration and allowed sufficient time for the microorganisms to adapt themselves to urea.

The results are shown in Table 20. All amino acids were present in greater quantities from steers supplemented with soybean oil meal. Also, amino acids accounted for 13 percentage units more of the total crude protein per liter when soybean oil meal was used as the protein supplement (56.3 vs. 43.3 and 61.2 vs. 48.0). The results show that true protein is produced from urea but the total true protein available for the animal is less than when soybean oil meal is supplied on an equal nitrogen intake. These results help explain the fact that feeding results with urea and other nonprotein-nitrogen are usually not quite so good as when natural or true protein is used.

Table 20

Amino acid content of rumen fluid from twin steers fed soybean oil meal or urea.[1]

Supplemental nitrogen	1 lb. soybean oil meal		60 gms. urea	
Steer	W1	R1	W2	R2
	Mgs. amino acid per liter[2]			
Aspartic acid	346.03	382.19	305.76	242.01
Threonine	173.09	199.75	154.06	84.32
Serine	137.38	150.73	97.74	32.52
Glutamic acid	496.91	517.14	491.60	377.24
Proline	299.62	283.42	251.63	190.78
Glycine	168.93	168.02	148.88	112.84
Alanine	190.35	213.52	189.78	149.32
Methionine	89.75	93.73	79.52	71.89
Isoleucine	229.40	249.98	197.85	156.80
Valine	197.46	213.52	189.78	149.32
Leucine	291.69	303.31	254.42	220.90
Tryosine	151.38	156.91	99.54	79.55
Phenylalanine	253.13	277.98	150.92	126.69
Histidine	67.50	77.58	62.74	53.83
Lysine	300.13	305.91	273.54	227.42
Arginine	139.04	152.56	137.34	101.34
Tryptophan	78.20	129.23	55.99	45.78
Cystine and cysteine	52.22	54.34	37.59	29.11
Grams crude protein/liter	6.514	6.376	7.310	5.146
Total grams amino acid/liter	3.666	3.903	3.168	2.471
% A.A. of total C.P./liter	56.3	61.2	43.3	48.0

1. Daily ration per steer (½ fed 7 a.m., ½ fed 5 p.m.)
   1 lb. alfalfa hay.
   4 lbs. prairie hay.
   5 lbs. cracked corn (6 lbs. for those receiving urea).

2. Four 200-ml. strained samples were taken at 7 (before feeding), 10, 1 and 4 o'clock. Determinations were made on the composite sample. Urea was fed 63 days before samples were obtained.

Improving Beef Cattle Through Breeding Methods (Project 286).

W. H. Smith, J. D. Wheat and H. G. Spies

The purebred Shorthorn cattle breeding program was continued during 1962 without modification of breeding plans. Inbreeding was continued in the two lines. The Wernacre Premier line is in its fifth generation and the Mercury line, its fourth generation of inbreeding. No outside breeding or outcrossing has been introduced in eather line since the project was initiated in 1949. The inbreeding plan has been basically to continue successive generations of half-sibbing in both lines.

This project was initiated to study the inheritance of production traits in beef cattle, to evaluate the effects of inbreeding in beef cattle, and to explore the feasibility of using inbred lines of beef cattle to improve production traits.

Many individual animal production data have been collected on all cattle produced in the project as it has progressed. No extensive line cross-

Table 21

Summary of the 1961 Shorthorn calves of the Wernacre Premier and Mercury lines.

Tag no.	Coefficient of inbreeding	Birth weight	Weaning weight	Weaning score	Days fed	Initial weight	Final weight	Total gain	Average daily gain	Final score	Pounds corn per cwt. gain	Pounds alfalfa per cwt. gain
					Wernacre Premier Line, Bulls							
3	28.01	86	370	2—	182	400	930	530	2.91	2+	356	182
4	29.81	67	335	2	182	370	890	520	2.86	2	381	189
12	23.74	64	320	2—	182	320	785	465	2.55	2—	429	217
Average	27.19	72	342	2—	......	363	868	505	2.77	2	389	196
					Heifers							
21	28.27	68	320	2—	182	345	700	355	1.95	2+	393	349
52	34.05	54	185	2—	182	196	490	294	1.62	3—	352	337
56	33.05	74	285	2	182	308	650	342	1.88	2	393	345
68	34.05	59	294	3—	182	294	574	280	1.54	3—	439	407
72	30.25	76	348	3+	182	348	740	392	2.15	2	389	327
Average	31.93	66	286	2—	......	298	631	333	1.83	2—	393	353
					Mercury Line, Bulls							
1	16.24	77	355	2+	182	384	953	569	3.13	1	366	178
2	15.92	72	370	2	182	395	790	395	2.17	2	443	237
11	11.77	70	358	2—	182	358	881	523	2.87	2	410	203
15	15.92	75	376	2	182	376	920	544	2.99	2+	406	197
Average	14.96	74	365	2	......	378	886	508	2.79	2+	406	204
					Heifers							
6	7.18	65	285	2	182	296	650	354	1.95	1—	362	322
7	6.25	72	370	1—	182	382	730	348	1.91	1	422	374
8	6.25	65	360	2	182	370	710	340	1.87	2	444	394
16	20.19	50	325	2+	182	350	735	385	2.12	1	430	379
13	19.99	63	290	2—	182	303	628	325	1.79	2—	437	394
14	15.92	64	305	2—	182	317	670	353	1.39	2—	504	448
36	18.25	55	320	2	182	336	705	369	2.03	2	393	352
87	19.23	65	252	2—	182	252	620	368	2.02	2—	306	310
146	20.24	70	357	2—	182	357	745	388	2.13	2	348	351
189	21.25	62	357	2	182	357	686	329	1.81	1—	357	383
194	20.29	64	241	2	182	241	603	362	1.99	2—	348	331
Average	15.91	63	315	2	......	324	680	356	1.91	2	396	367

ing has been attempted to date because of the relatively low level of inbreeding which has prevailed and the limited number of breeding animals in the project.

The management of the experimental cattle includes weighing each cow and calf immediately following parturition. Summer pasture breeding is practiced and the calves are born during the spring of each year. The cows are wintered on dry native grass. The calves are not creep fed during the suckling period. All calves are weaned, weighed, and scored for type when they are approximately six months old and the standardized weaning age for weaning weight correction is 180 days. The calves are placed on individual feeding trials for record-of-performance tests for 182 days shortly after they are weaned. Body weight gain and feed consumption records are maintained on all calves during the feeding period. The calves are scored for type or conformation as yearlings when they complete the prescribed feeding test.

The full-feed ration for the bulls consists of 75% cracked corn and 25% chopped alfalfa hay; that for the heifers, 55% cracked corn and 45% chopped alfalfa hay. All calves are fed twice daily by means of individual feeders while the feed tests are in progress.

Production data for the 1961 calves are summarized in Table 21. The 1961 calves had not completed their feeding test at the time of this report, so production data for them are not included. Thirty-four calves of the 1962 calf crop are being individually fed.

Swine

Kansas Swine Improvement Association Testing Station

Berl A. Koch and Wendell A. Moyer

The boar testing program was changed to a slaughter-pig testing program a year ago. The testing station committee of the Association made the change because of the difficulty in identifying carriers of infectious atrophic rhinitis. In the group of boars tested during the winter of 1961-62, one of the better performing boars showed positive symptoms of infectious atrophic rhinitis soon after he sold. Yet he had shown no symptoms of infection while on test.

Table 22 lists data collected during the summer 1962 test. In every case, two litter mate pigs were fed in a pen. The pigs received ration S-35-A until they weighed approximately 150 pounds when they were changed to ration S-47. Ration compositions are shown in Table 23. Average testing cost per pig was $34 and the average return per carcass was $36. Twenty of the 42 pigs on test met or exceeded carcass certification requirements.

Table 24 lists data collected during the winter 1962-63 test. Pigs in this test received ration S-35-A throughout the growing-finishing period. Average testing cost per pig was $25 and the average return per carcass was $32. Fourteen of the 38 pigs on test met or exceeded carcass certification requirements.

Tables 25 and 26 list testing costs in some detail.

Table 22
Kansas Swine Testing Station—Summer 1962
Pigs put on test between April 1, 1962, and May 15, 1962

Breeder	Sex	B	Age at 200 lbs. (days)	A.D.G. lbs.	Feed eff.	Lgth. in.	B.F. in.	L.E. sq. in.	% L.C.	Index
	PRODUCTION DATA[1]					CARCASS DATA[2]				
W. Talkington	B	D	147	1.88	292	28.8	1.50	3.62	50.3	66.1
Matfield Green	B	D	146	1.84		28.9	1.22	3.35	51.0	52.8
W. Talkington	G	D	160	1.72	274	28.6	1.10	4.95	53.5	99.5
Matfield Green	B	D	156	1.84		29.2	1.45	4.13	51.2	82.3
W. Taliaferro	G	H	157	1.54	296	29.9	1.10	5.33	56.0	103.3
Effingham	B	H	143	1.81		28.75	1.45	4.40	50.7	72.8
W. Taliaferro	G	H	171	1.35	284	29.7	1.17	5.14	55.8	101.4
Effingham	B	H	161	1.57		29.55	1.15	5.27	56.9	109.7[3]
O. Hughes	B	Y	160	1.75	292	31.1	1.22	4.07	56.0	90.7
Broughton	B	Y	163	1.75		29.6	1.57	3.54	47.3	62.4
F. Alexander	G	D	148	1.75	275	29.55	1.20	4.47	54.1	80.7
Corning	B	D	143	1.96		30.1	1.40	4.19	51.3	66.9
M. Shipley	G	H	164	1.44	294	29.4	1.37	4.47	54.3	103.7
Esbon	B	H	158	1.56		29.95	0.95	4.66	56.8	97.6
C. E. Wittum	B	PC	158	1.63	306	28.0	1.27	4.40	52.2	91.0
Caldwell	G	PC	186	1.25		29.25	0.98	5.33	56.3	110.3
Balthrop Farm	G	H	154	1.57	310	29.45	1.15	4.84	55.4	93.4
Wichita	B	H	163	1.48		29.75	1.23	3.50	49.9	66.0
Balthrop Farm	G	H	139	1.75	304	28.5	1.50	4.02	50.1	75.2
Wichita	B	H	138	1.76		29.2	1.50	4.17	50.3	78.7
O'Bryan Ranch	G	H	140	1.86	290	30.9	1.30	4.58	53.8	94.8
Hiattville	B	H	140	1.92		29.2	1.30	4.16	51.6	80.6
O'Bryan Ranch	G	H	160	1.43	334	29.1	1.12	3.70	54.6	87.0
Hiattville	B	H	152	1.43		28.8	1.50	3.35	49.5	62.5
O'Bryan Ranch	G	H	158	1.50	296	30.85	1.25	4.24	54.4	93.4
Hiattville	B	H	151	1.57		29.3	1.38	3.93	51.7	77.3
O'Bryan Ranch	B	H	133	1.66	312	30.35	1.22	3.94	53.0	89.4
Hiattville	B	H	133	1.63		31.65	1.13	4.43	56.1	93.3
O'Bryan Ranch	B	H	152	1.58	309	30.4	1.10	4.10	51.7	69.0
Hiattville	B	H	160	1.57		29.55	1.18	4.60	53.8	84.0
J. V. Cundiff	G	S	163	1.42	309	29.45	1.12	4.14	55.4	97.4
Talmage	B	S	143	1.87		28.5	1.47	3.46	51.5	79.6
J. V. Cundiff	G	S	171	1.36	302	28.60	1.13	4.44	52.5	95.4
Talmage	B	S	152	1.65		29.35	1.28	4.04	53.6	91.4
Juniata Farm	B	D	168	1.49	295	29.15	1.12	3.43	52.9	74.3
Manhattan	B	D	168	1.46		30.10	1.13	3.88	54.4	92.8
Juniata Farm	B	H	154	1.50	318	28.25	1.43	4.06	50.7	83.6
Manhattan	G	H	169	1.40		30.1	1.32	4.73	53.5	100.3
KSU	G	P	174	1.32	299	28.70	1.33	5.13	53.6	112.3
Manhattan	B	P	158	1.57		28.95	1.25	4.93	53.6	93.3
KSU	G	D	153	1.65	264	29.35	1.27	4.15	52.3	88.5
Manhattan	B	D	140	1.96		28.85	1.10	4.50	52.6	88.0
SUMMARY										
11 Breeders	42 Pigs (26B + 16G)		154	1.62	299	29.4	1.25	4.28	53.0	86.5
			(133	(1.96	(274	(31.6	(0.95	(3.35	(56.9	(62.4
			186)	1.32)	334)	28.0)	1.57)	5.33)	47.3)	112.3)

1. B = breed; A.D.G. = average daily gain; Feed efficiency = an average for two pigs fed together.
2. Lgth. = carcass length; B.F. = average carcass backfat; L.E. = loin eye area; % L.C. = % lean cuts on carcass weight basis; Index = index according to 1962 National Barrow Show Index (a pig with 5.00 sq. in. of loin eye and 15% of live weight in trimmed ham will index 100.0).
3. Highest indexing carcass meeting or exceeding all certification requirements.

Table 23
Composition of rations used in swine trials.[1]

Ration no.	29-B	29-C	33	34—34A[2] 35—35A	44	47
Meal or pellet	Pellet	Pellet	Pellet	See note 2	Pellet	Pellet
Grain used	Sorghum	Sorghum	Sorghum	See note 2	Sorghum	Sorghum
Rations						
Corn or sorg. grain, lbs.	1,624	1,624	1,544	1,550	1,544	1,450
Soybean oil meal, lbs.	280	280	202	400	200	350
Meat scraps (50%), lbs.	......	......	60	......	60	......
Fish meal (60%), lbs.	......	......	40	......	40	......
Dried skim milk, lbs.	50	50	......	......	......	......
Brewers yeast, lbs.	20	20	......	......	......	......
Molasses, lbs.	......	......	50	......	50	......
Dehyd. alf. meal, lbs.	......	......	60	......	60	150
Dicalcium phosphate, lbs.	......	......	15	20	15	20
Limestone, lbs.	8	8	8	20	10	20
Bonemeal, lbs.	8	8	......	......	......	......
Salt, lbs.	8	8	10	10	10	10
T-M premix (5% Zn), lbs.	0.5	0.5	1	1	1	1
Vitamin A, I.U.	200,000	800,000	2,000,000	3,000,000	3,000,000	2,000,000
Vitamin D, I.U.	120,000	120,000	300,000	300,000	300,000	300,000
Vitamin E, I.U.	......	......	20,000	......	20,000	......
B-complex, lbs.[3]	2	2	2	2	2	2
D-L Methionine, lbs.	......	......	2	......	2	......
Lyanine (20% lysine), lbs.	......	......	2	......	2	......
Aurofac 1.8-1.8 lbs.	......	......	6	6	6	......
Proferm 20, lbs.	1	1	......	......	......	0.5
Arsanilic acid, gms.[4]	......	......	......	......	90	......

1. All rations prepared by Department of Flour and Feed Milling Industries.
2. Rations 34 and 34A contained corn.
Rations 35 and 35A contained sorghum.
Rations 34 and 35 were fed in meal form.
Rations 34A and 35A were fed in pellet form.
3. Contained 2.0 gms. riboflavin; 6.0 gms. niacin; 3.68 gms. D-pantothenic acid and 20.0 gms. choline chloride per lb. of supplement.
4. Supplied by Abbott Laboratories, North Chicago, Ill.

Table 24
Kansas Swine Testing Station—Winter 1962-63
Pigs put on test between October 1, 1962, and November 15, 1962

	PRODUCTION DATA[1]					CARCASS DATA[2]				
Breeder	Sex	B	Age at 200 lbs. (days)	A.D.G. lbs.	Feed eff.	Lgth. in.	B.F. in.	L.E. sq. in.	% L.C.	Index
J. Talkington	B	Y	159	1.80	292	29.4	1.37	3.85	52.9	83.8
Matfield Green	B	Y	153	1.87		30.5	1.55	3.93	51.1	82.3
J. Talkington	B	Y	159	1.81	331	28.2	1.42	4.79	54.6	94.4
Matfield Green	B	Y	177	1.44		27.1	1.48	4.57	52.6	82.4
W. Talkington	B	D	154	1.87	321	28.6	1.27	3.74	51.9	76.2
Matfield Green	B	D	158	1.79		30.7	1.32	4.05	52.1	78.3
N. Walker	B	Y	134	2.07	300	29.8	1.48	4.08	51.0	84.9
McPherson	G	Y	138	1.99		30.2	1.25	5.61	56.1	106.8
N. Walker	B	Y	143	2.04	285	30.2	1.23	4.15	53.5	79.4
McPherson	G	Y	139	2.08		30.5	1.32	4.26	53.2	86.2
F. Germann	B	D	148	1.92	319	29.1	1.42	3.94	52.3	88.4
Dwight	B	D	148	1.77		29.2	1.20	4.47	52.4	94.4
M. Shipley	B	H	171	1.59	324	28.8	1.12	4.64	56.6	100.0
Eshon	G	H	173	1.56		28.1	1.33	4.69	55.0	105.7
Maurer-Neuer	B	H	149	2.06	316	29.4	1.37	4.72	54.3	94.2
Arkansas City	B	H	161	1.73		27.0	1.43	4.73	56.0	106.9
Maurer-Neuer	B	Y	168	1.72	337	30.2	1.47	3.95	49.2	78.7
Arkansas City	B	Y	150	2.07		30.0	1.72	3.89	48.4	68.9
Maurer-Neuer	B	Y	174	1.58	328	30.6	1.27	4.62	52.9	93.6
Arkansas City	B	Y	164	1.80		31.0	1.22	4.25	54.4	94.9
J. Balthrop	B	H	178	1.45	366	29.1	1.00	4.37	57.4	102.5
Wichita	B	H	170	1.55		28.9	1.05	3.91	56.1	89.4

1. B = breed; A.D.G. = average daily gain during test period; Feed efficiency = an average for two pigs fed together.
2. Lgth. = carcass length; B.F. = average carcass backfat; L.E. = loin eye area; % L.C. = % lean cuts on carcass weight basis; Index = index according to 1962 National Barrow Show Index (a pig with 5.00 sq. in. of loin eye and 15% of live weight in trimmed ham will index 100.0).

Table 24 (Continued)

Breeder	Sex	B	Age at 200 lbs. (days)	A.D.G. lbs.	Feed eff.	Lgth. in.	B.F. in.	L.E. sq. in.	% L.C.	Index
	PRODUCTION DATA[1]					CARCASS DATA[2]				
J. Balthrop	B	H	165	1.68	378	27.6	1.38	4.92	54.3	88.0
Wichita	G	H	172	1.47		27.5	1.13	4.74	54.7	93.6
J. Balthrop	B	H	186	1.27	412	29.2	1.05	4.33	56.4	97.7
Wichita	G	H	181	1.42		28.0	1.07	4.64	56.4	105.2
W. Huston	B	D	151	1.86	339	28.0	1.62	3.57	49.4	66.9
Americus	G	D	162	1.80		28.1	1.38	4.52	54.0	100.6
O'Bryan Ranch	B	H	152	1.45	330	30.1	0.93	5.35	61.7	111.3[4]
Hiattville	G	H	162	1.30		28.4	0.95	5.87	61.1	131.8
O'Bryan Ranch	B	H	160	1.73	344	29.4	1.10	3.82	53.9	82.0
Hiattville	G	H	146	1.52		33.02	1.00	4.58	58.3	109.3
O'Bryan Ranch	G	H	179	1.65	330	28.9	1.12	5.00	57.7	99.5
Hiattville	G	H	210	1.27		28.8	0.87	4.79	60.1	112.3
O'Bryan Ranch	B	H	160	1.25	332	28.0	0.85	4.59	62.7	117.3
Hiattville	G	H	143	1.44		29.5	1.05	5.48	60.2	117.3[3]
KSU	B	D	138	1.88	366	27.8	1.43	3.92	48.7	74.9
Manhattan	G	D	149	1.61		29.4	1.18	4.03	53.8	87.6
SUMMARY										
10 Breeders	38 Pigs (26B + 12G)		160 (134 210)	1.69 (2.08 1.26)	334 (285 412)	29.0 (27.0 31.0)	1.25 (0.93 1.72)	4.18 (3.57 5.87)	54.7 (48.4 62.7)	93.9 (66.9 131.8)

1. B = breed; A.D.G. = average daily gain during test period; Feed efficiency = an average for two pigs fed together.
2. Lgth. = carcass length; B.F. = average carcass backfat; L.E. = loin eye area; % L.C. = % lean cuts on carcass weight basis; Index = index according to 1962 National Barrow Show Index (a pig with 5.00 sq. in. of loin eye and 15% of live weight in trimmed ham will index 100.0).
3. Highest indexing carcass meeting or exceeding all certification requirements.
4. Cryptorchid.

Table 25
Swine testing expenses—summer 1962

Slaughter charge (42 pigs @ $7.00)	$ 294.00
Labor (297.5 hours @ $1.15)	342.12
Electricity	000.00
Feed (9 tons)	516.97
Veterinary service and medicine	58.70
Bedding and fly spray	20.00
Supplies and equipment	00.00
Postage, envelopes, etc.	6.00
Depreciation and maintenance (42 pigs @ $5.00)	210.00
	$1,447.79

$1,447.79 ÷ 42 = $34.47 per pig
(Rounded to $34.00)

Table 26
Swine testing expense—winter 1962-63

Slaughter charge (38 pigs @ $7.00)	$ 266.00
Labor (123 hours @ $1.15)	141.45
Electricity (Oct. through Feb.)	78.60
Feeds (8 tons)	482.16
Veterinary service and medicine	26.50
Supplies and equipment	11.00
Bedding and fly spray	10.00
Postage, envelopes, etc.	13.75
Depreciation and maintenance (38 pigs @ $5.00)	190.00
	$ 959.46

$959.46 ÷ 38 = $25.25 per pig
(Rounded to $25.00)

Actual production cost was $18.25 per pig or approximately $13.00 per 100 pounds of gain.

Concrete Floor vs. Elevated Wooden, Slotted Floor (Project 110).

B. A. Koch

The practice of raising pigs on an elevated slotted floor is receiving wide publicity. Slotted floors have been used in various parts of the world for many years, but they have only recently been used extensively in this country. Slotted floors take some of the labor from swine production and permit pigs in growing-finishing units to be crowded.

Experimental Procedure

Twenty-four feeder pigs weighing approximately 50 pounds each were divided into two similar groups for this study. The pigs had previously been vaccinated for hog cholera and erysipelas and had been wormed with piperazine. They were placed in two adjacent pens. One pen had a slotted floor raised nine inches above the original concrete floor. The other pen had a concrete floor. Manure was allowed to collect under the slotted floor.

The slotted floor sections were made up of oak slats 1¼ inches wide with ⅝-inch slots between slats. The sections were purchased commercially. Railroad crossties were used to elevate the floor above the concrete.

Pigs on concrete had approximately 15 square feet of floor space each while those on slats had approximately 8 square feet of floor space each. Both groups of pigs were self-fed complete meal ration number S-35. The ration formulation is listed in Table 23. Both groups drank from automatic water fountains and there was one mist-type fogging nozzle over each pen. Each pen was partially under roof.

Observations

Table 27 summarizes the average performance of pigs in each pen. Pigs on the slotted floor were always clean. All manure went through the floor and no cleaning was ever necessary. Pigs on the concrete floor were always dirty, even though the pen was scraped each day. The whole area was sprayed regularly to control flies.

During hot weather pigs on the slotted floor suffered noticeably from the heat and/or humidity. One pig became overheated and died August 6. Maximum temperature that day was 98° F. with high relative humidity. In contrast pigs on the wet, dirty floor showed little evidence of discomfort from heat even on the warmest days. Apparently the concrete floor helped cool the pigs.

Since feed efficiency figures are similar for the two groups, it is suggested that differences in weight gain were due to differences in feed intake due to temperature effect. It would be possible to overcome this effect in a properly designed slotted floor unit.

Table 27

Performance of pigs on a concrete floor vs. those on an elevated wooden, slotted floor.

June 7, 1962, to September 15, 1962—99 days.

	Concrete floor	Slotted floor
No. pigs	12	12[1]
Ration no.	S-35	S-35
Av. initial wt., lbs.	54	55
Av. final wt., lbs.	214	178
Av. daily gain, lbs.	1.61	1.28
Standard error	±0.04	±0.03
Av. feed eff., lbs.	3.30	3.35
Feed cost per cwt. gain	$10.06	$10.22

1. One pig died August 6. Post-mortem examination indicated heat prostration.

Corn vs. Sorghum and Pellets vs. Meal for Growing-finishing Swine (Project 110).

B. A. Koch

This is a continuation of feeding trials comparing the feeding value of corn and sorghum grain under Kansas conditions.

Experimental Procedure

Forty feeder pigs, 12 Poland Chinas and 28 Durocs averaging 55 pounds each, were randomly divided by breed and sex into four groups. All pigs had been previously vaccinated for cholera and erysipelas and wormed with piperazine.

The pigs were fed and housed on concrete where each pig had 18 square feet of space. There was an electrically heated, automatic waterer in each pen. Each group of 10 pigs had access to a three-hole fence line self-feeder.

Ration formulations are listed in Table 23. Rations 34 and 34A contained corn while 35 and 35A contained sorghum grain. Sorghum grain replaced corn on a pound-for-pound basis with no other changes in formulation. In each case one ration was fed as meal and one as pellets. Individual pigs were removed from test as they reached market weight. Carcasses were examined on the rail after slaughter.

Observations

Table 28 summarizes performance and cost data for the study. There was no significant difference between average daily gain figures for the various lots. In a previous study, pigs eating pelleted rations gained somewhat faster than those eating meal rations. The pigs eating the pelleted rations were more efficient than those eating meal. This was also true in a previous study.

Pigs performed as well on sorghum grain as on corn whether the ration was pelleted or in meal form. The corn and sorghum used in this study had similar protein levels, thus the change in grain did not change the crude protein level of the rations.

Under prices at the time of the study the sorghum grain rations produced cheaper gains than the corn rations. Pelleted rations produced gain more efficiently than meal rations in both comparisons even though the cost per ton of the pelleted rations was higher.

Carcasses from the various lots did not differ significantly in USDA grade.

Table 28

Corn vs. sorghum grain.

(Feeding period began December 16, 1961.)

Ration no.[1]	35	34	34A	35A
Av. % crude protein	16	16	16	16
Grain	Sorghum	Corn	Corn	Sorghum
Preparation	Meal	Meal	Pellet	Pellet
No. of pigs	10	10	10	10
Av. on-test wt., lbs.	52	54	56	56
Av. off-test wt., lbs.	215	206	222	220
Av. daily gain, lbs.	1.60	1.51	1.61	1.60
Standard error	±0.07	±0.07	±0.08	±0.07
Av. feed efficiency, lbs.	372	365	349	346
Av. feed cost per cwt. gain	$ 9.93	$10.73	$10.61	$ 9.58
Feed cost per ton	$53.40	$58.80	$60.80	$55.40

1. See Table 23 for ration formulation.

Swine Breeding Investigations (Project 242) (Progress Report).

B. A. Koch

A crossbred barrow sired by a Duroc boar (University Charm 16753), and out of a Poland China sow (Prince's Maiden 20-521492), was first place crossbred barrow at the 1962 Kansas State Fair. The barrow produced the champion carcass when slaughtered.

Carcass data follow:

Carcass length, 29.9 inches; backfat, 1.06 inches; loin eye area, 5.80 square inches; lean cuts, 53.67% of carcass weight and 39.1% of live weight.

Vitamin A Levels for Growing-finishing Pigs (Project 311).

B. A. Koch

Vitamin A supplementation recommendations vary considerably from station to station. Most research indicates that supplementation recommendations are generally much higher than actually necessary. This study was designed to determine performance response to low-level vitamin A supplementation of an otherwise adequate diet.

Experimental Procedure

Twenty-five crossbred (Duroc x Poland China) feeder pigs were randomly divided into two groups. They had previously been vaccinated for cholera and erysipelas and treated for worms with piperazine.

The pigs were confined on concrete with water and feed before them at all times.

Ration formulations are listed in Table 23. One ration contained 100 I.U. of added vitamin A per pound and the other 400 I.U. Analysis of the rations indicated that essentially no vitamin A or provitamin A was coming from other sources.

Individual pigs were removed from the pens as they reached slaughter weight. Carcasses were evaluated on the rail after slaughter.

Observations

Increasing the vitamin A content of the diet from 100 to 400 I.U. per pound did not change the average daily gain or the feed efficiency of the pigs. Both groups did as well as similar pigs consuming diets with much higher vitamin A content. Carcasses from pigs receiving the lower level (100 I.U.) of vitamin A tended to carry more backfat than those from pigs on the higher level.

Stomachs were recovered at slaughter and examined by Dr. W. J. Griffing as part of a School of Veterinary Medicine study of stomach ulcers in swine. No difference in incidence or severity of ulcer symptoms was noted between the two groups.

Table 29
Vitamin A levels for growing-finishing pigs.
(Started on feed, December 16, 1961)

Ration no.	29-B	29-C
Av. % crude protein	15.8	15.8
I.U. vitamin A added/lb.	100	400
No. of pigs	12	13
Av. on-test wt., lbs.	52	49
Av. off-test wt., lbs.	223	211
Av. daily gain, lbs.	1.62	1.56
Standard error	±0.10	±0.08
Av. feed efficiency, lbs.	342	333
Av. feed cost per cwt. gain	$10.70	$10.42
Feed cost per ton	$62.60	$62.60

Arsanilic Acid in Growing-finishing Swine Rations (Project 110).

B. A. Koch and Tran Nam

Arsanilic acid is one of the many feed additives approved by the Food and Drug Administration for use in swine rations. Results from an uncontrolled feeding demonstration suggested that arsanilic acid effectively increased daily gain and improved feed efficiency. This study was designed to check further the value of dietary arsanilic acid.

Experimental Procedure

Thirty head of Poland China and Duroc weanling pigs were randomly divided by breed and sex into three groups and started on test, December 16, 1961. Before the trial started all pigs had been vaccinated for erysipelas and cholera and had been wormed with piperazine.

Two groups were closely confined on concrete; the third had access to winter rye pasture. Individual pigs were removed from test pens as they reached market weight.

Observations

Table 30 summarizes the performance of the three groups. There were no statistically significant differences in average daily gain. However, pigs fed in confinement and supplemented with arsanilic acid had the highest average daily gain. Pigs on rye pasture required the most feed per pound of gain. They spent considerable time on pasture, but still had the poorest feed efficiency of any group.

The rye pasture, an old hog pasture, apparently increased incidence of roundworms in that group of pigs. They threw more roundworms when all groups were treated with piperazine 60 days after going on test. They also walked more than the pigs in confinement pens.

Feed costs per 100 pounds of gain were highest on the rye pasture because of poorer feed efficiency. Although pigs receiving no arsanilic acid in confinement gained slightly less per day than confined pigs receiving arsanilic acid, highest efficiency and lowest cost per 100 pounds of gain were from nonarsanilic acid, confined pigs.

Table 30
Arsanilic acid in growing-finishing swine rations.
(Feeding period began December 16, 1961.)

No. of pigs	10	10	10
Ration no.[1]	33	44	44
Av. % crude protein	15	15	15
Arsanilic acid	No	Yes	Yes
Rye pasture	No	No	Yes
Av. on-test wt., lbs.	43	52	48
Av. off-test wt., lbs.	204	230	218
Av. daily gain, lbs.	1.56	1.73	1.51
Standard error	±0.07	±0.09	±0.10
Av. feed efficiency, lbs.	325	338	369
Av. feed cost per cwt. gain	$ 9.98	$10.44	$11.40
Feed cost per ton	$61.40	$61.81	$61.81

1. See Table 23 for ration composition.

Some Effects of Dietary Nitrate and Nitrite on Growing-finishing Pigs (Project 311).

Siripong Sukhonthasarupa, D. B. Parrish and B. A. Koch

The presence of nitrates and nitrites in feed and drinking water of farm animals apparently has caused some serious nutritional problems. This study was to establish more clearly some ways the nitrites interfere with normal processes in the animal body.

Experimental Procedure and Observations

A pilot study using two pigs per treatment was initiated in June, 1962. Table 31 shows the general design of the study plus average results of data collected. Either sodium nitrate ($NaNO_3$) or sodium nitrite ($NaNo_2$) was mixed into the ration at the indicated level.

The pigs were fed on concrete from a self-feeder and were watered by hand. A fog nozzle was over each pen on the outside of the shed or shade areas. Blood samples were taken from the anterior vena cava area.

Results shown in Table 31 indicate that the two levels of dietary $NaNO_2$ caused an increase in the methemoglobin level of the blood, a decrease in serum vitamin A level and some decrease in growth rate.

Table 31
Dietary nitrate and nitrite for growing-finishing pigs.
June 20, 1962, to August 29, 1962.

Treatment group (2 pigs per group)	A.D.G. lbs.	Feed eff. lbs.	Hemoglobin (gms./100 ml.) Initial	Hemoglobin (gms./100 ml.) Final	Methemoglobin (% total Hb.) Initial	Methemoglobin (% total Hb.) Final	Serum vitamin A Final
Positive control[1]	1.74	2.88	14.3	16.1	1.30	3.25	20.05
+ 0.6% $NaNO_3$[2]	1.66	3.02	15.5	14.3	1.07	2.52	10.01
+ 1.2% $NaNO_3$[3]	1.74	3.16	16.2	15.7	1.62	2.37	11.10
+ 0.15% $NaNO_2$[4]	1.46	2.76	14.4	12.5	2.22	4.78	2.06
+ 0.30% $NaNO_2$[5]	1.39	3.07	12.1	13.3	1.87	25.53	2.06
Negative control[6]	1.57	2.93	15.1	16.1	2.37	2.59	6.04
+ 0.6% $NaNO_3$[7]	1.50	3.11	14.0	16.2	2.81	2.53	7.21

1. Basic sorghum grain ration—contained 1% alfalfa meal.
2. Increased to 1.0% $NaNO_3$ after 28 days.
3. Increased to 2.0% $NaNO_3$ after 28 days.
4. Increased to 0.2% $NaNO_2$ after 28 days.
5. Increased to 0.4% $NaNO_2$ after 28 days.
6. Basic sorghum grain ration—contained no alfalfa meal.
7. Increased to 1.0% $NaNO_3$ after 28 days.

A second trial is now in progress. Performance data, blood data and tissue data are being collected. The general design of the study follows:

1. Control—basic sorghum grain ration plus 5% alfalfa meal
2. Control + 3% $NaNO_3$
3. Control + 5% $NaNO_3$
4. Control + 0.3% $NaNO_2$
5. Control + 0.5% $NaNO_2$
6. Control + added carotene + 3% $NaNO_3$

Results of this study will be presented as they become available.

Sheep

Lamb Feeding Experiments 1962-1963.

Carl Menzies, K.S.U., and A. B. Erhart, Garden City

Lambs

Six hundred and forty mixed wether and ewe fine-wool, feeder lambs were received at the Zuni Indian Reservation near Gallup, N.M., October 18, 1962. They averaged 61.9 pounds at the receiving point and 58.6 pounds off railroad cars at Garden City, three days later.

General Procedure

During the 25-day pre-test period, lambs were fed mixed rye and vetch hay and average quality alfalfa hay. Lambs were weighed, lotted and started on test, November 15, when they averaged 66.1 pounds. All lambs were implanted with 3 mgs. Stilbestrol December 3, but not treated for internal parasites nor vaccinated for enterotoxemia.

Corn silage, sorghum silage, and alfalfa hay were compared as roughages in Lots 1, 5, and 2, respectively. Lambs were fed all the roughage they would eat, but whole sorghum grain, supplemental alfalfa hay, and cottonseed meal were limited.

Cottonseed meal plus ground limestone was compared with alfalfa hay as a supplement for a sorghum grain and sorghum silage ration in Lots 3 and 4.

Automatic, electrically heated waterers were installed in the lamb feedlot in 1962. To determine the effect on lamb performance, Lot 6 was watered with an unheated water trough, with lambs in Lot 5 fed a similar ration watered from a heated waterer, as controls.

Lambs in Lots 7, 8, and 9 were self-fed mixed rations of whole sorghum grain and ⅜-inch dehydrated alfalfa pellets. Lot 7 lambs were started on a mixture containing 25% sorghum grain, which was increased to 45% sorghum grain by the end of 90 days. Lots 8 and 9 were fed a mixture containing 80% sorghum grain from the start. Rye straw was supplied free choice to Lots 7 and 8, and sorghum silage was fed free choice to Lot 9.

Hybrid T 700 variety sorghum grain grown on one field contained 7.46% crude protein, while on another field the same variety of grain contained only 4.62% crude protein. The value of these two grains fed in a sorghum silage ration supplemented with .72 pound of alfalfa hay was studied in Lots 10 and 11.

Lambs in Lot 12 were grazed on alfalfa pasture.

Feed prices used in computing cost of gains follow:

Alfalfa hay	$25.00 per ton
Dehydrated alfalfa pellets	46.00 per ton
Corn silage	7.00 per ton
Sorghum silage	6.50 per ton
Rye straw	10.00 per ton
Sorghum grain	36.00 per ton
41% cottonseed meal	74.50 per ton
Salt	1.50 per cwt.
Ground limestone	1.00 per cwt.
Alfalfa pasture	.01 per head per day

Observations

Lambs fed corn silage in Lot 1 ate the same amount of silage as those fed sorghum silage in Lot 5. Gains were practically the same for both lots. In contrast to previous years' results, slightly slower and considerably more expensive gains were made by Lot 2 lambs fed alfalfa hay as the roughage.

Faster, more efficient, and cheaper gains were made by lambs in Lot 4, fed .72 pound of alfalfa hay per day, than those in Lot 3 fed .20 pound of cottonseed meal plus ground limestone. However, an additional .10 pound of cottonseed meal per lamb per day increased lamb performance and lowered feed cost per cwt. gain in Lot 5 compared with Lot 4.

Lambs having access to heated water consumed more silage and gained only slightly faster, but made cheaper gains than those watered from an unheated trough.

Lambs in Lot 7 ate an average ration of 35% whole sorghum grain and 65% dehydrated alfalfa pellets. They made fast, efficient gains, but alfalfa pellets made feed costs high. No trouble was experienced

Table 32

Comparative value of corn silage, sorghum silage and alfalfa hay as roughages and of cottonseed meal and alfalfa hay as protein sources for fattening lambs.

November 15, 1962, to February 13, 1963—90 days.

Lot no.	1	5	2	3	4
Treatment	Corn silage	Standard sorghum silage	Alfalfa hay	Sorghum silage, CSM	Sorghum silage, alfalfa hay
No. of lambs	47	49	50	47	49
Av. initial wt., lbs.	66.1	66.4	66.0	66.4	66.3
Av. final wt., lbs.	97.2	98.3	95.6	90.5	94.2
Av. total gain, lbs.	31.1	31.9	29.6	24.1	27.9
Av. daily gain, lbs.	.346	.355	.329	.268	.310
Daily feed per lamb, lbs.:					
Whole sorghum grain	1.35	1.35	1.35	1.35	1.35
Sorghum silage	....	2.41	....	2.87	2.27
Corn silage	2.41	....	....	....	....
Alfalfa hay	.72	.72	1.76	....	.72
41% cottonseed meal	.10	.10	....	.20	....
Limestone	....	....	....	.015	....
Salt	.014	.014	.014	.023	.014
Av. lbs. feed per cwt. gain:					
Whole sorghum grain	390.2	380.3	410.3	503.7	435.5
Sorghum silage	....	678.9	....	1070.9	732.2
Corn silage	696.5	....	....	....	....
Alfalfa hay	208.1	202.8	535.0	....	232.2
41% cottonseed meal	28.9	28.2	....	74.6	....
Limestone	....	....	....	5.6	....
Salt	4.0	3.9	4.2	8.6	4.5
Av. feed cost per cwt. gain[1]	$13.20	$12.70	$14.14	$15.51	$13.19
Av. feed cost per lamb[1]	4.10	4.05	4.18	3.74	3.68
Cost per lamb on test[1]	11.96	12.02	11.95	12.02	12.00
Av. total cost per lamb[1]	16.06	16.07	16.13	15.76	15.68
Av. total cost per cwt.[1]	16.52	16.35	16.87	17.41	16.64

1. Does not include cost of lamb losses or Stilbestrol implants.

Table 33

1. Heated vs. unheated water for lambs.

2. Self-fed mixtures of whole sorghum grain and dehydrated alfalfa pellets for fattening lambs.

November 15, 1962, to February 13, 1963—90 days.

Lot no.	5	6	7	8	9
Treatment	Heated water	Unheated water	Self-fed mix. of 35% whole sorg. grain, 65% dehy. alf. pellets + rye straw	Self-fed mix. of 80% whole sorg. grain, 20% dehy. alf. pellets + rye straw	Self-fed mix. of 80% whole sorg. grain, 20% dehy. alf. pellets + sorghum silage[1]
No. of lambs	49	48	49	39	45
Av. initial wt., lbs.	66.5	66.1	66.0	66.1	66.7
Av. final wt., lbs.	98.3	95.5	107.7	86.2	89.2
Av. total gain, lbs.	31.9	29.4	41.7	20.1	22.5
Av. daily gain, lbs.	.355	.327	.464	.223	.250
Daily feed per lamb, lbs.:					
Whole sorghum grain	1.35	1.35	1.25	1.31	....
Sorghum silage	2.41	2.13	....	....	....
Alfalfa hay	.72	.72	....	....	....
Dehy. alfalfa pellets	....	....	2.28	.33	....
Rye straw	....	....	.21	.32	....
41% cottonseed meal	.10	.10	....	....	....
Salt	.014	.017	.029	.022	....
Av. lbs. feed per cwt. gain:					
Whole sorghum grain	380.3	412.8	269.4	587.4	....
Sorghum silage	678.9	651.4	....	....	....
Alfalfa hay	202.8	220.2	....	....	....
Dehy. alfalfa pellets	....	....	491.4	148.0	....
Rye straw	....	....	45.2	143.5	....
41% cottonseed meal	28.2	30.6	....	....	....
Salt	3.9	5.2	6.2	9.9	....
Av. feed cost per cwt. gain[2]	$12.70	$13.52	$16.47	$15.02	....
Av. feed cost per lamb[2]	4.05	3.97	6.87	3.02	....
Cost per lamb on test[2]	12.02	11.96	11.95	11.96	....
Av. total cost per lamb[2]	16.07	15.98	18.82	14.98	....
Av. total cost per cwt.[2]	16.35	16.68	17.47	17.38	....

1. Lambs changed to sorghum grain, sorghum silage, and alfalfa hay ration after 15 days on test, because of serious digestive disturbances.
2. Does not include cost of lamb losses or Stilbestrol.

Table 34

High and low protein sorghum grain[1] of the same variety and alfalfa pasture for fattening lambs.

Lot no.	10	11	12
Treatment	High-protein sorghum grain	Low-protein sorghum grain	Alfalfa pasture
No. of lambs	49	49	50
Days on feed[2]	60	60	90
Av. initial wt., lbs.	66.4	66.9	66.8
Av. final wt., lbs.	84.3	80.4	100.9
Av. total gain, lbs.	17.8	13.5	34.1
Av. daily gain, lbs.	.297	.225	.379
Daily feed per lamb, lbs.:			
Whole sorghum grain	1.25	1.25	....
Sorghum silage	2.30	1.94	....
Alfalfa hay	.72	.72	....
Alfalfa pasture	....	....	Free choice
Salt	.015	.016	Free choice
Av. lbs. feed per cwt. gain:			
Whole sorghum grain	416.7	555.6	....
Sorghum silage	774.4	862.2	....
Alfalfa hay	242.4	320.0	....
Salt	5.0	7.1	....
Av. feed cost per cwt. gain[3]	$13.12	$16.91	$ 2.64
Av. feed cost per lamb[3]	2.34	2.28	.90
Cost per lamb on test[3]	12.03	12.11	12.09
Av. total cost per lamb[3]	14.37	14.39	12.99
Av. total cost per cwt.[3]	17.05	17.90	12.87

1. Sorghum grain was Hybrid T 700 variety grown on different fields.
2. Test was terminated after 60 days due to insufficient amount of desired sorghum grain.
3. Does not include cost of lamb losses or Stilbestrol implants.

in getting those lambs on feed. In contrast, lambs in Lots 8 and 9, self-fed the 80% sorghum grain and 20% dehydrated pellet mixture from the start, went off feed, scoured badly, and fatalities were high from enterotoxemia. It was felt, since these lambs had free access to either rye straw or sorghum silage, they might adjust to the concentrated ration without too much trouble. That was not the case; they should have been slowly adjusted as recommended. Digestive disturbances were more severe in Lot 9 fed the sorghum silage than in Lot 8 fed rye straw. Because of the trouble experienced in this lot, lambs were changed to a hand-fed sorghum silage, sorghum grain, and alfalfa hay ration. Lot 8 continued on its ration to the end of the test. This lot now has access to sorghum grain and alfalfa pellets in separate feeders to determine the proportion of each they will consume voluntarily. It can be seen from Table 35 that lambs in Lot 8 gained quite well after the first 30 days.

Lambs in Lot 10 fed the high-protein sorghum grain gained faster, more efficiently and cheaper than lambs in Lot 11 feed the low-protein sorghum grain. Considerably more silage was consumed by lambs fed the high-protein grain. Crude protein content of feeds was: high-protein grain, 7.64%; low-protein grain, 4.62%; sorghum silage, 1.33%; and alfalfa hay, 14.29%. Using these percentages and the average daily feed eaten, each lamb in Lot 10 was supplied .23 pound of protein daily and those in Lot 11 were supplied .19 pound. Both are less than the National Research Council recommendation of .34 pound of crude protein per 75-pound lamb per day. Had these two grains been compared in a ration high in protein, differences obtained here probably would not have existed. The sorghum grain and sorghum silage were lower in protein than currently used tables of nutritive composition indicated for them.

Alfalfa pasture produced fast, very cheap gains at the charged price. Two periods of low gains obtained on alfalfa pasture probably are explained by the causes listed in Table 36.

ACKNOWLEDGMENTS:

Dehydrated alfalfa pellets were furnished by Archer-Daniels-Midland Company, Holcomb, Kansas, and National Alfalfa Dehydrating and Milling Company, Garden City, Kansas.

Stilbestrol implants were supplied by Charles Pfizer and Company, Inc. Terre Haute, Indiana.

Investigations of Milk-fat Lamb Production Practices for Western Kansas, Results for 1961-62 and Preliminary Results, 1962-63.

Carl Menzies and Myron Hillman, Animal Husbandry Department, Kansas State University, and Evans Banbury, Superintendent, Colby Station.

Experimental Sheep

The Colby ewe flock consists of approximately 325 four- and five-year-old fine-wool ewes, that were purchased in southwest Texas as yearlings. Purebred Hampshire rams are used.

Table 35

Average daily gain per lamb by 15-day periods and total average daily gain for all lots, pounds.

Lot no.	Period 1	2	3	4	5	6	Total
1	.34	.35	.29	.31	.45	.35	.346
2	.32	.24	.26	.30	.47	.39	.329
3	.38	.07	.35	.26	.29	.14	.268
4	.42	.09	.36	.29	.31	.39	.310
5	.47	.47	.46	.31	.37	.37	.355
6	.43	.12	.26	.37	.41	.37	.327
7	.25	.44	.58	.54	.49	.49	.464
8	-.44	.20	.24	.36	.57	.38	.223
9	-.29	.15	.37	.36	.19	.41	.250
10	.35	.13	.40	.31	.43	....	.297
11	.35	.07	.16	.30	.41	....	.225
12[1]	-.45	.53	.78	.12	.61	.71	.379

1. Dogs chased and tore up several lambs during Period 1, and lambs were changed to new alfalfa pasture at end of Period 4.

Table 36

Death losses and cause by lots.

Lot no.	Enterotoxemia	Urinary calculi
1	1	2
2	0	0
3	2	1
4	1	0
5	0	1
6	0	2
7	1	0
8	11	0
9	5	0
10	0	1
11	1	1
12	0	0

General Procedure

This flock is handled in an early-lambing program, with the breeding season starting the last of May and extending to September 1. All lambs are sold as milk-fat lambs during spring and early summer.

Three separate tests are conducted during the year. The first attempts to determine the effect that varying the energy intake of ewes during a preflushing period has on lambing performance of the ewes. The second test compares various rations for flushing ewes, and the third studies various management practices and rations for ewes and lambs.

Preflushing Test—Spring, 1961

Procedure: 340 two- and three-year-old ewes were divided into two groups on the basis of age and number of lambs produced the previous year (April 24, 1961), and fed either of two rations for 17 days. One group was fed a low-energy ration of 2 pounds of alfalfa hay per ewe per day and one group received 2 pounds of alfalfa hay, ½ pound sorghum grain and 3 pounds of sorghum silage per ewe per day. At the end of this period an equal number of ewes from each lot were placed in each of six lots and fed different flushing rations for 40 days. (See flushing test, 1961, page 64.) Ewes were exposed to rams eight days after being placed on flushing rations.

Results and Discussion

Table 37

Gain and lambing performance of preflushed ewes—spring, 1961.

Preflushing ration	No. of ewes	Av. preflushing gain per ewe, lbs.[1]	Av. flushing gain per ewe, lbs.[2]	Cumulative % ewes lambing — Days after first lamb birth: 10	20	30	40	100	% lamb crop[3]
Low energy	171	−2.0	+13.1	2.9	18.1	80.7	91.2	95.8	120
Normal	169	+4.0	+ 9.0	5.3	20.7	79.3	86.4	94.7	117

1. 17-day period.
2. 40-day period.
3. Includes lambs dead at birth.

Ewes fed the low-energy ration lost weight during the preflushing period, and therefore made larger gains during the following flushing period. This group also had a slightly earlier average lambing date and a 3% larger lamb crop.

Preflushing Test—1962

Procedure: 327 three- and four-year-old ewes were allotted April 23, 1962, on the same basis and fed the same rations as in 1961. At the end of the 17-day preflushing period, ewes were again divided into six flushing lots (see flushing test, 1962, page 65) and were exposed to rams 17 days after going on flushing rations.

Results and Discussion

Table 38

Gain and lambing performance of preflushed ewes—spring, 1962.

Preflushing ration	No. of ewes	Av. preflushing gain per ewe, lbs.[1]	Av. flushing gain per ewe, lbs.[2]	Cumulative % ewes lambing — Days after first lamb birth: 10	20	30	40	100	% lamb crop[3]
Low energy	161	−11.6	14.6	16.8	48.4	91.3	93.2	95.6	123.0
Normal	163	.2	5.0	16.6	44.8	87.7	92.0	96.3	126.4

1. 17-day period.
2. 41-day period.
3. Includes lambs dead at birth.

Ewes fed the low-energy ration during the preflushing period lost considerable weight; the difference in gain response during the flushing period was the largest obtained during three test years. However, the lambing performance was not as expected nor as in past years. The ewes fed a low-energy preflushing ration tended to lamb slightly earlier, but the other group of ewes had a 3.4% larger lamb crop.

Ewe Flushing Test—Spring, 1961

Procedure: May 11, 1961, the two groups of preflushed ewes were divided equally into six lots on the basis of age, number of lambs produced by each ewe the previous year and preflushing treatment. Ewes were adjusted to flushing rations for three days and then fed their respective rations for 40 days, May 14 to June 22, 1961.

Twelve Hampshire rams were used to breed the ewes. Breeding season started May 22, eight days after ewes were started on flushing rations. The 12 rams were divided into six pairs and were with the ewes during the nights but not during days. Each pair of rams was rotated to a different ewe lot twice weekly. At the end of the flushing period, June 22, all ewes were turned together and grazed on buffalograss pasture. All rams were turned together with the ewe flock each night until the end of the breeding season, September 1.

Flushing rations for lots were as follows:

Lot 1. ¾ pound whole sorghum grain, full feed of alfalfa hay (average hay consumption per ewe per day was 4.8 pounds).

Lot 2. ¾ pound whole sorghum grain, 1¼ pounds alfalfa hay, full feed sorghum silage (average silage consumption per ewe per day was 5.5 pounds).

Lot 3. Cereal crop pasture plus ½ pound whole sorghum grain.

Results and Discussion

Table 39
Ewe gains and lambing performance for six flushing rations.
May 14, 1961, to June 22, 1961—40 days.

Lot no.	No. of ewes	Av. total gain per ewe, lbs.	No. ewes lambing	No total lambs[1]	No. sets of twins	% lamb crop[1]
1	57	17.3	54	68	14	119.3
2	57	9.9	56	62	6	108.8
3	56	8.0	53	71	18 + 1 triplet	126.8
4	57	8.0	53	73	18	128.1
5	56	11.1	53	61	8	108.9
6	57	12.1	55	68	13	119.3

1. Includes lambs dead at birth.

Table 40
Cumulative % ewes lambing by periods after first lamb birth—October 15, 1961.

Lot no.	Days after October 15: 10	20	30	40	100
1	5.3	15.8	75.4	87.7	94.7
2	5.3	21.0	71.9	86.0	96.5
3	3.6	16.1	75.0	83.9	94.6
4	1.8	12.3	80.7	86.0	93.0
5	....	19.6	78.6	87.5	94.6
6	3.5	14.0	79.0	94.7	96.5

Lot 4. Cereal crop pasture.

Lot 5. Buffalograss pasture plus ½ pound whole sorghum grain.

Lot 6. Buffalograss pasture.

Ewes grazing cereal crop pasture alone or supplemented with grain during the flushing period gained least, but had larger percentage lamb crops because of more multiple births. As in past years the lot receiving buffalograss pasture alone had one of the larger percentage lamb crops. There was no marked difference in early lambing between flushing rations as indicated in Table 4, and it should be noted that about 85% of the ewes in all lots lambed within a 40-day period.

Ewe Flushing Test—Spring, 1962

Procedure: May 11, 1962, the two groups of preflushed ewes were divided equally into six lots on the basis of age, number of lambs produced by each ewe the previous year, and preflushing treatment. These lots were fed different flushing rations for 41 days until June 21. Twelve Hampshire rams were used to breed the ewes starting May 28, 17 days after ewes were started on flushing treatments. Rams and ewes were handled the same as outlined for 1961 flushing tests.

Flushing rations for lots were as follows:

Lot 1. ¾ pound whole sorghum grain, 1¼ pounds alfalfa hay, and full feed of sorghum silage.

Lot 2. 1½ pounds whole sorghum grain, 1¼ pounds alfalfa hay, and full feed sorghum silage.

Lot 3. ¾ pound whole sorghum grain, ⅓ pound 41% pelleted soybean oil meal, and full feed sorghum silage.

Lot 4. Cereal crop pasture plus ½ pound whole sorghum grain.

Lot 5. Cereal crop pasture.

Lot 6. Buffalograss pasture.

Results and Discussion

Table 41
Ewe gains and lambing performance for six flushing rations.
May 11, 1962, to June 21, 1962—41 days.

Lot no.	No. of ewes	Av. total gain per ewe, lbs.	No. ewes lambing	No. total lambs[1]	No. sets of twins	% lamb crop[1]
1	55	10.4	52	59	7	107.3
2	54	13.0	52	63	11	116.7
3	53	9.2	51	58	7	109.4
4	55	9.3	54	85	29 + 1 triplet	154.6
5	54	7.1	50	72	22	133.3
6	53	9.6	52	67	15	126.4

1. Includes lambs dead at birth.

Table 42
Cumulative % ewes lambing by periods after first lamb birth—October 23, 1962.

Lot no.	Days after October 23: 10	20	30	40	100
1	23.6	50.9	94.6	94.6	94.6
2	20.4	40.7	88.9	90.7	96.3
3	13.2	50.9	88.7	92.4	96.2
4	12.7	50.9	89.1	94.6	98.2
5	13.0	44.4	88.9	88.9	92.6
6	17.0	41.5	86.8	94.3	98.1

Ewes in Lot 2, fed twice as much grain as Lot 1, gained more during the flushing period and had about 10% more lambs. While ewes in Lot 3 fed ½ pound soybean meal in place of alfalfa hay did not gain so much weight as ewes in Lot 1, they produced just as many lambs. As in past years ewes flushed with cereal crop pasture, cereal crop pasture plus grain, or with buffalograss pasture produced larger lamb crops than ewes fed other flushing rations. This was true even though ewe weight gain during flushing was not so large as with other rations.

Approximately 90% of the ewes lambed within a 30-day period, so differences among lots in date of lambing were small.

Lamb Feeding Tests (Winter 1961-62)

Procedure: Ewes and lambs were divided into six lots according to prior ewe treatment, date of lamb birth, and type of birth. A one-week adjustment after lamb birth was allowed before ewes and lambs were placed in their respective lots. Lambs were docked and castrated during that week. Creep rations were self-fed when lambs were one week old. Lambs were sent to market in periodic shipments as sufficient lambs weighing at least 95 pounds each were ready. All lambs not already sold or weaned were weaned April 20, 1962.

Treatments and rations fed various lots were:

Lot no.	Daily ewe ration	Self-fed lamb creep ration and treatment
1	1 pound whole sorghum grain 1¼ pounds alfalfa hay Full feed sorghum silage	Whole sorghum grain Alfalfa hay
2	1 pound whole barley 1¼ pounds alfalfa hay Full feed sorghum silage	Whole barley Alfalfa hay
3	1 pound whole sorghum grain 1¼ pounds alfalfa hay Full feed sorghum silage	Whole sorghum grain Wheat hay
4	1 pound whole sorghum grain 1¼ pounds alfalfa hay Full feed sorghum silage	Pelleted ration of 45% sorghum grain and 55% sun-cured alfalfa hay Alfalfa hay
5	Rye pasture	Rye pasture Whole sorghum grain Alfalfa hay
6	1 pound whole sorghum grain 1¼ pounds alfalfa hay Full feed sorghum silage After weaning, each ewe received 1 pound alfalfa hay and 6 pounds sorghum silage.	Whole sorghum grain Alfalfa hay (Weaned 8-10 weeks of age)

Results and Discussion

Performance and cost of gains of lambs fed the various creep rations are reported in Table 43.

Average lamb sale age varied from 137.2 days for Lot 5 to 188.5 days for Lot 3. Lambs in Lot 5 fed a creep of whole sorghum grain and alfalfa hay on rye pasture made fastest and cheapest gains. Lambs in Lot 4 fed the pelleted creep ration gained very well, but total cost of gain was highest of all lots except number 3. However, there were fewer digestive disturbances and death losses in Lot 4 (pelleted) than in other lots.

Lambs fed barley gained practically the same as those fed sorghum grain. Cost per cwt. gain was slightly higher with barley.

Lot 3 lambs gained slowest. Their creep ration was changed to include sorghum silage February 23, because the lambs appeared unthrifty and refused to eat much wheat hay. Their ration was again changed May

Table 43
Performance and cost of gains by lambs fed various creep rations—Fall, 1961, and Spring, 1962.

Lot no.	1	2	3	4	5	6
Treatment	Sorghum grain, alfalfa hay	Barley, alfalfa hay	Sorghum grain, wheat hay[1]	Pelleted 45% sorg. grain, 55% alfalfa hay	Rye pasture, sorghum grain, alfalfa hay	Early weaned, sorghum grain, alfalfa hay
No. lambs	58	63	50	66	61	62
Av. market wt., lbs.	102	102.2	93.6	107.5	107.8	101.7
Av. total gain, lbs.[2]	91.5	91.4	82.2	97.6	97.1	91.0
Av. daily gain, lbs.	.55	.52	.44	.69	.71	.50
Single lambs, lbs.	.58	.57	.49	.75	.76	.51
Twin lambs, lbs.	.50	.46	.32	.60	.62	.47
Av. market age, days	166.5	174.1	188.5	141.2	137.2	183.3
Daily feed per lamb, lbs.:						
Whole sorghum grain	1.18	....	1.12	....	1.33	1.30
Whole barley	....	1.14	....	....	....	....
Pelleted ration	....	....	.01	2.22	....	....
Alfalfa hay	.57	.60	.10	.19	.10	.92
Wheat hay	....	....	.08	....	....	....
Sorghum silage	....	....	.36	....	....	....
Av. lbs. feed per cwt. gain:						
Whole sorghum grain	214.1	....	257.5	....	187.6	261.1
Whole barley	....	217.0	....	....	....	....
Pelleted ration	....	....	2.3	322.7	....	....
Alfalfa hay	103.4	114.2	23.0	27.6	14.1	184.8
Wheat hay	....	....	18.4	....	....	....
Sorghum silage	....	....	82.8	....	....	....
Lamb feed cost per cwt. gain[3]	$4.93	$ 5.34	$ 5.11	$ 7.28	$ 3.29	$ 6.80
Ewe feed cost to April 20 per cwt. gain[4]	9.38	9.32	12.75	8.21	4.37	7.01
Total feed cost per cwt. gain	14.31	14.66	17.86	15.49	7.66	13.81

1. Ration changed February 23, due to feeding problems.
2. Market weight minus average birth weight for lambs in each lot.
3. No charge made for rye pasture for lambs in Lot 5. This was charged to ewe feed cost.
4. Includes cost of feeding nursing ewes and dry ewes having lambs weaned early up to April 20 when all lambs were weaned.

18 to whole sorghum grain, 45% sorghum grain-55% alfalfa hay pellets, and alfalfa hay. Results with the wheat hay emphasize that low-quality feeds should be avoided in creep feeding lambs.

Average weaning age of early weaned lambs in Lot 6 was 68 days, and average weaning weight was 51.7 pounds for single lambs and 41.9 pounds each for twins. These lambs gained slightly slower and consumed more feed (may not be actual, since lambs in non-weaned lots ate some feed with the ewes) than lambs nursing ewes and fed the same creep ration in Lot 1. It cost $1.87 more per cwt. gain for early weaned lambs; however, considering the reduced ewe feed cost to April 20 for Lot 6 the total feed cost per cwt. gain was $0.50 less for early weaned lambs.

Table 44
Lamb death losses and treatments by cause in indicated lots.

Lot no.	Urinary calculi	Enterotoxemia	Lameness and stiffness	Scours	Other causes	Death loss
1	3	2	1	9	..	4[1]
2	1	..	..	5	..	..
3	2	6	1	4	1	6[2]
4	..	..	..	..	3	..
5	1	..	..	1	3	..
6	..	3	1	14[3]	3	..

1. Two died of enterotoxemia, one of respiratory infection, and one foundered.
2. Three died of enterotoxemia, two from urinary calculi, and one was killed when shed collapsed.
3. Scours were not serious.

Feed prices used to calculate cost of ewe and lamb feeds were: rye pasture, 1½ cents per ewe per day; whole sorghum grain, $1.65 per cwt.; whole barley, $1.75 per cwt.; alfalfa hay, $27 per ton; sorghum silage, $8 per ton; 45% sorghum grain-55% sun-cured alfalfa hay pellets, $42.75 per ton (includes $8 per ton for processing and $2.60 per ton for sacks).

Lamb Feeding Tests (Winter, 1962-63)

Procedure: Ewes and lambs were managed the same during the week adjustment period as in 1961-62 feeding tests.

Following are the 1962-63 treatments:

Lot no.	Nursing ewe daily ration	Lamb ration creep
1	**Standard ration** 1 pound whole sorghum grain 1¼ pounds alfalfa hay Sorghum silage (full feed)	**Standard ration** Whole sorghum grain Alfalfa hay
2	Standard ration	Dry rolled sorghum grain Alfalfa hay
3	Standard ration	Dry rolled sorghum grain containing 10% soybean oil meal Alfalfa hay
4	Standard ration	Dry rolled sorghum grain containing 5% salt Alfalfa hay
5	Rye pasture—standard ration when needed	Standard ration Rye pasture
6	Standard ration Maintenance ration after lambs were weaned	Standard ration Wean lambs 8 to 10 weeks of age

One half the single male lambs in each lot were castrated and one half left as ram lambs.

Results of the above test in progress will be reported in the 1963 annual report.

Value of 3-mg. Stilbestrol Implants[1] for Young Lambs.

Carl Menzies, Myron Hillman and Doyne Lenhart

Considerable work has been conducted at this station and at the Garden City Branch Station to determine the value of various hormone treatments for feeder lambs. In a previous test (Circular 378) young lambs implanted with 3 mgs. Stilbestrol or Synovex gained less and shrank more enroute to market than controls. This test was conducted to obtain more information on Stilbestrol implants for young lambs.

Experimental Procedure

Forty-two crossbred lambs sired by Suffolk rams and out of commercial fine-wool ewes were used. Twenty-one were implanted with 3 mgs. Stilbestrol each.

Lambs averaged 24 days of age when started on test, February 17. They nursed their mothers until May 1, when all were weaned. A pelleted ration of 45% sorghum grain, 2.5% soybean oil meal, 7.5% molasses, 45% dehydrated alfalfa meal, and 10 mgs. aureomycin per pound was self-fed in a creep before lambs were weaned and in a self-feeder after that. Loose alfalfa hay was fed free choice in addition to the pellets.

Results and Discussion

Results are presented in Table 45. There was no significant difference in rate of gain. Since all lambs were fed together, feed efficiencies for different treatments could not be determined.

1. Supplied by Chas. Pfizer & Co., Inc., Terre Haute, Ind.

Table 45
3-mg. stilbestrol implants for young lambs.
February 17 to May 30, 1962—102 days.

Treatment	Control	3-mg. stilbestrol implants
No. lambs per lot[1]	21	21
Av. age at start of test, days	24	24
Initial wt. per lamb, lbs.	19.8	21.3
Final wt. per lamb, lbs.	76.8	79.9
Total gain per lamb, lbs.	57.0	58.6
Av. daily gain per lamb, lbs.	.559	.574

1. Control group consisted of 10 ewe and 11 wether lambs and the implanted group had 7 ewe and 14 wether lambs.

Heritabilities, Genetic, and Phenotypic Correlations Between Carcass and Live Animal Traits in Sheep (Project 347).

Carl Menzies, Myron Hillman, John D. Wheat, D. L. Mackintosh and D. H. Kropf

This is part of the North-Central-50 Regional Sheep Breeding Project. This station's project was initiated to determine relationships between various carcass measurements and live animal traits, to estimate heritability of those traits and to determine how findings may be applied to selecting and breeding meat-type lambs.

Experimental Procedure

Seventy-six lambs of known breeding born in the fall of 1961 were used. They were sired by eight unrelated Suffolk rams and were out of an original flock of 100 western ewes. Live animal estimates and measurements were obtained on the rams and lambs and several carcass estimates and measurements were obtained on the lambs. Data are being processed on these lambs. The fourth lamb crop from these ewes is being slaughtered now. Data similar to those on previous lamb crops will be reported.

Also during 1962, 12 Hampshire ram, 3-month-old lambs were obtained from eight breeders. The rams were sheared, adjusted to feed and individually fed. Average daily gain and feed conversion were calculated. These rams will be bred to the original flock of 100 western ewes in the summer of 1963. As in previous years, performance and carcass data will be obtained on lambs produced.

Data on the 176 crossbred lambs produced during the two previous years by mating 19 Hampshire rams to the original flock of 100 western ewes have been analyzed. Rams were scored and corrections calculated between ram scores and lamb production and carcass traits. Lambs were sheared, measured and slaughtered when they weighed 95 to 100 pounds.

Simple correlations and heritability estimates (paternal half-sib correlations) were computed on all lamb and carcass traits studied.

Results and Discussion

Performance data on Hampshire rams to be used to breed the ewe flock in 1963 are reported in Table 46.

The relationship between ram scores indicated that in selecting for general type, most emphasis was placed on muscling, size of bone, size of leg, and weight of ram. Size of rear leg was most closely correlated with estimated muscling, and shorter legged rams were believed to be heavier boned. Weight of ram was significantly related with depth of probe of the longissimus dorsi muscle of the live ram.

Only a few traits were significantly related with lamb carcass and production traits. Shorter legged rams sired lambs with greater loin eye, $r = .48$; depth of loin eye, $r = .50$; and larger loin eye areas, $r = .35$. Depth of the longissimus dorsi probe in the ram was negatively related to market age of his lambs, $r = .60$; and lamb carcass grade, $r = .59$.

The relationship between lamb production traits and their carcass characteristics indicated that lambs heavier at birth gained faster and reached market weight at an earlier age. The carcasses from younger lambs contained less feathering and marbling and consequently graded lower. Rate of gain was positively related to carcass traits indicating leanness and bone, and negatively related to carcass traits indicating fatness, denoting that up to 100 pounds, gain is primarily due to growth rather than to fat production.

Few correlations between lamb measurements and carcass characteristics, even those that were statistically significant, were large enough to be used effectively in a selection program. However, length of rump was significantly correlated with weight of leg, .51, and weight of leg was significantly correlated with loin eye area, .39, and grams of lean in the rack, .39. Width at the second lumbar vertebra was more closely correlated to carcass characteristics, indicating fatness.

Live lamb measurements did not accurately indicate the same measurements on the carcass. The most useful lamb or carcass measurements that could be used as indicators of lean, fat, or bone in the carcass were width of loin in the lamb and carcass as an indicator of fat; circumference of forecannon in the lamb and carcass as an indicator of the amount of bone. Length of rump in the lamb and width of hind leg in the carcass were the best indicators of lean.

Feathering and marbling were significantly related to fat factors and carcass grade, which were positively related to market age. Carcass grade was positively related with fat factors in the carcass and either nonsignificantly or negatively correlated with factors indicating leanness in the carcass. Weights of leg and shoulder were positively related to increased leanness in the carcass and weights of the loin, rack, and breast were positively related to increased fatness in the carcass.

Sire effects were highly significant for birth weight, average daily gain, length of rump and forecannon, feathering and marbling score, and weight of loin. Generally, production traits were more highly heritable than lamb measurements of carcass characteristics, except length of forecannon, .51, and length of rump, .50 for the lamb; and feathering, .57, and marbling, .39 in the carcass.

Table 46

Performance data on Hampshire ram lambs to be used to breed ewe flock in 1963.

Ram no. (single unless noted)	Birth date	Birth weight, lbs.	Av. daily gain, lbs.[1]	Days on feed	Feed conversion, lbs.
1. Twin	1-24-62	7	.55	134	7.19
2. Twin	1- 9-62	10	.64	92	6.31
3.	1-31-62	12.5	.74	104	5.83
4.	1-11-62	11	.70	118	5.69
5.	1-14-62	10	.56	129	7.03
6.	1-13-62	14	.69	118	5.81
7.	1- 1-62	13	.73	82	6.30
8.	1- 4-62	9	.54	134	6.06
9.	1- 7-62	10.5	.63	134	6.14
10.	1- 9-62	13	.47	134	7.20
11. Twin	1-31-62	12	.71	100	6.09
12. Twin	1-10-62	12	.91	58	4.86

1. Lambs were fed from approximately 60 days of age until they weighed 110 pounds. Four lambs not reaching this weight were fed for 134 days.

Meat

The Relation of Feathering and Overflow Fat of Lamb Carcasses to the Grade of the Lamb, Degree of Marbling, and Market Value of the Lamb (Project 580).

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A total of 279 crossbred lambs were slaughtered over a three-year period at an approximate live weight of 90 pounds. USDA carcass grade and the various quality factors influencing grade were scored by a representative of the Federal Grading Service. The rack was dissected into fat, lean, bone, overflow and intercostal muscle. The **longissimus dorsi** and intercostal muscles were removed for fat analyses by the Modified Babcock Method. Color was determined in the **longissimus dorsi** and **rectus abdominis** with a Photovolt Reflectance Colorimeter. Loin samples were used for taste panel evaluations. Myoglobin concentration, by the Poel Cyano Method, pH, and expressible moisture, by the filter paper method, were also determined in the **longissimus dorsi, rectus abdominis,** and intercostal muscles.

Thirty-two crossbred lambs were randomly allotted to four treatments of eight lambs each in the color phase of the study. Lot 1 was the control; Lot 2 received 700 mgs. iron sulfate and 70 mgs. copper sulfate per pound of creep ration; Lot 3a, 5-cc injections of a 1:1000 solution of epinephrine hydrochloride in physiological saline at 12 and again at two hours prior to slaughter; Lot 3b, 10-cc injections of the epinephrine solution 12 and two hours prior to slaughter; Lot 4a, four lambs were exercised to near exhaustion immediately prior to slaughter on a treadmill; and in Lot 4b, four lambs were exercised to near exhaustion with a sheep dog.

Feathering accounted for between 40 and 50% of the variation in USDA grade. Conformation, fat streaking in the flank steak, fat streaking in the other flank muscles, quantity of external finish, color of lean in the flank steak, overflow fat, and kidney and pelvic fat were all significantly correlated with carcass grade. Marbling and percent fat in the **longissimus dorsi** muscle were both significantly correlated with grade.

Marbling was the best indicator of quality as evaluated by a taste panel. Feathering was not so good an indicator of quality, even though both the objective and subjective evaluations of marbling and feathering were significantly correlated. Carcass grade was more closely related to juiciness than to any other sensory factor.

Many subjective and objective quality evaluations were significantly correlated, suggesting that the use of subjective methods in carcass quality evaluation may be justified. Subjective conformation score was more closely related to the amount and proportion of fat in the carcass than the amount and proportion of lean.

Thickness of fat over the **longissimus dorsi** muscle appears to be a better indicator of the percent fat, lean, and bone in the carcass, although **longissimus dorsi** area was highly significantly correlated with weight of lean in the rack. **Longissimus dorsi** area appears to be influenced more by slaughter weight and chilled carcass weight than any of the other factors studied. Thickness of fat was observed to be highly correlated with internal and external fat deposits in the carcass.

Data from the color phase of the study indicate that color and pH of muscle tissue can be influenced by preslaughter treatments, such as subcutaneous injections of high levels of adrenalin and exhaustive exercise. Also, the maturity class may be influenced by factors other than age, such as stress conditions prior to slaughter. Although the analyses did not indicate significant treatment differences in USDA grade, the final grade was influenced by color of the tissue in some carcasses.

Feed Costs

Sorghum grain	$ 1.80 cwt.
Sorghum silage	$ 6.00 ton
Alfalfa hay	$20.00 ton
Prairie hay	$16.00 ton
Soybean meal	$ 3.50 cwt.
Cracked corn, cwt.	$ 2.15

Table 47
Chemical analysis of feeds used in beef cattle experiments.

Description	% protein (N x 6.25)	% ether extract	% crude fiber	% moisture	% ash	% N-free extract	% calcium	% phos-phorus	Carotene, mgs./100 gms. (dry basis)
Sorghum silage	1.95	0.75	7.38	68.49	1.54	18.89	......	......	0.44
Alfalfa hay	11.98	1.19	35.67	5.00	3.11	43.05	......	......	2.20
Prairie hay	4.94	2.18	31.74	7.87	6.69	46.58	0.39	0.11	2.93
Prairie hay (three years old)	6.44	1.63	34.83	8.58	6.14	42.38	0.45	0.09	0.55
Prairie hay (some old growth present in hay)	4.94	2.18	30.73	9.75	7.13	45.27	0.41	0.11	3.43
Sorghum grain	10.56	3.23	1.85	9.35	1.71	73.30	0.03	0.30	......
Ground sorghum grain	11.00	3.33	1.69	8.44	1.59	73.95	0.03	0.30	......
Soybean meal	46.50	2.18	5.60	6.68	6.59	32.45	0.42	0.68	......
Dicalcium phosphate	......	......	......	......	......	......	23.75	19.30	......