Colorado State University

50th

Beef Cattle Breeding at the San Juan Basin Research Center 1946-1999

Celebrating the 50th Annual Field Day and Sale
1950–1999

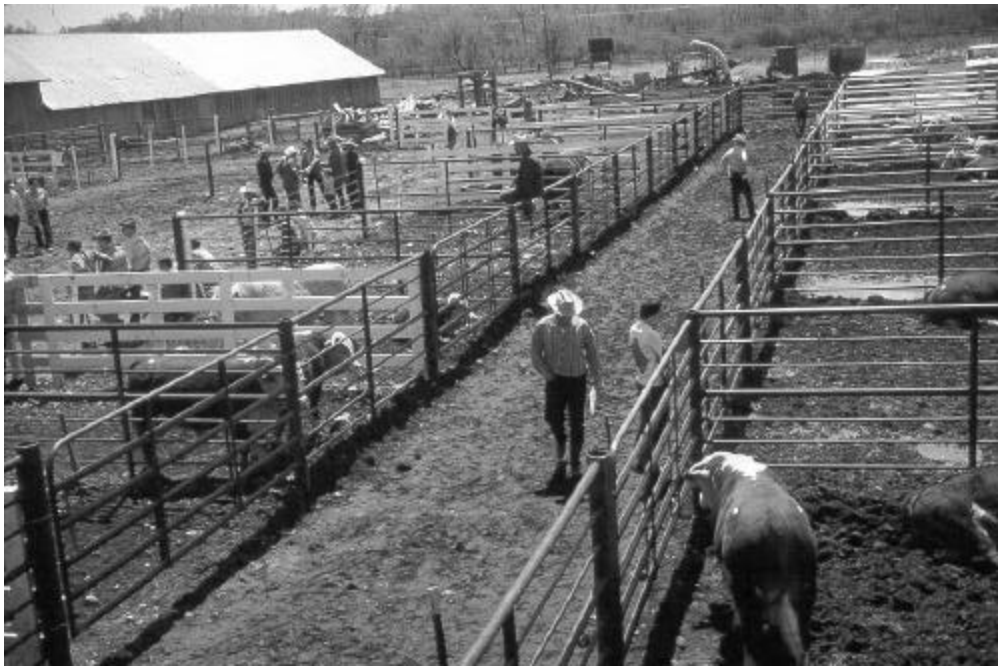
PREFACE

The San Juan Basin Research Center has a long and productive history in beef cattle breeding and production research. The beef cattle breeding project began in 1946 under the leadership of Dr. H.H. (Stony) Stonaker and is continuing today. The Center has served as a valuable resource for graduate students in animal breeding, veterinary studies and undergraduate interns throughout its history. Under the leadership of Dr. Stonaker, 25 M.S. theses and 4 Ph.D. dissertations were completed (1946-1966). Dr. Jim Brinks followed Stonaker and served as advisor for 44 M.S. theses and 29 Ph.D. dissertations (1967-1994).

This publication discusses some of the research highlights and lists the theses and dissertations along with journal articles and bulletins published using data from the Center. In addition, there were hundreds of articles and written presentations that are not listed. The Annual Beef Cattle Improvement and Sale Data bulletins contain research reports and project updates for the period of 1950-1999. The Center has been extremely productive over the past 53 years and is still generating useful data for the beef cattle industry.

J. S. Brinks

Ranchers began performance testing bulls at the Center in the fall of 1949 and the first joint sale took place in 1950. Thus, 1999 marks the 50th year of the joint bull sale.



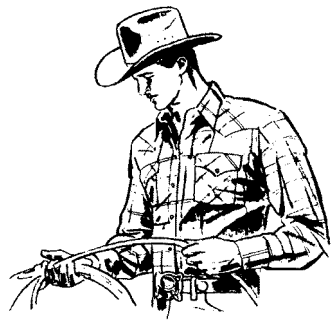
ACKNOWLEDGEMENTS

Many people were associated with the beef cattle portion of the research program at the San Juan Basin Research Center. The primary personnel located at the Center that were directly involved are listed below, along with the principal investigators. Many of the contributing scientists from Colorado State University are noted in the text. Also, graduate students who assisted in the collection and analysis of data are listed in the theses and dissertation section.

The authors also wish to thank Cheryl Miller for typing, Mary Liz Stonaker for typing and editing, and Jackie Whittemore for graphics and publication preparation for this bulletin.

Primary Personnel Associated with the Beef Cattle Breeding Project

Superintendents/Farm Managers Herdsmen/Managers		***Principal Investigators***
Jim Ingalls	Stony Stonaker	Andrew Canterbury
Ted Rowe	Jim Brinks	Don Morrow
Jim Stephens	Ronnie Green	Bob Wilcox
W.O. Harrel		John Childears
Ray Groves		Bill Confer
Kent Riddle		Joe Walck
Peter Fagerlin		Gary Conrad
Warren Mangus		
Al Denham		
Dave Schafer		



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BEGINNINGS OF THE COLORADO PROJECT

The project began through the active cooperation of Fort Lewis A & M College and the Animal Investigations Section of the Colorado Agricultural Experiment Station. Fort Lewis owned a herd of registered Hereford cattle, which was managed similarly to management regimes practiced by commercial cattlemen providing an ideal opportunity for cattle breeding research. The first systematic weights on the herd were taken in 1943. Record keeping was discontinued during the war years until 1946 when Dr. H. H. Stonaker returned from military service. The initial projects were studies on type and hybrid vigor in Hereford cattle organized on a cooperative basis between the two Colorado institutions. Cooperative agreements with the U.S.D.A. Bureau of Animal Industry were drawn up in 1946 providing regional coordination and appreciable assistance of Federal personnel and research funds. Research was conducted under Western Regional Project W-1, "The Improvement of Beef Cattle Through the Application of Breeding Methods" where the Western State Experiment Stations and the U.S. Department of Agriculture cooperated. In addition, financial aids and facilities were furnished in part by Fort Lewis A & M College, Sears Roebuck Foundation and the American Hereford Association.

DEVELOPMENT OF INBRED LINE, LINECROSS AND COMPOSITE POPULATIONS

Inbred Lines

There was considerable interest in development of inbred lines of livestock and subsequent crossing of lines to obtain hybrid vigor after these methods proved highly successful in corn breeding. The objectives in developing inbred lines of Hereford cattle in the Colorado project were: 1) to increase the predictability of breeding performance of beef animals, 2) to explore the possibility of exploiting hybrid vigor within a pure breed and to determine whether methods could be adapted to commercial use, and 3) to report the effects of inbreeding in Hereford cattle (1950).

A brief pedigree description and history of the inbred lines along with the number born and percent inbreeding by line and year (1946-74) is listed in the 26th Annual Beef Cattle Improvement Report and Sale Data publication (1975). Seven of the original lines were begun with foundation females from the existing Fort Lewis herd that had been divided based on pedigree and type. These females were predominantly of Prince Domino breeding. These included the Colorado, Fort Lewis, La Plata, Mesa (comprest), Prospector, Royal and San Juan lines. The other lines originated from breeders in Colorado and surrounding states and included the Animas, Bonanza, Brae Arden, Don, Monarch, Tarrington, Real Prince, Model Domino, and Electra lines. The Ouray and Hermosa lines produced their first progeny in 1970 and were developed using linecross females mated to top linecross bulls after which the lines were closed to outside breeding.

The Red Angus (Dolores) and Angus (Mancos) lines produced their first progeny in 1970. The Red Angus females were of Beckton breeding and were mated to Choctaw Chief 373 to begin the line. The Angus females came from several breeders and the first sire selected for use within the line was Mancos 1552 by Flints Bobo Geordus F67.

Linecrosses

Inbred sires used within the lines were simultaneously mated to unrelated linecross females each year throughout the study to obtain estimates of heterosis.

Composites

Two composite populations were established in 1986 to demonstrate the feasibility of crossing phenotypically alike but genetically diverse populations to take advantage of heterosis while maintaining uniformity in progeny type and performance.

In Phase 1 of the study, System I sires used were from three existing composites, MARC III (¼ Pinzqauer, ¼ Red Poll, ¼ Angus, ¼ Hereford), CASH (¼ Charolais, ¼ Angus, ¼ Brown Swiss, ¼ Hereford) and RX3 (½ Red Angus, ¼ Red Holstein, ¼ Hereford) which were mated to the Center's linecross Hereford females. The System II herd was begun by mating Brangus ($^5/_8$ Angus, $^3/_8$ Brahman), Barzona (¼ Angus, ¼ Hereford, ¼ Africander, $^5/_{32}$ Shorthorn, $^3/_{32}$ Brahman), and Beefmaster (½ Brahman, ¼ Shorthorn, ¼ Hereford) to the Center's outbred Angus and Red Angus females.

During Phase 2, sires from the initial composites were mated to unrelated 2-way cross Phase I female progeny to produce 3-way cross progeny. In Phase 3, 3-way Phase 2 sires were mated to 3-way Phase 2 females to produce ¼ MARC III, ¼ R X 3, ¼ CASH, ¼ Hereford progeny. Phase 4 consisted of mating Phase 3 progeny inter se. System II was developed in the same manner and resulted in ¼ Brangus, ¼ Beefmaster, ¼ Barzona, and ¼ Angus or Red Angus. The mating of relatives was avoided in order to maintain as much heterozygosity as possible. The complete experimental design is presented in the 1990 annual report.

BREEDING FOR BEEF
1946-1966 -- H.H. Stonaker

The first twelve years of the project on improvement of beef cattle through breeding undertaken at the San Juan Basin Branch Experiment Station was summarized in the *Breeding for Beef* bulletin (501-S) that went through four printings and 11,000 copies. I had trouble finding even one copy! On the 50th anniversary of field days and sales held at Hesperus, I'll recall some of the highlights of that bulletin and in addition the more interesting events through 1966. Dr. Brinks and Dr. Schafer will cover the period since then. We have been able to recover all of the annual bull sale catalogues which include some experimental results for fifty years. The project[1] began in 1946. I apologize for not giving the proper credit due to the many wonderful people who contributed their ideas, their time, the use of their ranches and cattle in the interest of furthering many studies.

Coming from Iowa State, where I worked for my PhD degree under J.L. Lush, the emphasis was on developing inbred lines of Poland China and Danish Landrace hogs. After all, this was Henry Wallace and Pioneer hybrid corn and poultry country; so we students were embued with that philosophy in our research.

Colorado State was A&M in 1946. Sherman Wheeler was department head; Homer Henney was dean and director. They were as supportive as they could have been. Ted Rowe, farm manager at Fort Lewis, and I had gotten our heads together at the cattlemen's meeting in Gunnison in 1943. Ted offered full cooperation in starting a breeding project with the Fort Lewis purebred Hereford herd. The dean at Fort Lewis, Ernest Bader, was also encouraging.

Establishment of the project at the experiment station at Fort Lewis was initially justified in terms of two objectives. The first was to compare performance, costs, and returns from the new "comprest" and conventional types of cattle. The second objective was to study the effects of inbreeding and crossing of lines.

Kent Riddle, superintendent 1956 to 1969.

THE FIRST 12 YEARS -- 1946–1957

A Selection Index for Beef Cattle

Using very limited data, Lindholm evaluated the relative importance of traits most affecting beef income (1956). Indexing traits most affecting net income, he found that weaning weight was easily the most important. In his study, traits considered were weaning weight, daily

[1] W-1, a Western region cooperative project including eleven Western states and Hawaii, funded federally through the U.S. Department of Agriculture.

gain, days to finish, slaughter grade, feed per pound of gain, and cost of cow maintenance as affected by cow size. Only weaning weight and daily gain seemed important in a selection index. Lindholm's index was Weaning Weight+50 Daily Feedlot Gain. We found that heavier calves also graded higher because of thickness and "bloom". In his study, reproductive performance and calving rate were not included. Open cows or heifers were routinely culled in the fall, so culling of them was automatic.

The data on the type-test steers also were analyzed by sire groups in order to develop heritability estimates. The large standard errors of those heritability estimates indicated this was a futile effort with such limited data (Stonaker, 1958, Table 17).

Kent Riddle (L) and H.H.Stonaker (R).

The Comprest Cattle

Shape and size became a hot topic in beef breeding with the appearance of a partial dwarfing gene called "comprest" in Herefords. The American Hereford Association financed the acquisition of a herd to study the effect of the gene in the cow herd, in the feedlot, and in the carcass. The breeding females were wintered on hay alone and ate amounts almost directly in proportion to their body weights. In the feedlot, the different types when fed to approximately the same degree of fatness showed almost the same level of feed efficiency and took the same amount of time to reach low choice. In other words, comprest did not fatten more quickly or economically. Many body measurements were taken on the steers in the type studies. The most promising relationship found in predicting cutout value among carcasses was greater body length relative to depth. We concluded at the time that opportunities are small for increasing carcass value relative to increasing weaning weights or feed efficiency.

Recessive Dwarfism

In the 1950s there was much interest in the investigation of recessive dwarfism. The Hereford Association was particularly aggressive in its efforts to solve the problem. Dr. Paul Gregory at the University of California had devised an instrument for profiling the heads of bulls. Measurements were taken and predictions made of the bull's genotype for dwarfism. Dr. Emmerson and Dr. Hazel of Iowa State University, using x-rays on baby calves, had developed a classification of newborn calf vertebrae for prediction of the heterozygous genotype.

Since all bull calves were kept entire at Fort Lewis and none were purposely removed before yearling age, there was a good population to study both the x-rays of lumbar regions and the head profiles of the bulls. We rejected the profilometer's usefulness based on the Fort Lewis bulls. Emmerson and Hazel (1950) also had us x-ray the lumbar region of many of the calves

from the lines. Although no dwarfs had occurred, forty calves in the Brae Arden line showed a high incidence of vertebral structure noted in Hazel's dwarf carrier category. Later the Iowa scientists found other bloodlines that did not seem to fit into the anatomy typical of most dwarf, heterozygote, or normal. Thus the accuracy of the vertebra classifications was questioned and later discarded.

Other Deleterious Genes in the Lines

Two spastic calves that became completely rigid when handled were observed in one line. Crossed eyes were observed in another inbred line. Hypoplasia of testes was observed in another line. Striking abnormalities were not common, however, in the lines.

Blood Antigens

A deep concern in establishing inbred lines is the integrity of the pedigrees. While most pastures were double-fenced to prevent bulls or cows from escaping, we were able to use the safeguard of blood-typing with the assistance of the Ohio State Agricultural Experiment Station. The lines showed a definite difference in blood-types (Table 35, Stonaker 1958). In some lines, the incidence of certain antigens is high and yet may be almost totally absent in others (Kushwaha 1955). Actually the disappearance rate of antigens exceeded that expected from calculated inbreeding.

Weaning Weights

A five-year summary of weaning weights of bull and heifer calves shows an appreciable difference between outbred and inbred calves (Table 16, Stonaker, 1958). The outbred heifer calves exceeded the inbred heifers by about 15%, whereas the outbred bull calves exceeded the inbred bull calves by only 9%. Ages of cows and calves in these groups were essentially the same. Why was there more hybrid vigor expressed in the heifers? It was interesting to speculate on that one.

Calving Difficulty, Calf Crop, Cow Culling

Difficulty in calving occurred 26% of the time in two-year old heifers and 42% of those calves died. Four percent of the calvings were difficult in older females. There was only a 19-pound difference in fall weights of the difficult vs. the non-difficult calvings. The inbred cows raised about 10% fewer calves than did the linecross Herefords.

The accuracy in prediction of pregnancy through palpation was very high. Days predicted pregnant was not so good, and subject to a standard deviation of about 15 days. The range in difference between actual birth date and predicted birth date was –32 to + 66 days, so predictions were not very useful insofar as deciding when to move cows into the calving lot.

Miles Davies (1950) found a high correlation of .5 between the weights of succeeding calves from the same dams. Thus a cow with a 50 lb above average calf, would be expected to

produce future calves averaging 25 lbs above average. There is a problem, however, with culling heavily on calf weight in the cow herd. Culling bred cows means keeping more bred heifers which will, because of their young age produce lighter calves. This dictates selling more cows at a lower price per pound. So the total herd income is reduced if bred cows are culled. Culling open cows usually increases herd production irrespective of the production level of the open cows.

SOME RESULTS DURING 1958–1966

Genetics of Selecting Heavier Calves

Armstrong (1964) made an evaluation of the productivity of lines and their crosses based upon larger numbers of weaning weights and daily gains. Selection effects were discouraging. Selection differentials for bulls were about 50% on weaning weights. That is, bulls in the best 50% were used, whereas 94% of the females in weaning weight were used, or there was essentially no selection pressure among females for weaning weight. In the lines it appeared there was –3.78 lbs genetic loss per year in weaning weight. However, the best of the lines and crosses were far above the average of all lines. The culling of *low* producing *lines* and *crosses* could lead to a much improved herd (San Juan Basin Branch Experiment Station, 1965).

Prospector 0716, born 1970, 36% inbred.

Calf Death Losses

Calf death losses were dramatically different for inbreds, linecrosses, and controls (Table 1, San Juan Basin Branch Experiment Station, 1966). Death loss in the linecross herds was only 6% in 1200 calvings over the years. In 900 inbred calvings, losses were about 13%, more than double that of the linecrosses; whereas in the controls, losses were about 12%. This remarkably low death loss in the linecrosses could be one of the most economically important genetic advantages we encountered.

Semen Characteristics

Semen characteristics were recorded and again inbred bulls scored appreciably lower in all characteristics, especially morphology of sperm cells and semen quality score. Inbreds scored 83% and 85% of the semen quality scores of linecross bulls. Intriguing was the observation that the *haploid* sperm cells showed hybrid vigor! Apparently the environment of the hybrid testes enhances the quality of sperm.

The Somascope for Estimating Fat Thickness

Browsing through *Life Magazine*, we found an article relative to the visualization of fat and lean tissue in a leg of lamb by ultrasound. The two scientists were Douglas Howry and Gerald Posakony of University of Colorado Medical School. They were looking for better and less invasive methods of visualization of human tissue. We contacted them and they were enthused to see what application could be made with meat animals. We loaded up a steer and took him to the grocery dock at C.U. Medical School in Denver. They rolled their equipment out to the truck. We shaved the hair off a strip of rib area from the live steer. The transducer, a short plastic pipe filled with water retained with a thin rubber condom, was applied to the shaved skin area. By eliminating air between the transducer and skin we got good visualization of the hide and fat layers on the live steer.

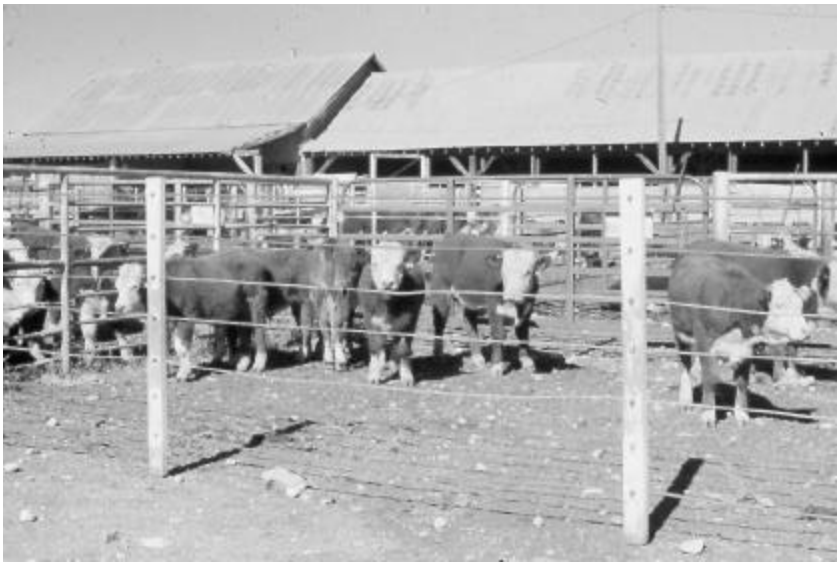
Bob Temple and H.H. Stonaker using somascope.

This kicked off Masters studies by Temple and Rowden (1956) on a number of cattle including bulls at Fort Lewis. The application has led to much refinement mainly by Dr. Stauffer at Cornell University. Currently the improvements are so great that visualization of marbling of live animals is claimed.

In conclusion, we learned much from the herd at Fort Lewis in the early years. We have been especially fortunate to have had the work continue uninterrupted over such a long period. It is a resource to continue to help meet challenges facing the cattle industry today.

Bill Confer (L) and Richard Benson (R) working cattle.

Cattle and cattle facilities at San Juan Basin Research Center.



Brae Arden 5410, born 1965, 44% inbred.

RESEARCH HIGHLIGHTS
1967-1994 – J.S. Brinks

Reproduction

Data for much of the pioneering work relating to the genetics of reproduction were collected at the San Juan Basin Research Center. These studies were made possible through close cooperation with the College of Veterinary Medicine. Veterinarians cooperating in the early years included: Drs. Harold Hill, Lloyd Faulkner, Jim Scott, followed by Drs. Ed Carroll, Peter Chenoweth, Bruce Abbitt, Gary Rupp and Robert Mortimer. Also, Donald LeFever of the Department of Animal Sciences aided in pregnancy diagnoses along with pelvic area measures of bulls and females and reproductive tract scores in yearling heifers.

Several studies on **semen quality** were performed over the years. The early semen characteristics studied were concentration, motility, live cells, percent primary abnormalities, percent secondary abnormalities, percent normal sperm and both gross and individual motility. Heritabilities of and genetic correlations between these traits were obtained. This information was used to update the **Breeding Soundness Examination** (BSE).

One of the most important research results occurred after Dr. Ed Carroll returned from sabbatical at Cornell University in 1968 where he studied semen quantity and quality as related to testicle size in dairy bulls. We decided to measure testicle size using **scrotal circumference** (SC) at the same time as the BSE information was taken. A year earlier (1967) we initiated a study measuring **age at puberty** (first heat) in yearling heifers using marking harnesses on altered bulls. After a few years we obtained means of both age at puberty and scrotal circumference by line of sire and noted there was almost a perfect correlation between the two traits. Both traits were found to be fairly highly heritable and the genetic correlation between the two traits indicated that they were essentially the same trait. Other researchers later established this and SC became a major component of the BSE. Today many breed associations publish expected progeny differences (EPD) for SC. Later, LeFever developed a reproductive tract score for estimating age at puberty via rectal palpation.

Calving difficulty scores were recorded throughout and several studies were completed. Also, **pelvic measures** including height, width and area were also taken on yearling heifers and bulls beginning in the early 1980's. Birth weight of calf was the most important factor contributing to calving difficulty followed by the dam's pelvic area. All cesarean sections occurred when progeny birth weight was in excess of 80 lb. And when pelvic height and width were less than 12 cm and 11.5 cm, respectively. Pelvic measures were all highly heritable. The genetic correlations between male and female pelvic measures were moderate to high with male pelvic height being highly correlated to all female measures indicating that male pelvic height may be a useful selection criterion to increase female offspring pelvic size.

Calving date was found to be a better measure of calving consistency than **calving interval** when a fixed breeding season is employed.

Libido and **serving capacity**, measures of sex drive, along with **social dominance** measures were studied in yearling bulls. Differences among lines and sires/lines were found for libido scores. In another study, the relationship of seminal vesicle size and measures of libido showed no significant correlations.

Selection

Response to **selection** for increased weaning weight was studied over a 25-year period using repeat matings as the environmental trend estimate. Genetic improvement was estimated at 2.6 lbs. and 4.6 lbs. per year for the inbred and linecross populations, respectively.

In a separate study, selection intensity, generation intervals, indices in retrospect along with expected and realized responses were studied. Sire selection accounted for 79% of the total selection differentials in an index calculated in retrospect. Inbred populations differed greatly in response to selection and progress averaged less than expected but response was positive for the linecross populations for most traits.

Inbreeding

The effects of increased **inbreeding** was accounted for and reported in almost all studies related to growth and efficiency. In addition, a bulletin on the effects of inbreeding on fitness and growth traits was published using data from 48 lines developed at 10 experiment stations in 8 Western states. Increased inbreeding of both calf and dam had a detrimental effect on all fitness traits (open vs. pregnant, aborted vs. born, dead vs. alive at birth, died vs. weaned, abnormal vs. normal and weaned vs. not weaned). Increased inbreeding of calf had a detrimental effect on all

growth traits studied (birth weight, gain birth to weaning, weaning weight, initial weight on test, gain on test and final weight). Increased inbreeding of dam had a detrimental effect for all growth traits in male offspring and all but birth weight and postweaning gain in females. Results indicated that response to increased inbreeding varied greatly between lines.

Heterosis

There were several studies that estimated the amount of within breed heterosis by comparing the performance of inbreds versus linecrosses. Heterosis estimates were 10.3% and 10.5% for bull and heifer weaning weights. For post weaning traits of bulls, heterosis estimates were 9.6% for weight on test, 7.9% for final weight, 6.1% for feed consumption, .5% for feed efficiency and 5.3% for daily gain. General combining ability between lines was important for all traits except weight on test. Specific combining ability was important only for daily gain of bulls.

In a separate study, heterosis estimates were obtained for weights from birth through maturity at 6 month intervals on Hereford females. Heterosis estimates were 5.3% at birth, 10.0% at 3, 5 and 7 months of age, 9.8% at 12 months, and 7.6% at 18 months. After 18 months linecross females maintained a weight advantage ranging from 4.9% at 36 months to 8.0% at 114 months. The average percent heterosis for cow weights from 24 through 120 months was 6.6%.

Another study suggested that there was more heterosis in good years than in poor years for weaning weight (10.9 vs. 8.9% for females and 10.1 vs. 9.9% for males).

Growth

There were several studies over the years that estimated the **heritabilities** along with the **phenotypic**, **genetic and environmental correlations** among weights and gains from birth through maturity. Weaning weight averaged the least heritable (about 30%) and mature weight the most heritable (about 70%) with heritabilities of other weights being intermediate. Genetic correlations between weights were high followed by phenotypic correlations with environmental correlations being the lowest.

A comprehensive study on growth from birth through maturity using both Brody's and Richard's **growth curve function** was completed to describe growth curve differences between the Hereford lines and between inbreds and linecrosses. Linecrosses reached maturity at about 60 lbs. heavier than inbreds. There were large differences between the Hereford lines with the Prospector, Monarch, Brae Arden and Ouray lines being the heaviest and the Colorado and Don lines the lightest at maturity. Cows that were earlier maturing were also lighter at maturity. Angus cattle were earlier maturing and reached mature size at younger ages than Herefords.

Feed Efficiency

A comprehensive study to evaluate various ways to measure and express feed efficiency was conducted using data on individually fed bulls during their performance test. Feed efficiency was expressed four different ways as:

1. **Gross efficiency** calculated as the ratio of total gain to total feed,
2. **Partial efficiency** as the ratio of gain to feed available for gain after subtracting the calculated feed used for maintenance,
3. ***O-E* ratio**, a ratio of the observed gain divided by the expected gain, and
4. **A regression technique** in which individual efficiency was expressed as a deviation of each animal's gain from the regression of gain on TDN consumption after adjusting for expected maintenance requirements. **Appetite** was measured as 1) gross TDN consumption and 2) relative consumption as a ratio of total feed consumed to the feed required for maintenance. Other traits studied were total gain on test and final weight. Heritability estimates are shown below.

Heritability estimates of performance traits.

Trait	Heritability
Efficiency	
Gross Efficiency	.33 ± .11
Partial Efficiency	.43 ± .12
O-E Ratio	.16 ± .10
Appetite	
Gross TDN	.23 ± .11
Relative Consumption	.03 ± .09
Growth	
Total Gain	.21 ± .10
Final Weight	.20 ± .10

Partial efficiency had the highest heritability indicating that adjusting feed consumption for expected maintenance requirements made feed efficiency a better indicator of genetic differences among bulls. Appetite was found to be mainly a function of size. Also, younger animals of the same weight as older animals were somewhat more efficient.

In a separate study on the repeatability of daily gain, feed consumption and feed efficiency of bulls over five 28-day periods, results showed that for feed consumption and average daily gain, over 70% of the total variation was accounted for by two and three periods of

accumulation, respectively. For feed efficiency, four 28-day periods were required to account for 65% of the total variation.

Cow Maternal Ability

Cow productivity associated with maternal ability affecting weaning weights was the focus of several studies. **Most Probable Producing Ability (MPPA)** values were calculated for all cows based on repeatability, her calves' weaning weights and number of calves.

In a study on environmental factors affecting MPPA it was evident that a detrimental effect upon subsequent cow productivity resulted from higher levels of the heifers preweaning nutrition and that relatively lower levels of preweaning nutrition resulted in higher subsequent MPPA values. Heifers born in poorer nutritional years or from very young or very old dams had higher MPPA values. Weaning weights were divided into high, medium and low categories by generation number. Analyses indicated an every other generation effect on MPPA values of cows. It appears that this phenomenon was caused by fatty tissue being accumulated in the mammary tissue under the higher nutritional levels. In a companion study using the same data, heritabilities of weaning weight from paternal half-sib, regression of offspring on sire and regression of offspring on dam were .24, .28 and .11. The lower estimates from the regression on dam analysis was probably due to the environmental factors discussed above.

The effect of creep feeding bull calves on MPPA values of dams was studied. Creep feeding of bull calves for 62 days over a three-year period increased weaning weight 30 lbs. Repeatability of weaning weight was .49 and .52 for heifer and bull calves not creep fed but was reduced to .30 for creep fed bull calves. Creep feeding of bull calves reduced differences among dams' MPPA values and thus masked maternal differences among cows.

A study of **placental traits** (placental weight and cotyledon weight, numbers and surface area) indicated that increased values of placental traits were associated with somewhat higher dam MPPA values and increased preweaning growth of offspring.

Another study indicated that age at puberty was favorably related to subsequent MPPA values. The size and shape of the udder and teats were found to be highly heritable in an early study.

Another study indicated that phenotypic correlations of cow weights, heights, weight/height ratios and changes in weights and weight/height ratios with MPPA were low and are of limited usefulness in predicting cow productivity measured by MPPA.

High Mountain Disease

High Mountain Disease or **Brisket Disease** occurs in cattle ranging at high altitudes, usually above 7,000 feet and is a cause of significant losses in cattle and monies. The genetics of the disease were first studied at the Center in cooperation with Drs. Cy Card and D.H. Will of the

College of Veterinary Medicine using **pulmonary arterial pressure** (PAP) values as a measure of susceptibility to the disease.

The initial study indicated consistent but low correlations between PAP values and weights and gains of calves at 3, 6, and 12 months of age indicating that higher pressures were associated with somewhat lower weights and gains. In later studies the heritability of PAP in yearling bulls was estimated to be high (78%). Phenotypic correlations between PAP and post weaning weights and gains were again low with genetic correlations being moderate to high again indicating that higher PAP values were associated with less performance. The heritability estimates of PAP in cows were estimated much lower ranging from 13% to 20%. Significant line and breed differences in PAP values were obtained.

The PAP measurements have been taken each year at the Center since the initial studies as well as at many ranches at higher elevations. Use of bulls with lower PAP values has lowered the incidence of High Mountain Disease throughout Colorado and surrounding states.

Composites

Many conventional crossbreeding schemes have resulted in non-uniform cow herds and progeny performance when diverse breeds are used. These systems require several breeding pastures unless AI is used and are difficult to manage.

Two **composite populations** were initiated in 1984 as an alternate method of maintaining hybrid vigor and uniform performance of cows and progeny and utilizing breed complementarity as compared to conventional crossing systems.

Sires and semen from three existing composites (CASH, RX3 and MARC III) that were uniform in phenotype but genetically diverse were mated to the Center's Hereford cows to form System I. Three other existing composites (Brangus, Barzona and Beefmaster) were mated to Angus and Red Angus cows to form System II. Matings in subsequent generations were designed for each system to form new multi-breed composites after generation three. Modeling studies indicated that the percent of heterozygosity needed for high levels of hybrid vigor would be about the same as 3-way rotational crossing systems.

Results have been reported in the field day reports (1986-present) and indicate high levels of uniformity and performance including weights, gains and carcass cutability and quality. Representative pens of steers from these composites have performed well above average in the Great Western Beef Expo each year as well as at the NAPI feedlots.

EPDs have been calculated for these populations and need to be updated each year.

Eye Lesions and Ocular Pigmentation

Eye lesions including bovine squamous cell carcinoma or **cancer eye** were studied in Herefords in cooperation with Dr. Kainer, Department of Anatomy. The herd incidence rates were 35.7% for all lesions and 1.7% for cancerous lesions. The average age of cows with cancer eye was 7.3 years. There was a highly significant difference among lines of sire for both the incidence and numbers of tumors.

The amount and distribution of **ocular pigmentation** in Hereford cattle was also studied. A genetic influence was indicated with large differences between lines of sire and dam's lines of sire. Heritability estimates for pigmentation for eyelid, skin and lacrimal lake were moderate to high, ranging from 20% to 60%.

Hoof Growth

Hoof growth scores on cows using a scoring system of 1 (normal) through 5 (extreme growth with vertical cracks) were studied. Scores increased with age of cow from two through six years and thereafter remained about the same. Heritability was estimated at 81%.

A student Field Day at the SJBRC facilities.

Al Denham, superintendent 1974 to 1993.

Dave Schafer (L), manager and superintendent 1991 to 1999, and Don LeFever (R), research associate from the Animal Sciences Department, Colorado State University.

Jim Brinks with graduate students and veterinary students from Colorado State University.

M.S. THESES AND Ph.D. DISSERTATIONS

H.H. Stonaker, Advisor (1946-1966)

Ingalls, James E. 1948. Comparative feedlot performance of individually fed purebred Hereford steers of comprest and conventional Type. M.S. Thesis, Colorado State University.

Bingham, Dale E. 1950. The effects of different selection methods and breeding systems on pupae length in *Musca domestica* (Linn.). M.S. Thesis, Colorado State University.

Hellstrom, Carl Fredrick. 1950. The heritability of hair color in Hereford cattle and the correlation between color and selected feedlot and carcass characteristics of steers. M.S. Thesis, Colorado State University.

Holland, Lewis A. 1950. A selection of index for Hereford feeder calves based upon optimum weighing of genetic and economic variations in weaning weights and grades. M.S. Thesis, Colorado State University.

Price, Donald A. 1950. Lamb production in Navaho and crossbred sheep. M.S. Thesis, Colorado State University.

Safley, C.E. 1950. A comparison of comprest and conventional types of Hereford steers as evaluated by body and carcass measurements. M.S. Thesis, Colorado State University.

Schleicher, E.W. 1950. Variation in the characteristics and carcasses from comprest and conventional types of Hereford steers. M.S. Thesis, Colorado State University.

Mankin, J.D. 1951. A study of the effect of mating systems on rate of pupae production in *Musca domestica* (Linn). M.S. Thesis, Colorado State University.

Burgess, James Bradford. 1952. Environmental and genetic effects on the weaning weight of Hereford calves. M.S. Thesis, Colorado State University.

Burke, Louis R. 1954. Effects of age on reproduction in beef cattle. M.S. Thesis, Colorado State University.

Behrens, W.C. 1955. The genetic and phenotypic relationship between estimates of fat deposition in Hereford beef steers. M.S. Thesis, Colorado State University.

Kushwaha, Nathu S. 1955. Association between inbreeding and antigen occurrence in inbred lines of Hereford cattle. M.S. Thesis, Colorado State University.

Hughes, Michael B.G. 1956. The relationship of lumbar spine radiographics, body measurements, and scores to dwarfism in Hereford calves. M.S. Thesis, Colorado State University.

Lindholm, Howard B. 1956. Selection indexes for beef cattle, incorporating the genetic and economic importance of various traits. M.S. Thesis, Colorado State University

O'Bleness, George V. 1956. The combining ability of twelve inbred lines of Hereford cattle. M.S. Thesis, Colorado State University.

Temple, Robert S. 1956. Estimation of fat thickness in cattle. M.S. Thesis, Colorado State University.

Moore, D. B. 1958. Rates of gain in Hereford bulls as affected by inbreeding, line, age, weight, years, pens, stall positions, and weaning grade. M.S. Thesis, Colorado State University.

Rowden, Walter W. 1958. Further studies on estimation of fat depth in cattle by an ultrasonic device, the somascope. M.S. Thesis, Colorado State University.

Urick, Joseph J. 1958. Effect of age of cow, sex, and age of calf on weaning weights of Hereford range calves. M.S. Thesis, Colorado State University.

Davenport, Ronald Lee. 1959. Heritability of reproductive performance in beef cows. M.S. Thesis, Colorado State University.

Campbell, Dudley. T. 1960. Estimation of carcass quality characteristics in living sheep by use of ultrasonics and other techniques. M.S. Thesis, Colorado State University.

Lickley, Charlene R. 1960. Relationship between mature size, daily gain, and efficiency of feed utilization in beef cattle. M.S. Thesis, Colorado State University.

Peterson, Wallace J. 1960. Reproductive performance in beef cattle as affected by artificial insemination and natural breeding. M.S. Thesis, Colorado State University.

Twombly, Louis T. 1961. A comparison of index selection with single trait selection in sheep. M.S. Thesis, Colorado State University.

Knapp, Bradford Ward. 1962. Heritability of characteristics of the mammary system of Hereford cows. M.S. Thesis, Colorado State University.

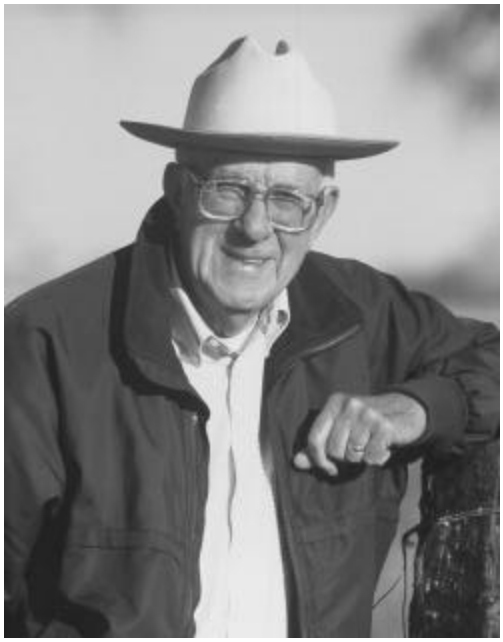
Harwin, Geoffrey O. 1963. The effect of inbreeding and environmental factors on weaning weight and postweaning growth of range Hereford cattle. Ph.D. Dissertation, Colorado State University.

Armstrong, Joe B. 1964. Evaluation of selection intensity and genetic change in an experimental herd of Hereford cattle. Ph.D. Dissertation, Colorado State University.

McNitt, James I. 1965. Genetic aspects of estimated breeding soundness of beef bulls. M.S. Thesis, Colorado State University.

Theurer, Larry. 1965. Factors affecting death loss and removal rate in a Hereford herd. M.S. Thesis, Colorado State University.

Kyomo, Martin L. 1966. Carcass characteristics of beef cows. Ph.D. Dissertation, Colorado State University.



"Stony" Stonaker, 1997.

Stony and Charlie Redd from Redd Ranches, one of the first producers to test bulls at SJBRC. (1957)

Royal 0740, born 1970, 51% inbred.

Front Row, left to right: Dr. Ed Carroll, Jim Brinks, Pete Fagerlin and Bill Confer (far right) with graduate students from Colorado State University.

Producers viewing calf crop.

M.S. THESES AND Ph.D. DISSERTATIONS

J.S. Brinks, Advisor (1967-1994)

Linton, Arthur C. 1967. Factors affecting weaning weights. M.S. Thesis, Colorado State University.

Fagerlin, Peter T. 1968. Aspects of calving interval in Herefords. M.S. Thesis, Colorado State University.

Hohenboken, William D. 1968. Effect of correction factors on repeatability of weaning weight in Angus cattle. M.S. Thesis, Colorado State University.

Richardson, Glenn Leroy. 1968. Carcass merit of beef bulls and heifers. M.S. Thesis, Colorado State University.

Hohenboken, William D. 1969. Relationships between direct and maternal effects on growth in Herefords. Ph.D. Dissertation, Colorado State University.

Mangus, Warren Lee. 1969. Factors affecting beef cow productivity. M.S. Thesis, Colorado State University.

Morrow, Donald Lee. 1969. Factors affecting beef cow production. M.S. Thesis, Colorado State University.

Abadia Rueda, Daniel. 1971. Milk in Hereford heifers. M.S. Thesis, Colorado State University.

Childears, John Marion. 1971. Perinatal effects on weaning weight. M.S. Thesis, Colorado State University.

Olson, James Edward. 1971. Inheritance of dystocia in beef cattle. M.S. Thesis, Colorado State University.

Abadia, Daniel. 1972. Genetics of semen traits in beef bulls. Ph.D. Dissertation, Colorado State University.

Benson, Charles R. 1972. Genetic response to selection. M.S. Thesis, Colorado State University.

Grapevine, Patrick W. 1972. General and specific combining abilities of inbred lines of Hereford cattle. M.S. Thesis, Colorado State University.

Keller, D. Gene. 1973. Inbreeding and mating system by environment interactions in beef cattle. Ph.D. Dissertation, Colorado State University Library.

Nwakalor, L.N. 1973. Response to selection in a linecross herd of Hereford cattle. M.S. Thesis, Colorado State University.

Mukasa-Mugerwa, Eddie. 1974. Genetics of bovine spermatozoan morphology. Ph.D. Dissertation, Colorado State University.

Mangus, W.L. 1975. Predicting beef breeding values. Ph.D. Dissertation, Colorado State University.

Miller, W.C. 1975. Mathematical modeling of beef production systems. Ph.D. Dissertation, Colorado State University.

Nwakalor, L.N. 1975. Selection intensity and response in inbred and linecross populations of Hereford cattle. Ph.D. Dissertation, Colorado State University.

Russell, W.C. 1975. Ocular lesions in Hereford cattle: A herd study. M.S. Thesis, Colorado State University.

Benson, Charles Richard. 1976. Systems analysis of beef production. Ph.D. Dissertation, Colorado State University.

Ferjani, Youseff. 1976. Heterosis in weights of Hereford females. M.S. Thesis, Colorado State University.

Hernandez Boada, Gustavo. 1976. Genetic factors in beef cattle cross in Colombia, Ph.D. Dissertation, Colorado State University.

Davis, Michael E. 1977. Breeding values of beef bulls. M.S. Thesis, Colorado State University.

Hoff, Chris G. 1977. Repeatability of measure of gain and efficiency of bulls. M.S. Thesis, Colorado State University.

Linton, Arthur. 1977. Genetic aspects of feed efficiency. Ph.D. Dissertation, Colorado State University.

McInerney, Michael James. 1977. Genetics of puberty in beef heifers. M.S. Thesis, Colorado State University

Wagner, Wayne, R. 1977. An evaluation of growth, carcass and economic traits in feedlot cattle. M.S. Thesis, Colorado State University.

Hays, William Gordon, 1978. The relationship of weight and height to beef cow productivity. M.S. Thesis, Colorado State University.

LeValley, Stephen Byron. 1978. Pulmonary hypertension in beef cattle: A herd study. M.S. Thesis, Colorado State University.

Ochoa, Pedro G. 1978. Effect of creep feeding bull calves on dam MPPA values. M.S. Thesis, Colorado State University.

Russell, William Charles. 1978. Changes in genetic variances with increased inbreeding. Ph.D. Dissertation, Colorado State University.

Wagner, Wayne Reed. 1978. Cow-calf unit efficiency in beef cattle. Ph.D. Dissertation, Colorado State University.

Elfellah, Tarek Kamal. 1979. Mating system by environment interactions. M.S. Thesis, Colorado State University.

Hermas, Suleiman, A. 1979. Genetic and environmental aspects of fertility in Colorado dairy cattle. M.S. Thesis, Colorado State University.

Bourdon, Richard M. 1980. Gestation length, birth weight and performance traits in beef cattle. M.S. Thesis, Colorado State University

Davis, Michael E. 1980. Selection and concurrent inbreeding in simulated beef herds. Ph.D. Dissertation, Colorado State University.

Fetcher, John R., Jr. 1980. Predicting maternal breeding values. M.S. Thesis, Colorado State University.

Pounds, James Caesar. 1980. Genetic aspects of ocular pigmentation in Hereford cattle. M.S. Thesis, Colorado State University.

Werre, Joel F. 1980. Relationship of age at puberty in heifers to subsequent fertility and productivity, M.S. Thesis, Colorado State University.

Knutson, DeVon. 1981. Factors affecting sow productivity. M.S. Thesis, Colorado State University.

Schimmel, J.G. 1981. Genetic aspects of high mountain disease in beef cattle. Ph.D. Dissertation, Colorado State University.

DeNise, Roni Sue Kersey. 1982. Relationships among the growth curve parameters and productivity traits in beef cows. Ph.D. Dissertation, Colorado State University.

Bourdon, Richard M. 1983. Simulated effects of genotype and management on beef production efficiency. Ph.D. Dissertation, Colorado State University.

Quaas, Richard L. 1983. Genetic variation in growth curves of Hereford females. Ph.D. Dissertation, Colorado State University.

Elfellah, Tarek Kamal. 1984. Genetic parameters and selection intensity in two synthetic breeds of beef cattle. Ph.D. Dissertation, Colorado State University.

Sheldon, Clarissa D. 1984. Placental traits in beef cattle. M.S. Thesis, Colorado State University.

Bailey, Derek Wayne. 1985. Genetic parameters of reproductive traits in beef cows. M.S. Thesis, Colorado State University.

Green, Ronald D. 1985. Genetic aspects of pelvic measures in beef cattle. M.S. Thesis, Colorado State University.

Asbury, Willard C. 1986. Genetic characterization of simulated beef cattle crossbreeding systems. M.S. Thesis, Colorado State University.

Smith, Beth A. 1986. The relationship of sire scrotal circumference on offspring reproduction and subsequent productivity. M.S. Thesis, Colorado State University.

Vicklund, J. Adele. 1986. Growth, carcass and economic characteristics of progeny test steers. M.S. Thesis, Colorado State University.

Anderson, Kent James. 1987. Reproductive tract scores, condition scores and performance traits in beef cattle. M.S. Thesis, Colorado State University.

Field, Thomas Gordon. 1987. Estimation of genetic parameters for mature weight in Hereford females. M.S. Thesis, Colorado State University.

Fitch, Gerald Quinnelle. 1987. Characterization of breeding soundness examinations in rams. M.S. Thesis, Colorado State University.

Schafer, David Wain. 1987. Estimation of genetic parameters and time trends in a herd of Angus cattle. M.S. Thesis, Colorado State University.

Winder, John A. 1987. Characterization of direct and maternal influences on growth of Red Angus cattle. Ph.D. Dissertation, Colorado State University.

Clarke, Linda Sue. 1988. Effect of inbreeding on performance traits in Hereford cattle. Ph.D. Dissertation, Colorado State University.

Hughes, Steven Thomas. 1988. Breeding soundness examinations as selection parameter in beef cattle. Ph.D. Dissertation, Colorado State University.

Posegate, Rhonda P. 1988. Phenotypic and genetic responses to selection in beef cattle. M.S. Thesis, Colorado State University.

Field, T.G. 1990. Genetic prediction of mature weight in Hereford females. Ph.D. Dissertation, Colorado State University.

Andersen, Kent James. 1991. Reproduction, calving ease and growth traits in beef heifers. Ph.D. Dissertation, Colorado State University.

Enns, Richard Mark. 1991. Parameter estimates of insulin-like growth factor I and performance traits in beef cattle. M.S. Thesis, Colorado State University.

Golden, Bruce L. 1991. A national beef cattle evaluation program using best linear unbiased prediction. Ph.D. Dissertation, Colorado State University.

Mebane, Tad C. 1991. Factors that affect calving ease score in beef cattle. M.S. Thesis, Colorado State University.

Schafer, David Wain. 1991. Within-herd predicted breeding value comparisons and genetic trend in Red Angus cattle. Ph.D. Dissertation, Colorado State University.

Speer, Nevil C. 1991. Parameter estimation and genetic relationships within a crossbred beef cattle population. M.S. Thesis, Colorado State University.

Fitch, Gerald Q. 1992. Estimation of genetic parameters, breeding values and genetic trends in the Targhee sheep breed. Ph.D. Dissertation, Colorado State University.

Redman, Kenneth J. 1992. Genetic parameters for linear and performance measures in Simmental cattle. M.S. Thesis, Colorado State University.

Reverter, Antonio I. Gomez. 1992. Behavior of expected progeny differences over time with increases in accuracy values. M.S. Thesis, Colorado State University.

Speer, Nevil C. 1993. Genetic relationships between sex-specific traits in a crossbred beef cattle population. Ph.D. Dissertation, Colorado State University.

Enns, Richard Mark. 1995. Simulation of across-breed comparisons for direct and maternal weaning weight in beef cattle. Ph.D. Dissertation, Colorado State University.

Choy, Yun Ho. 1997. Genetic analyses of mature weight, hip height and body condition score in an Angus herd. Ph.D. Dissertation, Colorado State University.

Prospector 7558, born 1967, 40% inbred.

PUBLICATIONS (SAN JUAN BASIN RESEARCH CENTER)

H.H. Stonaker and Others (1943-1965)

Washburn, L.E., J. K. Matsushima, H. F. Pearson, and R. C. Tom. 1948. Nutrient utilization by "compact" and conventional type Shorthorn steers. J. Anim. Sci. 7:127–134.

Davis, Miles. 1950. Repeatability of weaning weights in beef calves. Special problems in animal husbandry [unpublished]. Colorado State University.

Lucas, K., F.X. Gassner, H.H. Stonaker, and S. S. Wheeler. 1950. Relationships of thyroid, adrenal, and pituitary characteristics to body development in small and conventional types of fat Hereford steers. Am. Soc. Anim. Prod. West. Sect. Proc. 1:73–78, Logan, Utah.

Safley, C.E., H.H. Stonaker, and S.S. Wheeler. 1950. A comparison of small and conventional types of Hereford steers as evaluated by body and carcass measurements. West. Sect. Am. Soc. An. Prod. Proc. 1:90–101, Logan, Utah.

Schleicher, E.W., H.H. Stonaker, M.H. Hazaleus, and S.S. Wheeler. 1950. Feed-lot and carcass characteristics of small and conventional type Hereford steer calves. West. Sect. Am. Soc. An. Prod. Proc. 1:68–72. Logan, Utah.

Stonaker, H.H., M.H. Hazaleus, and S. S. Wheeler. 1950. Feed-lot and carcass characteristics of Hereford steers of small and conventional type. (Abs.) J. Anim. Sci. 9(4):639.

Stonaker, H.H. 1951. A unique herd of Hereford cattle. J. Hered. 42(4):207–209.

Stonaker, H.H., J.E. Ingalls, and S.S. Wheeler. 1952. Winter hay consumption of breeding females of large, intermediate, and comprest type Hereford cattle. J. Anim. Sci. 11(1):26–33.

Stonaker, H.H., M.H. Hazaleus, and S. S. Wheeler. 1952. Feed-lot and carcass characteristics of individually fed comprest and conventional type Hereford steers. J. Anim. Sci. 11(1):17–25.

Burgess, J.B., Nellie L. Landblom, and H.H. Stonaker. 1954. Weaning weights of Hereford calves as affected by inbreeding, sex, and age. J. Anim. Sci. 13:843–851.

Kushwaha, N.W., L.C. Ferguson, and H.H. Stonaker. 1954. Association between inbreeding and antigen occurrence in inbred lines of Hereford cattle. (Abs.) J. Anim. Sci. 13:960.

Stonaker, H.H. 1954. Dwarfism in beef cattle. Am. Soc. Anim. Prod. West. Sect. Proc. 5:239. Corvallis, Oregon.

Stonaker, H.H. 1954. Observations on reproduction, growth, feed utilization, and grades of inbred and outbred Hereford cattle. (Abs.) J. Anim. Sci. 13:963.

Emmerson, M.A. and L.N. Hazel. 1956. Radiographic demonstration of dwarf gene carrier beef animals. J. Am. Vet. Med. Assn 128(8).

Lindholm, H.B. and H.H. Stonaker. 1956. Relative economic importance of traits affecting net income in beef cattle. Am. Soc. Anim. Prod. West. Sect. Proc. 7:LVI. Reno.

Temple, R.S., H.H. Stonaker, Douglas Howry, G. Posakony, and M.H. Hazaleus. 1956. Ultrasonic and conductivity methods for estimating fat thickness in live cattle. Am. Soc. Anim. Prod. West. Sect. Proc. 7:LXX. Reno.

Harris, Laura A., L.C. Faulkner, and H.H. Stonaker. 1958. The effect of inbreeding on the estimated breeding soundness of yearling Hereford bulls. Am. Soc. Anim. Prod. West. Sect. Proc. 9:XLIV. Davis, California.

Stonaker, H.H. 1958. Breeding for Beef. Colorado Agricultural Experiment Station. Bulletin 501-S. Fort Collins, Colo.

Davenport. R.L., H.H. Stonaker, T.M. Sutherland, and K.H. Riddle. 1959. Heritability of reproductive performance in beef cattle. J. Anim. Sci. 18(4):8.

O'Bleness, George V, H.H. Stonaker, and C.R. Henderson. 1959. Combining abilities of thirteen inbred lines of Hereford cattle. J. Anim. Sci. 4(14):66.

Harris, L.A., L.C. Faulkner, and H.H. Stonaker. 1960. The effect of inbreeding on the estimated breeding soundness of yearling Hereford bulls. J Anim. Sci. 19: 665–673.

Lickley, Charlene R., H. H. Stonaker, T.M. Sutherland, and K.H. Riddle. 1960. Relationship between mature size, daily gain, and efficiency of feed utilization in beef cattle. Am. Soc. Anim. Prod. West. Sec. Proc. Logan, Utah

Harwin, G.O., H.H. Stonaker, and M.H. Hazaleus. 1961. Factors influencing marbling in yearling beef steers. Am. Soc. Anim. Prod. West. Sec. Proc. 12:20.

Twombley, L.T., T. M. Sutherland, H.H. Stonaker, and A.L. Esplin. 1961. A comparison of index selection with single trait selection in sheep. Am. Soc. Anim. Prod. West. Sec. Proc. 12:17.

Stonaker, H.H. 1963. A genetic hypothesis for sex-mating system interactions in growth of cattle and poultry. J. Anim. Sci. 22(2):320.

Davenport. R.L., H.H. Stonaker, Kent Riddle, and T.M. Sutherland. 1965. Heritability of reproductive performance in inbred and linecross beef cows. J. Anim. Sci. 24 (2):434–437.

Stonaker, H.H. 1965. Goals and methods in beef cattle improvement. Colorado Agriculture Experiment Station Bulletin 423-S. Fort Collins.

Ouray 9120, born 1979, 16% inbred.

PUBLICATIONS (SAN JUAN BASIN RESEARCH CENTER)

J. S. Brinks and Others (1966-1994)

Harwin, C.O., J.S. Brinks and H. H. Stonaker. 1966. Genetic and environmental interactions affecting weaning weights of Hereford calves. J. Animal Sci. 25(3):779-782.

Fagerlin, P.T., J.S. Brinks and H. H. Stonaker. 1968. Environmental effects on calving interval in Herefords. Am. Soc. Anim. Sci. West. Sect. Proc. 19:307.

Richardson, G.L. J.S. Brinks and D.A. Cramer. 1968. Predicting bull carcass cutability as retail values. Am. Soc. Anim. Sci. West. Sect. Proc.19:259.

Hohenboken, W.D. and J.S. Brinks. 1971. Relationships between direct and maternal effects on growth in Herefords: II. Partitioning of covariance between relatives. J. Animal Sci.32(1):26-34.

Hohenboken, W.D. and J.S. Brinks 1971. Relationships between direct and maternal effects on growth in Herefords: III. Covariance of paternal half-brother and sister performance. J. Animal Sci. 32(1):35-41.

Mangus, W.L. and J.S. Brinks. 1971. Relationships between direct and maternal effects on growth in Herefords: I. Environmental factors during preweaning growth. J. Animal Sci. 32(1):17-25.

Abadia, D. and J.S. Brinks. 1972. Milk production of Hereford heifers. Am. Soc. Anim. Sci. West. Sect. Proc. 23:23.

Brinks, J.S. and J. M. Childears. 1972. Perinatal effects on weaning weight and rebreeding. Am. Soc. Anim. Sci. West. Sect. Proc. 23:48.

Brinks, J.S., J.E. Olson and E.J. Carroll. 1973. Calving difficulty and its association with subsequent productivity in Herefords. J. Anim Sci. 36(1):11-17.

Brinks, J.S. and B.W. Knapp. 1975. Effects of inbreeding on performance traits of beef cattle in the western region. Colorado State University Experiment Station, Fort Collins, Tech. Bull. 123. 36 pages.

Grapevine, P.W., J.S. Brinks, and G.V. Richardson. 1975. General and specific combining abilities of inbred lines of Hereford cattle. J. Animal Sci. 41(2):527-533.

Abadia, D., J.S. Brinks, and E.J. Carroll. 1976. Genetics of seminal traits in young beef bulls. Am. Soc. Anim. Sci. West. Sec. Proc. 27:30.

Brinks, J.S., D.H. Will, C.B. Runburg, W.L. Mangus, A.H. Denham and L.M. Panepinto. 1976. P.A. pressure and weight relationships in cattle. Amer. Soc. Anim. Sci. West. Sect. Proc. 27:52.

Keller, D.G. and J.S. Brinks. 1976. Response to inbreeding in Hereford lines. Amer. Soc. Anim. Sci. West. Sect. Proc. 27:38.

Nwakalor, L.N., J.S. Brinks, and G.V. Richardson. 1976. Estimated genetic improvement in weaning weight of beef cattle. J. Animal Sci. 43:2:396-403.

Russell, W.C., J.S. Brinks and R.A. Kainer. 1976. Incidence and heritability of ocular squamous cell tumors in Hereford cattle. J. Animal Sci. 43:6:1156-1162.

Miller, W.C. and J.S. Brinks. 1977. Selecting crossbred cows by computer. Am. Soc. Anim. Sci. West. Sect. Proc. 28:46-48.

Brinks, J.S., M.J. McInerney and P.J. Chenoweth. 1978. Relationship of age at puberty in heifers to reproductive traits in young bulls. Amer. Soc. Anim. Sci. West. Sec. Proc. 29:28-30.

Hoff, C.G., J.S. Brinks, G.V. Richardson, and D.E. Johnson. 1978. Repeatability of performance among 28-day periods in young beef bulls. Amer. Soc. Anim. Sci. West. Sec. Proc. 29:39-41.

Keller, D.G. and J.S. Brinks. 1978. Inbreeding by environment interactions for weaning weight in Hereford cattle. J. Animal Sci. 46(1):48-53.

Keller, D.G. and J.S. Brinks 1978. Mating system by environment interactions for weaning weight in Hereford cattle. J. Animal Sci. 46(1):54-59.

Miller, W.C., J.S. Brinks and T.M. Sutherland. 1978. Computer assisted management decisions for beef production systems. Inter. J. Agri. Systems 3(2):147-158.

Brinks, J.S., M.E. Davis, W.L. Mangus and A.H. Denham. 1979. Genetic aspects of hoof growth in beef cattle. Amer. Soc. Anim. Sci. West. Sec. Proc. 30:25-27.

Chenoweth, P.J., J.S. Brinks, and T.M. Nett. 1979. A comparison of three methods of assessing sex-drive in yearling beef bulls and relationships with testosterone and LH levels. Theriogenology 12(4):223-233.

Mangus, W.L., J.S. Brinks, J.A. Winder and A.H. Denham. 1980. The relationship of weights and measurements of performance tested bulls. Amer. Soc. Anim. Sci. West. Sec. Proc. 31:17-19.

Schimmel, J.G., J.S. Brinks, B.E. Russell, W.L. Mangus and A.H. Denham. 1980. Genetic aspects of high mountain disease in beef cattle. Amer. Soc. Anim. Sci. West. Sec. Proc. 31:20-22.

Bourdon, R.M. and J.S. Brinks. 1981. Optimal replacement rates for genetic improvement in beef cattle. Amer. Soc. Anim. Sci. West. Sec. Proc. 32:324-326.

Ochoa, P.G., W.L. Mangus, J.S. Brinks and A.H. Denham. 1981. Effect of creep feeding bull calves on dam most probable producing ability values. J. Animal Sci. 53(3):567-574.

Ologun, A.G., P.J. Chenoweth and J.S. Brinks. 1981. Relationships among production traits and estimates of sex drive and dominance value in yearling beef bulls. Theriogenology 15(4):379-388.

Pounds, J.C., J.S. Brinks and R.A. Kainer. 1981. Amount and distribution of ocular pigmentation in Hereford cattle. Amer. Soc. Anim. Sci. West. Sec. Proc. 32:344-346.

Schimmel, J.G., J.S. Brinks, W.L. Mangus and G.V. Richardson. 1981. Heritability and repeatability of pulmonary arterial pressures in beef cows. Amer. Soc. Anim. Sci. West. Sec. Proc. 32:307-309.

Schimmel, J.G. and J.S. Brinks. 1982. Relationships of pulmonary arterial blood pressures and postweaning traits in yearling beef bulls. Amer. Soc. Anim. Sci. West. Sec. Proc. 33:203-205.

Berry, J.G., J.S. Brinks and W.C. Russell. 1983. Relationship of seminal vesicle size and measures of libido in yearling beef bulls. Theriogenology 19(2):279-284.

Bourdon, R.M. and J.S. Brinks. 1983. Calving data versus calving interval as a reproductive measure in beef cattle. J. Anim. Sci. 57(6):1412-1417.

Davis, M.E. and J.S. Brinks. 1983. Selection and concurrent inbreeding in simulated beef herds. J. Anim. Sci. 56(1):40-51.

DeNise, R.S. Kersey, J.S. Brinks, G.V. Richardson and T.M. Sutherland. 1983. Relationships among growth curve parameters and selected productivity traits in beef cows. Amer. Soc. Anim. Sci. West. Sec. Proc. 34:48-51.

Schimmel, Joseph G. and James S. Brinks. 1983. Heritability and relationships of pulmonary arterial blood pressure with preweaning performance traits. Amer. Soc. Anim. Sci. West. Sec. Proc. 34:25-28.

Davis, M.E. and J.S. Brinks. 1984. Selection and concurrent inbreeding in simulated beef herds: Model development. J. Anim. Sci. 59(6):1488-1500.

Russell, W.C., J.S. Brinks, and G.V. Richardson. 1984. Changes in genetic variance with increased inbreeding of beef cattle. J. of Heredity 75(1):8-10.

DeNise, R.S. Kersey and J.S. Brinks. 1985. Genetic and environmental aspects of the growth curve parameters in beef cows. J. Anim. Sci. 61(6):1431-1440.

Bailey, D.W., J.S. Brinks and R.M. Bourdon. 1985. Repeatability estimates of beef cow reproduction traits by degree of adjacency. Amer. Soc. Anim. Sci. West. Sec. Proc. 36:21-22.

Golden, B.L., J.S. Brinks, J.D. Tatum and R.M. Bourdon. 1985. Profitability analysis of alternative beef production strategies utilizing beef heifers. Amer. Soc. Anim. Sci. West. Sec. Proc. 36:187-191.

Hughes, S.T., J.S. Brinks, and G.P. Rupp. 1985. Effects of age, breed and weight on breeding soundness traits. Amer. Soc. Anim. Sci. West. Sec. Proc. 36:50-53.

Sheldon, C.C. and J.S. Brinks. 1985. Relationships of placental traits to calf and dam production. Amer. Soc. Anim. Sci. West. Sec. Proc. 36:21-22.

Asbury, W.C., J.S. Brinks and B.L. Golden. 1986. Estimation of heterozygosity in crossbreeding systems utilizing composite breeds of cattle. Amer. Soc. Anim. Sci. West. Sec. Proc. 37:289-291.

Bourdon, R.M. and J.S. Brinks. 1986. Scrotal circumference in yearling Hereford bulls: Adjustment factors, heritabilities and genetic, environmental and phenotypic relationships with growth traits. J. Anim. Sci. 62:958.

Nwakalor, L.N., J.S. Brinks and G.V. Richardson. 1986. Selection in Hereford cattle. I. Selection intensity, generation interval and indexes in retrospect. J. Anim. Sci. 62:927- 936.

Nwakalor, L.N., J.S. Brinks, and G.V. Richardson. 1986. Selection in Hereford cattle. II. Expected and realized response. J. Anim. Sci. 62:937-949.

Smith, B.A., J.S. Brinks and G.V. Richardson. 1986. Estimation of genetic parameters among breeding soundness examination components and growth traits in yearling bulls. Amer. Soc. Anim. Sci. West. Sec. Proc. 37:292-295.

Werre, J.F. and J. S. Brinks. 1986. Relationships of age at puberty with growth and subsequent productivity in beef heifers. Amer. Soc. Anim. Sci. West. .Sec. Proc. 37:300-303.

Bailey, D.W., J.S. Brinks, and R.M. Bourdon. 1987. Genetic parameters for reproductive traits in beef cows. Amer. Soc. Anim. Sci. West. Sec. Proc. 38:29-32.

Bourdon, R. and J.S. Brinks. 1987. Simulated efficiency of range beef production. I. Growth and milk production. J. Anim. Sci. 65:943-955.

Bourdon, R.M. and J.S. Brinks. 1987. Simulated efficiency of range beef production. II. Fertility traits. J. Anim. Sci. 65:956-962.

Bourdon, R.M. and J.S. Brinks. 1987. Simulated efficiency of range beef production. III. Culling strategies and nontraditional management systems. J. Anim. Sci. 65:963-969.

Brinks, J.S. 1988. Genetic aspects of calving ease. Agri-Practice, Vol. 9, No. 6.

Gilbert, R.P., C. T. Gaskins, J.K. Hillers, J.S. Brinks and A. H. Denham. 1988. Inbreeding and immunoglobulin G. concentrations in cattle. J. Anim. Sci. 66:2490-2497.

Andersen, K.J., J.S. Brinks, D.G. LeFever and K.G. Odde. 1988. Genetic aspects of reproductive tract scores, condition scores and performance traits in beef heifers. Amer. Soc. Anim. Sci. West. Sec. Proc. 39:265-270.

Field, T.G., J.S. Brinks, R.E. Taylor and J.D. Tatum. 1988. Estimation of genetic parameters for mature weight in Hereford females. Amer. Soc. Anim. Sci. West. Sec. Proc. 39:30-32.

Green, R.D., J.S. Brinks, and D.G. LeFever. 1988. Relationships between male and female pelvic measures in beef cattle. Amer. Soc. Anim. Sci. West. Sec. Proc. 39:37-39.

Brinks, J.S. and W.C. Miller. 1990. Optimizing cow size, milk level and labor by computer modeling. Amer. Soc. Anim. Sci. West. Sec. Proc. 41:152-154.

Green, R.D., J.S. Brinks, and D.G. LeFever. 1988. Genetic characterization of pelvic measures in beef cattle: Heritabilities, genetic correlations and breed differences. J. Anim. Sci. 66:2842-2850.

Brinks, J.S. 1989. Genetics of reproductive traits in bulls. Agri-Practice. Vol. 10, No. 2.

Smith, B.A., J.S. Brinks, and G.V. Richardson. 1989. Relationships of sire scrotal circumference to offspring reproduction and growth. J. Anim. Sci. 67:2881-2885.

Smith, B.A., J.S. Brinks and G.V. Richardson. 1989. Estimation of genetic parameters among reproductive and growth traits in yearling heifers. J. Anim. Sci. 67:2886-2891.

Smith, B.A., J.S. Brinks and G.V. Richardson. 1989. Estimation of genetic parameters among breeding soundness examination components and growth traits in yearling bulls. J. Anim. Sci. 67:2892-2896.

Brinks, J.S. 1990. Cattlemen's handbook for expected progeny differences. Colorado State University, 38 pages.

Andersen, K.F., D.G. LeFever, J.S. Brinks, and K.G. Odde. 1991. The use of reproductive tract scoring in beef heifers. Agri-Practice. 12:19-20, 22-23, 25-26.

Golden, B.L., J.S. Brinks and R.M. Bourdon. 1991. A performance programmed method for computing inbreeding coefficients from large data sets for use in mixed-model analyses. J. Anim. Sci. 69:3564-3571.

Martin, L.C., J.S. Brinks, R.M. Bourdon and L.V. Cundiff. 1992. Genetic effects on beef heifer puberty and subsequent reproduction. J. Anim. Sci. 70:4006-4017.

Andersen, K.J., J.S. Brinks, D.G. LeFever and K.G. Odde. 1993. The factors associated with dystocia in cattle. Vet-Med 88:764,766,768, 770-772, 774-776.

Andersen, K.J., J.S. Brinks, D.G. LeFever and K.G. Odde. 1993. A strategy for minimizing calving difficulty. Vet-Med. 88: 778,780-781.

Reverter, A., B.L. Golden, R.M. Bourdon and J.S. Brinks. 1994. Method R variance components procedure: Application on the simple breeding value model. J. Anim. Sci. 72:2247-2253.