PROCEEDINGS

BEEF IMPROVEMENT FEDERATION

RESEARCH SYMPOSIUM & ANNUAL MEETING

BEEF IMPROVEMENT FEDERATION

20TH ANNIVERSARY MEETING

MAY 12-14, 1988

B I F

ALBUQUERQUE, NM

1988 BIF CONVENTION PROGRAM

WEDNESDAY, MAY 11 - Evening

6:00 Dinner Meeting, BIF Board of Directors

THURSDAY, MAY 12 - **Genetic Prediction Workshop**

Presiding, A. L. Eller, Jr., VPI & SU

Morning

8:00 *Purposes of the Workshop*, A. L. Eller, Jr., VPI & SU

8:15 *Current Genetic Prediction Systems*, E. J. Pollak, Cornell University

8:50 *Evaluating and Reporting Growth and Maternal Traits*, D. E. Wilson, Iowa State University

9:25 Coffee Break, *Compliments of A.I. Firms*

9:50 *Evaluating and Reporting Reproductive Traits*, D. R. Notter, VPI & SU

10:25 *Evaluating and Reporting Carcass Traits*, L. L. Benyshek, University of Georgia

11:05 *Measuring, Understanding and Using Correlated Responses*, R. L. Quaas, Cornell University

11:40 Questions and Discussion

12:00 Lunch

Afternoon

2:00 *Questions Most Often Asked About Genetic Prediction*
Panel Moderator, Roy A. Wallace, Select Sires
Craig Ludwig, American Hereford Association
Wayne Vanderwert, Am. Limousin Foundation
John Crouch, American Angus Association
Keith Vandervelde, American Breeders Service

3:30 Coffee Break, *Compliments of A.I. Firms*

3:50 *What's Available from Breed Associations , A.I. Firms and Highlights of Extension Programs*- Presiding, Rich Whitman, American Simmental Association (Select any four presentations to visit)

FRIDAY, MAY 13, 1988 - Morning

8:30 *The Challenges of Specification Beef Programs*, Bob Dickinson, BIF President, Presiding
What is Being Done and What is Needed in Specification Programs, Gary C. Smith, Texas A&M University
Live Animal Evaluation to Determine Carcass Traits, Robert Long, Texas Tech Univ.

10:00 Coffee Break, *Compliments of A.I. Firms*

10:20 Packer-Producer Panel Discussion
Packer-Feeder Panel
Gary C. Smith, Texas A&M University, Moderator
Rod Bowling, Monfort of Colorado
Del Allen, Excel Corp.
W. L. Mies, Texas A&M University
Producer Panel
Robert Long, Texas Tech University, Moderator
Dave Nichols, Anita, Iowa
Leonard Wulf, Morris, Minnesota
Dallas Horton, Wellington, Colorado
Panel Summary

FRIDAY, MAY 13, 1988 - Afternoon

12:30 Presiding, Jim Gibb, Am. Polled Hereford Assoc.

Welcome to New Mexico, John Owens, Dean of College of Agr. & Home Economics, NMSU

Reflections on 20 Years of BIF, Frank Baker, Winrock International

Seedstock and Commercial Nominee Introductions, Bill Warren, Santa Gertrudis Breeders Int'l
Ron Bolze, Ohio State University

Charge to Committees, Dixon Hubbard and Gary Weber, USDA-ES

2:30 BIF Committee Meetings
Genetic Prediction Committee, Larry Cundiff, Chairman
Live Animal and Carcass Trait Evaluation Committee, John Crouch, Chairman
Central Test Committee, Charles McPeake, Chairman

3:15 Coffee break, *Compliments of A.I. Firms*

5:00 *Caucus for Election of Directors*, Bob Dickinson, President

6:00 *Social Hour - Cash Bar*

7:00 *Awards Banquet*
Presiding, Daryl Strohbehn, Iowa State University
Tales of Southwestern Culture - Joe Hayes, Santa Fe, N. M.
Awards, Roy Wallace, Chairman, Awards Comm.

SATURDAY, MAY 14, 1988 - Morning

6:30 BIF Board of Directors Meeting

7:30 Breakfast - President's Remarks, Bob Dickinson

9:30 Depart for Tour of Beef Operations in New Mexico

Stop 1: King Brothers Feedlot and Ranches, Stanley, N. M.

The King family has been involved in livestock and farming operations in the Estancia Valley for many years. Their operations include irrigated farming enterprises, two feedlots, and purebred, commercial cow-calf and stocker cattle enterprises.

Stop 2: Cook Ranch, Galisteo, N. M

The Cook ranch is primarily a stocker operation utilizing short duration grazing. A movie site is also located on the ranch. A barbecue lunch will be served at the movie site where such movies as *Silverado* were filmed.

Stop 3: Canon Blanco Ranch, White Lakes, N. M.

The Canon Blanco Ranch is a Beefmaster cow-calf operation also utilizing short duration grazing cells.

Proceedings of Beef Improvement Federation
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PURPOSE OF THE GENETIC PREDICTION WORKSHOP STARTED AS A WORKSHOP FOR EXTENSION SPECIALISTS ONLY

A. L. Eller, Jr., Extension Animal Scientist, VPI&SU, Blacksburg, Virginia

1. The purpose of this workshop is to understand where we have been in beef cattle performance testing and genetic prediction.

2. To understand where we are with genetic predictability, and the measures and procedures we use.

3. To understand how to better utilize the data and procedures which are available. The whole idea is to: (1) to get individual animal performance data collected and reported to National Breed Associations; (2) for breed associations to follow uniform procedures in computing measures of GENETIC PREDICTION; and (3) to get genetic prediction data on individual animals utilized in breeding and selection programs in seedstock and commercial herds at the farm and ranch level.

Determining the best estimate of BREEDING VALUE on individual animals for the traits on economic importance is what the entire procedure is all about. This day will be one of understanding and formulating programs to expand the useage of genetic prediction data.

WHERE HAVE WE BEEN?

Research on herdability of economically important traits began in the 1930's, and continued thru the 40's, and especially the 50's. State extension services started on-farm performance testing programs, and the computation of performance data thru their computers in the 50's, and this activity has been continued. State Beef Cattle Improvement Associations were formed beginning in 1955, and running thru the 1970's, with most being put in motion in the 1960's. Performance Registry International was active on a national scale in the late 50's thru the 60's, and to a lesser degree in the 70's. Breed associations performance programs were started up in the 1960's, and have gotten stronger until today they are performing the performance testing, sire summary, and entire breed population performance summaries for their particular breeds. The U.S. Beef Performance Records Committee, amalgamating the efforts of BCIA's and Breed Associations, and PRI made the first stab of standardization of performance programs with the Baker Report in 1965. In 1968 BIF was founded, and has continued to amalgamate the efforts of all associations, and groups doing performance testing in the United States and Canada.

It is interesting to look at the BIF Annual Meeting and Research Symposium major topics down thru the years which are as follows:

1969 in Kansas City - technical and educational working committees hammering out guidelines. National Sires Evaluation effort started.

1970 Kansas City - characterization of breeds, how many beef performance recording oganizations ?, national sire evaluation.

1971 Kansas City - standardization possibilities of multi-state beef improvement programs, USDA carcass evaluation program. National Committee on standardization met in Knoxville.

1972 Omaha - reproduction, bull fertility, distocia, size and calving difficulty.

1973 Omaha - grading and evaluation of the live animal, cross-breeding, efficiency.

1974 Denver - efficiency of production, national sire evaluation, cow efficiency. Dave Nichols, President, predicted a bust in the cattle business which happened later that year. He said "up to now we have searched for breeders who had bred performance cattle--now we've got to figure out how to breed cattle from that base".

1975 Des Moines. Efficiency, growth curves, carcass characteristics with different end points, birth defects.

1976 Kansas City - birth weights, calving difficulty, line-breeding.

1977 Bozeman - correlated traits, indicator traits, testicular traits, serving capacity, age and weight at puberty, direct and maternal breeding value.

1978 Blacksburg - review weaning and yearling weight adjustment factors, breeding values, EPD's, what are BCIA's to do, listening conference.

1979 Lincoln - growth rate and frame size, linear measurement, feed efficiency.

1980 Denver - sire evaluation, sire evaluation demonstration. Guidelines.

1981 Stillwater - performance data utilization, performance data needs, specification buying and selling of bulls.

1982 Rapid City - systems concept, systems approach to cattle breeding, future direction of beef industry, use of computers.

1983 Sacramento - sire evaluation

1984 Atlanta - maternal evaluation (ET, paternal effects, genetic-environmental interaction)

1985 Madison - calving ease, sire evaluation concerns with calving ease, breeding for optimums, merchandizing beef improvement.

1986 Lexington - male fertility, specification seedstock, what impact for raising beef for profit.

1987 Wichata - crossbred bulls, the market target.

A major activity of BIF has been formulating and printing guidelines for uniform beef improvement programs. Guidelines were printed in 1970, 1972, 1976, 1981, and 1986.

WHERE ARE WE?

Folks, we have moved from weighing and grading calves and calculating adjusted average daily gains to computing adjusted 205 day weights, and ratios, and adjusted yearling weights and ratios. We have moved from central bull test stations where only test average daily gain was computed and deemed to be important to the utilization of central bull test stations where data is complete including EPD's. We have moved to complete data collection on all animals in a herd where contemporary groups are accurate. Data collected include: birth weight, calving difficulty, weaning weight, yearling weight, scrotal circumference, hip height, and others. These data are fed into National Breed Association data banks. Breed Associations have moved from structured national sire evaluation programs to field data sire evaluation using the best linear unbiased predictor (BLUP) system. Now those associations are using the animal model, and are doing genetic prediction of parent and non-parent cattle in terms of EPD's with relevant accuracies on traits of economic importance.

Today we have strong Breed Association performance and genetic prediction programs--some much better developed than others at this point, though all are functional and useful. We have had open AI in the industry for a number of years. Embryo transfer and other embryo manipulative technology is in widespread use.

WHERE DO WE GO FROM HERE?

We have the tools for use in beef cattle breeding and selection, the problem is there is still too little understanding and far to little use of this technology, both in purebred, and commercial herds. There is still a tremendous educational job to be done. A great deal of that chore lies with us in this room. We must understand genetic prediction and learn how to apply this technology, and teach others at the seedstock and commercial level how to make proper application.

Sire summaries and genetic predication being done as follows: Colorado State University - Polled Hereford, Gelbvieh, Charolais, Red Angus, Tarentaise. University of Georgia - Hereford, Angus, Limousin, Brangus, Shorthorn, Beefmaster, Brahman, and Santa Gertrudis. Cornell University - Simmental. APHA - Salers, and South Devon.

Current Genetic Prediction Systems Used in the Beef Cattle Industry

E. John Pollak
Department of Animal Science
Cornell University

Robert Bakewell, a famous 18th-century English livestock breeder, is often quoted as saying, "Mate the best to the best." He left us with two relevant questions to ponder--first, how to define best, and second, how to identify the best given our definition. The objective of this particular workshop is to describe how the beef industry is dealing with the latter question. I will concentrate specifically in this presentation on the genetic prediction systems currently in use which provide the information on genetic merit of beef cattle within a breed.

Expected Progeny Differences

The objective of a genetic prediction system is to combine the potentially vast and varied sources of information available on an animal into a single value for each trait of concern. The value obtained is used for the purpose of ranking animals for selection and is called, in the beef industry, the Expected Progeny Difference (EPD).

EPD's are quite simple to use and to understand if viewed in the correct light. The best way to consider EPD is as a comparison. For example, assume the EPD's of two bulls for weaning weight are +20 for bull A and +10 for bull B. The comparison tells us bull A's progeny are expected to weigh 10 lb more at weaning than the progeny of bull B. That is, the EXPECTED DIFFERENCE in the PROGENY of the two bulls is 10 lb.

If we were to take bulls A and B and mate them at random to a large number of cows that were similarly managed, we would expect to see a 10-lb difference if we weighed their progeny at weaning. What differs between the progeny from these two bulls? We assume because we mated the bulls randomly to a large number of cows that the genetic merit of the cows will average out to be the same. We also assume that since the progeny were similarly managed, any particular environments that were encountered by the progeny of the two bulls will average out to be the same. Hence, we are predicting the differences resulting from the successful gametes of the bulls. The EPD, then, is actually predicting the average value of a parent's gametes (sperm in males, ova in females). Because of the large genetic differences that can occur between two gametes produced by the same parent, we do not always expect to find two calves, one from each of our bulls, differing by 10 lb. In fact, in some cases, the progeny of bull B may be heavier at weaning than the progeny of bull A. The EPD's tell us what to expect on average.

Information Included in the Current Sire Summaries

As previously stated, the amount of information available on any one particular individual may be vast and quite varied. For example, we can partition information into that obtained on the individual's ancestors, on the individual itself, and on the individual's descendants. In the past, producers have probably attempted to weigh the available information in their own mind when making a decision on the sale or purchase of an animal. The two problems they faced were 1) the human mind cannot comprehend the vastness of information available and 2) we would all probably assign different weights to the various information that we were examining. For any given set of information, there is an appropriate set of weights. The theory currently being used for genetic evaluation was developed by Dr. C. R. Henderson and is called best linear unbiased prediction (BLUP). Using BLUP theory leads us to the appropriate weights assigned to each source of information given the model chosen to analyze the data with. The model used by most systems today is the animal model (Henderson and Quaas, 1976).

The Animal Model

Before describing the animal model, a discussion of some desirable features for any beef evaluation is necessary. One can then show how these features are incorporated in a system using the animal model. First, an evaluation of an individual should include as much information on that individual and his relatives as possible to increase the accuracy of evaluation. Second, traits such as weaning weight have both a direct and maternal component which should be included in the analysis. The evaluation for direct and maternal traits will be addressed by Dr. Wilson in this program. Third, the genetic merit of an animal's mates should be accounted for when considering progeny data to eliminate the influence of nonrandom mating. Fourth, all evaluations are based on comparisons within contemporary groups, and the genetic superiority or inferiority of the group should be accounted for. Fifth, there is information available from correlated traits, and where possible this information should be included in the analyses. Dr. Quaas will be covering correlated traits in his presentation. BLUP theory conveniently allows for all these features to be included in an animal model analysis.

To describe the animal model, let's begin with the simplest animal model equation. This equation may be written as:

$$y_{ij} = CG_i + a_{ij} + e_{ij}$$

where y_{ij} is the observation, CG_i is the contemporary group effect associated with the record, a_{ij} is the genetic merit of the animal in the contemporary group making the record, and e_{ij} is the random environmental effect, measurement error, etc., associated with the record. The contemporary group represents a comparison group. That is, it consists of all animals exposed to the same management and general environmental effects. In some analyses, contemporary groups are further defined by such effects as sex of calf, e.g., the Simmental analysis. The important concept, however CG's are defined, is that the comparison of records for two animals within a group is a fair genetic comparison allowing us to estimate the a_{ij}'s.

The model equation tells us what sources of variation are perceived to be important in explaining the variation observed in the data. To complete the specification of the model requires describing the nature of the effects in the model equation. All current analyses consider the CG effects to be fixed effects and a_{ij}'s and e_{ij}'s to be random. The variation associated with the

a_{ij}'s is the genetic variation (variation among breeding values) and that associated with the e_{ij}'s, the within contemporary group environmental variation. All analyses assume, within a trait, that there is no covariation between environmental effects. Covariation does exist, however, between observations on related animals because they have genes in common influencing their genetic potential. All current systems use what is called the relationship matrix through which covariation among relatives' records is included in the analysis.

Mixed Model Equations for the Animal Model

In analyzing the beef data sets using Henderson's mixed model methodology for BLUP, a system of equations are built and solved simultaneously, yielding estimates of all effects in the model equations. In our simple model, this means we obtain estimates of the CG effects and all the animal's genetic merits. These equations are shown here as a reference for how information on an animal and its relatives gets included in that animal's evaluation. Matrix notation will be used.

The animal model equations can be written as:

$$y = X\beta + Za + e$$

where y is the vector of observations of order n x 1 for n records; β is the vector of the CG_i contemporary group effect, i = 1,...,p; X is an incidence matrix relating the observation to its contemporary group with order n x p; a is the vector of breeding values for all t animals considered; Z is the matrix relating the breeding value of the animal to its records and has order n x t; and e is the vector of unknown environmental effects. Note, if every animal has one record, t = n and Z is the identity matrix. We can, however, have multiple records per animal and include animals without records.

To complete the specifications of the model:

$$V \begin{bmatrix} a \\ e \end{bmatrix} = \begin{bmatrix} A\sigma_a^2 & 0 \\ 0 & R \end{bmatrix}$$

where A is the matrix of relationships among animals and σ_a^2 is the genetic variation. The mixed model equations are:

$$\begin{bmatrix} X'R^{-1}X & X'R^{-1}Z \\ Z'R^{-1}X & Z'R^{-1}Z+A^{-1}\sigma_a^{-2} \end{bmatrix} \begin{bmatrix} \hat{\beta} \\ \hat{a} \end{bmatrix} = \begin{bmatrix} X'R^{-1}y \\ Z'R^{-1}y \end{bmatrix}$$

and if $R = I\sigma_e^2$, then:

$$\begin{bmatrix} X'X & X'Z \\ Z'X & Z'Z+A^{-1}\alpha \end{bmatrix} \begin{bmatrix} \hat{\beta} \\ \hat{a} \end{bmatrix} = \begin{bmatrix} X'y \\ Z'y \end{bmatrix}$$

where α is the ratio of σ_e^2 to σ_a^2. If an animal does not have a record, its corresponding row and column in Z'Z, its column in X'Z and row in Z'X are all null. The evaluation of this animal is achieved through information on relatives. If an animal has one or more records, then the number of records appears on the diagonal of Z'Z. The column of X'Z and row Z'X contain the number of times the animal is associated with each particular contemporary group.

Note that in the mixed model equations, the inverse of the relationship matrix is used. The elements of this inverse are easily written down following a set of rules (Henderson, 1975). These rules will be applied as we examine equations for individual animals with varying amounts and sources of information.

First, consider the case where all animals have one record and a particular animal has no pedigree or progeny information. The equation from the mixed model equations for that animal is

$$\widehat{CG}_i + (1 + \alpha)\hat{a}_{ij} = y_{ij}$$

where the ^'s represent estimates. Then

$$\hat{a}_{ij} = [1/(1+\alpha)](y_{ij} - \widehat{CG}_i) \quad .$$

It can be shown that

$$1/(1+\alpha) = h^2 \quad .$$

Hence,

$$\hat{a}_{ij} = h^2(y_{ij} - \widehat{CG}_i) \quad .$$

This formula is essentially how breeding values are estimated from a performance test. The animal's observation is deviated from an estimate of the contemporary group and regressed by the h^2 of the trait.

Now let's consider the case of a sire with progeny information only.

We will assume that each progeny has both parents identified. In A^{-1} a value of -1 appears between a progeny and the parent and a value of +.5 between the sire and the dam of that progeny. Also, on the diagonal for that sire a .5 is added for each progeny. Hence, for a sire with progeny information only, the equation is:

$$[(1+.5q)\alpha]\hat{a}_{ij} + .5\alpha\hat{a}^M_{ij} + .5\alpha\hat{a}^M_{ij} + \ldots + .5\hat{a}^M_{ij}$$
$$- \alpha\hat{a}^P_{ij} - \alpha\hat{a}^P_{ij} - \ldots - \alpha\hat{a}^P_{ij} = 0$$

where q is the number of progeny, $\hat{a}^M_{ij}$ is the breeding value of the mate producing a particular progeny and a^P_{ij} a progeny. Note there is no CG effect since the sire does not have his own record and for the same reason the right-hand side of the equation is zero. The solution for this sire is:

$$\hat{a}_{ij} = 1/(1+.5q)\Sigma(\hat{a}^{P}_{ij} - .5\hat{a}^{M}_{ij})$$

Note, the sire solution is a function of its progeny's breeding value deviated from 1/2 the breeding value of the dam. The genetic merit of the mate is included in the sire's evaluation. The sum of the deviations can be represented as:

$$\Sigma(\hat{a}^{P}_{ij} - .5\hat{a}^{m}_{ij}) = q \text{ \underline{times} the average deviation.}$$

Hence, the coefficient becomes:

$$q/(1+.5q)$$

which approaches 2 as q becomes large.

Another example is to consider an animal with a record and whose parents are included in the evaluation. That animal's equation is

$$\widehat{CG}_{i} - \alpha\hat{a}^{S}_{ij} - \alpha\hat{a}^{D}_{ij} + (1 + 2\alpha)\hat{a}_{ij} = y_{ij}$$

where $\hat{a}^{S}_{ij}$ and $\hat{a}^{D}_{ij}$ are the breeding values of a_{ij}'s sire and dam, respectively. The α's and the 2α are from $A^{-1}\alpha$ and again are calculated using Henderson's rules. Solving for $\hat{a}_{ij}$ gives:

$$\hat{a}_{ij} = [1/(1 + 2\alpha)] \{y_{ij} - \widehat{CG}_{i}\} + [\alpha/(1 + 2\alpha)] \{\hat{a}^{S}_{ij} + \hat{a}^{D}_{ij}\} \quad .$$

Note the animal's deviated performance is still used but with a smaller weight than for an animal with no parents known [$1/(1+\alpha)$ versus $1/(1+2\alpha)$]. Also, the parent's information is now included in the animal's evaluation. If we divide $\hat{a}^{S}_{ij} + \hat{a}^{D}_{ij}$ by 2, we obtain the pedigree index estimate of $\hat{a}_{ij}$'s breeding value. Substitution of this into our formula yields:

$$\hat{a}_{ij} = [1/(1+2\alpha')] \text{ (performance deviation) } + [2\alpha/(1+2\alpha)] \text{ (pedigree index)} \quad .$$

Our final example is the most complex case, that being for an animal with its parents known, its own record, <u>and</u> with progeny. The solution for this animal is:

$$\hat{a}_{ij} = \{1/[1+(2+q)\alpha]\} \, [(y_{ij}-\widehat{CG}_{i}) + \alpha(\hat{a}^{S}_{ij}+\hat{a}^{D}_{ij}) + \alpha\Sigma\hat{a}^{P}_{ij} - .5\alpha\Sigma\hat{a}^{M}_{ij}]$$

Note $(y_{ij}-\widehat{CG}_{i})$ is the performance test, $\alpha(\hat{a}^{S}_{ij} + \hat{a}^{D}_{ij})$ is the pedigree information, $\alpha\Sigma\hat{a}^{P}_{ij}$ is the progeny test and $.5\alpha\Sigma\hat{a}^{M}_{ij}$ is the adjustment made for the merit of the animal's mates. Also, note the weights for the performance and pedigree information gets smaller as q increases:

$$1/[1+(2+.5q)\alpha] \rightarrow 0 \text{ as } q \rightarrow \infty \quad ,$$

and

$$\alpha/[1+(2+.5q)\alpha] \rightarrow 0 \text{ as } q \rightarrow \infty \quad .$$

The terms $\alpha\Sigma\hat{a}^P_{ij}$ and $.5\alpha\Sigma\hat{a}^M_{ij}$ again can be combined as $\alpha\Sigma(\hat{a}^P_{ij}-.5\hat{a}^M_{ij})$ and as before this sum can be written as q times the average deviation. Hence, the weight for the progeny test is

$$\alpha q/[1+(2+.5q)\alpha]$$

and this term approaches 2 as q approaches infinity. Examining these weights as q gets large shows quite simply the increasing value of the progeny test and decreasing impact of the pedigree and performance information.

In all of the examples in which an animal has its own record, the equations could be arranged to contain a term for the performance deviation, $y_{ij} - \hat{CG}_i$. One of the features listed as desirable for any evaluation was that the genetic superiority (or inferiority) of the competition be accounted for. That is, our $\hat{CG}_i$ should be one which is adjusted for the average genetic merit of the animals it contains. If we examine an equation for a particular contemporary group (say b) from the mixed model equations it would appear as:

$$n_b\hat{CG}_b + \Sigma\hat{a}_{bj} = \Sigma y_{bj} \quad ,$$

and the solution for the CG can be represented as:

$$\hat{CG}_b = \bar{y}_b - \Sigma\hat{a}_{bj}/n_b$$

where n_b represents the number of animals in that CG and $\bar{y}_b$ the mean of observations in that CG. The term

$$\Sigma\hat{a}_{bj}/n_b$$

represents the average breeding value of the animals in the $\hat{CG}$. If they average greater than zero, the phenotypic mean is adjusted down while if they average below zero, the mean is adjusted upward. Hence, the genetic superiority (or inferiority) of the group is accounted for.

A necessary condition allowing for the adjustment of genetic merit in the CG estimate is that there be genetic ties across environments. In a sense, these ties allow us to observe the same genes in different CG's which supplies the information necessary to partition the environmental and genetic components in y within any CG. Sire progeny across CG's is one example of a genetic tie and was the rationale for the use of reference sires made by several breeds in the 70's and early 80's.

The exercise of examining these equations is informative in that it shows the sources of information on relatives which can be incorporated easily in the animal's evaluation. These sources of information are appropriately weighted. Also, the simultaneous estimation of the breeding values and contemporary groups allows for correct deviations of each individual's performance, i.e., adjusted for the genetic merit of that individual's competition.

Reduced Animal Model (RAM)

The animal model is the most complete additive genetic model. A disadvantage of this model, however, is that every animal in the population has an equation to be solved. Quaas and Pollak (1980) introduced an equivalent model, RAM, which gives the same evaluations but reduces the number of equations initially solved. In this model, there is an equation for every animal that is a parent; there is no equation for nonparents although their information is used.

The basic principle of RAM is that an animal's breeding value can be written as:

$$a_{ij} = 1/2a^{S}_{ij} + 1/2a^{D}_{ij} + \phi_{ij}$$

where ϕ_{ij} is the Mendelian sampling associated with animal ij. The Mendelian sampling is uncorrelated with the breeding values of the parents. When using RAM, two models are considered. For a parent with a record, we use the animal model:

$$y_{ij} = CG_{i} + a_{ij} + e_{ij}$$

and for an animal which is not a parent we use:

$$y_{ij} = CG_{i} + 1/2a^{S}_{ij} + 1/2a^{D}_{ij} + (\phi_{ij} + e_{ij}) \quad .$$

If an animal is not a parent, we relate its record to its sire and dam and combine its Mendelian sampling with the residual. Hence, only parent breeding values are involved in the initial analysis. In matrix notation, this can be written again as

$$y = X\beta + Za + e$$

However, now Z is a matrix containing a 1 if the record is on the parent or a 1/2 in the column of the sire and the dam of the animal with a record if that animal is not a parent. For parent records, the $V(e_{ij}) = \sigma^2_e$ and for nonparent records $V(\phi_{ij} + e_{ij}) = 1/2\sigma^2_a + \sigma^2_e$. The mixed model equations are then built as before. After obtaining solutions for parents, solutions for nonparents can be obtained by building each animal's equation one at a time (hence, computationally simple) and backsolving using the solutions obtained in the initial analysis. Hence, RAM is a computational approach to achieving an animal model analysis.

National Evaluations

There are currently three centers at which national evaluations are being run. At the University of Georgia, evaluations are run for Limousine, Shorthorn, Brangus, Brahman, Santa Gertrudis, Beef Master, Angus and Hereford. At Colorado State, evaluations are run for Tarentaise, Polled Hereford, Charolais, Red Angus, and Gelbvieh. At Cornell University, evaluations for the U.S. and Canadian Simmentals and Simbrah are run.

At Georgia, all breeds with birth weight evaluations obtain expected progeny differences using the reduced animal model for birth weight, fitting both direct and maternal components. For all breeds other than Angus and Herefords, a multiple trait RAM for weaning weight and gain is used. The evaluation for weaning weight also includes direct and maternal components. The magnitude of the Angus and Hereford data sets currently precludes a multiple trait approach, hence, weaning weight (direct and maternal) evaluations are done separately from gain. Yearling weight evaluations are obtained as the sum of the weaning weight evaluations plus the postweaning gain evaluations.

At Colorado, all breeds other than Polled Hereford are done with a multiple trait weaning weight and postweaning gain evaluation. Again, for weaning weight, direct and maternal effects are included. The Polled Hereford data are analyzed at Colorado in much the same way as the Hereford and Angus data are at Georgia, that is, a separate evaluation for weaning weight (direct and maternal) and postweaning gain. At Cornell, two evaluations are run routinely. The first is a multiple trait evaluation of the weight traits, which includes birth weight(direct and maternal), weaning weight (direct and maternal) and gain. The other evaluation is for calving ease where records on first-calf heifers are considered as a different trait than records on older cows. For both first-calf heifers and older cows, direct and maternal effects are fit. The model used at Cornell is a sire/maternal grandsire model. This model provides evaluations of all bulls in the data. Equations like those in the animal model for a single trait are fit in the within-house program run at the American Simmental Association. Solutions to these provide the EPD's for cows and calves. All of these systems are serving the industry well and providing accurate and reliable estimates of the transmitting ability of individuals upon which selection decisions may be made with confidence.

References

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Evaluating and Reporting Growth and Maternal Traits

Doyle E. Wilson
Iowa State University, Ames, Iowa

Introduction

The use of EPDs by the purebred beef industry has proven to be a powerful tool for making genetic improvement. The use of this technology will continue to expand and be improved upon as breeders, extension specialists and researchers collectively work to improve upon the methodology and expand the number of traits evaluated. One of the new frontiers for adoption of this technology is the commercial bull buyer. Certainly the commercial bull buyer has capitalized on the efforts of the purebred industry as genetic improvements have been made, but this capitalization will become even greater as the commercial bull buyer begins to incorporate EPD values into selection decisions.

In early 1988, Daryl Strohbehn (ISU Extension Beef Specialist) and I conducted nine Iowa Bull Selection Clinics developed for the commercial bull buyer. The purpose of each clinic was to help set the stage for making a sound bull selection decision using the latest technology: 1) determining current situation and defining future breeding objectives, 2) learning about and putting EPDs to work, and 3) understanding the requirements of bull breeding soundness examinations.

The highlight of these clinics was the parade of three bulls that were used to demonstrate the use of EPDs in comparing bulls. The bulls were all yearlings with interim EPD values for birth weight, weaning weight, yearling weight, and maternal milk along with direct calving ease and maternal calving ease for one Simmental bull. The bulls and their EPDs stimulated some very interesting discussion with the audiences. These commercial buyers are ready for EPDs. Their questions were not only tough, they were at times very critical.

I have structured my presentation for this workshop series using questions asked by the commercial bull buyers in Iowa as they define their long-range breeding programs. Questions given here relate to the growth and maternal traits currently being evaluated in the national cattle evaluation programs: birth weight, weaning weight, yearling weight and maternal milk. Although the questions came from the commercial bull buyers, the questions are equally relevant to purebred breeders as the EPD system becomes the norm rather than the exception for buying and selling bulls.

Birth Weight (BW) EPD

Reproductive performance is the number one concern in a list of breeding program objectives for the commercial cow-calf producer. A live calf, born unassisted, is of paramount importance to these producers. The following two questions focus on their thoughts with respect to this objective.

Q 1: The breed I am looking at only has birth weight (BW) EPD, and I want a calving ease bull to use with replacement heifers. How reliable is the BW EPD in predicting calving ease?

A 1: Since your objective is to avoid calving difficulty problems in heifers, you need to identify bulls that will minimize your risk. The BW EPD is one of the best indicators available for predicting calving ease.

Birth weight of the calf has the most influence of all the factors studied that affect calving ease followed by age of dam and sex of the calf. The phenotypic correlation between birth weight and calving ease is reported to be .3 to .4; the genetic correlation in first-calf heifers has been reported to be as high as .9. Other factors you should consider when making your selection decision follow:

1) Birth weight is positively correlated with weaning and yearling weights. Therefore, generally, bulls siring light birth-weight calves generally sire calves with lighter weaning and yearling weights. But as indicated in beef sire summaries, this is not true for all bulls. There are exceptions to the general rules.

2) You need to know what the average BW EPD is for the group of bulls in the breed from which you will make your bull selection. The average BW EPD is probably not zero, and since many of the breeds are experiencing a positive genetic trend for this trait, each new crop of yearling bulls probably will have a higher average BW EPD. For example, the average BW EPD for Angus bulls born in 1986 is +2.9 lbs; the average for bulls born in 1987 is +3.2 lbs. Your best choice will be to select a bull that is close to the average, or within one standard deviation on the negative side, as well as a bull that will not penalize you on weaning and yearling weight.

3) Avoid using bulls that are extreme for BW EPD on the negative side (BW EPDs that are more than 2.5 standard deviations below the average) unless you can confirm the bull is an easy calver and the calves are thrifty at birth. Analysis of Angus field records has indicated a significantly lower livability among calves that are extremely light in birth weight; the situation for other breeds is probably the same.

4) If you are selecting a bull of a breed different from that of your replacement heifers, you should account for any mature size difference and expected heterosis effects when establishing the acceptable range of BW EPD. If the mature size of the bull is larger than the heifers, adjust the acceptable range downward; if the mature size is smaller, you can expand the range.

5) Calving ease is not an "all or none" trait. Birth weights vary within sire progeny groups, and some calving difficulties can occur with easy calving bulls.

6) If your objective was to develop a group of females genetically superior for calving ease, EPD for direct calving ease and maternal calving ease would be other traits to consider in your selection decision.

Q 2: When I see BW EPD reported on yearling bulls, they usually have an accuracy value of less than .25. With this low accuracy, can I really depend on the bull performing like his EPD says he will?

A 2: If you were to sample several bulls, the answer would be: "Yes, on the average." However, "on the average" is not good enough for the bull buyer who only uses one bull or is buying a bull to use on replacement heifers. You really need to know the possible change associated with the given accuracy. EPD values are regressed (brought closer) to the breed average in proportion to the amount of information that went into the calculation. Low accuracy bulls are regressed more than high accuracy bulls.

Assume that the maximum BW EPD is +5.0 lbs you will accept and you are considering a bull with a BW EPD of +3.8 with an accuracy of .20. This accuracy value corresponds to a possible change of $\pm$2.5. This is not the bull for breeding to your heifers because 3.8+2.5 is greater than the acceptable upper level of 5.0 lbs. It is true that the bull could stay the same or even go down in BW EPD. But are you willing to accept the risk of this not happening?

The accuracy value is an indicator of the amount of information that has gone into the calculation of the bull's EPD. The more information, the higher the accuracy. Bulls that have accuracy values less than .25. will have EPDs that have been determined from their sire and dam EPDs and their own performance, in this case on the bull's own birth weight.

Accuracy values can be related to corresponding possible change or standard error of prediction values. For a given accuracy, approximately 67 percent of the bulls will not change more than + or - the possible change value when re-evaluated with additional progeny information. For example, assume the BW EPD on a yearling Angus bull is +3.5 with an accuracy value of .20. If this bull were to be evaluated a year later with more progeny records, we would expect his updated EPD to be within + or - 2.5 lbs of his first EPD or from +1.0 to +6.0 lbs.

Many of the breed associations have conversion tables in their sire summaries that will allow you to convert any accuracy value to a possible change value. It should be noted that possible change values are for given accuracy values are different for each trait. The possible change values are also different for each breed because of differences in genetic variation.

Direct Weaning Weight (WW) EPD

Commercial bull buyers are also interested in growth to weaning since a majority of them market pounds of weaned calf. The direct weaning weight (WW) EPD reflects growth to weaning at 205 days of age. This EPD uses 205-day adjusted weaning weight records that are additionally adjusted for age-of-dam to account for differences in milk production levels. The following series of question relate to selecting bulls for genetic improvement in growth to weaning.

Q 3: When I look at performance records on a bull, I want to know his adjusted 205-day weaning weight and ratio. Isn't this information as important as his WW EPD?

A 3: First, never use adjusted weights to genetically compare two bulls unless: 1) weights are all that you have and 2) the bulls were reared in the same contemporary group. If EPDs are available, use them only to make genetic comparisons because too many non-genetic factors can affect actual (and subsequently adjusted) weights and mask genetic merit for these two growth traits. For example, differences in level of management (creep versus noncreep), season, and environment could easily account for a 100 lb difference between two genetically identical bulls. The genetic evaluation methodology used to compute the EPD accounts for non-genetic factors and removes them as potential sources of bias.

Second, contemporary group WW ratios are valid only for within herd comparisons because they only remove seasonal and management differences. However, ratios are even limited for within herd comparisons, because ratios do not account for genetic trends that may exist. Breeders and commercial bull buyers need to be able to make fair comparisons between generations, and this cannot be done with ratios. The average value of 100 does not represent the same level of genetic merit except in the absence of genetic trend. Additionally, ratios cannot be compared across contemporary groups using different intensities of selection previous to the time when performance measurements were taken.

Q 4: Can I compare an Angus yearling bull with a Polled Hereford yearling bull on their WW EPD?

A 4: No. Only bulls of the same breed and considered in the same genetic evaluation can be directly compared on their EPD values. EPDs suffer from the same problem that ratios have in terms of not being able to compare them across herds, in this case across breeds. The genetic reference points are just not the same.

It should also be noted that average EPD values for specific traits will vary from breed to breed. For example, the average YW EPD for all Angus bulls born in 1986 is +15.6 lbs, and, the average WW EPD for Polled Hereford bulls born in 1987 is +4.9 lbs. The difference of 10.7 lbs (15.6-4.9) has nothing to do with genetic differences between these two breeds. Neither is the EPD standard deviation the same across breeds.

The only way you can really compare these two bulls is if you have used bulls (with known EPD) from the Angus and Polled Hereford breed and have maintained a set of performance records on the calves. Assuming the bulls were bred to cows of equal merit, the breed of sire average difference in performance of the calves should give you a measure of the breed EPD differences.

Yearling Weight (YW) EPD

The YW EPD is an indicator of growth to a year of age, combining weaning weight with postweaning gain. The questions commercial bull buyers have with this EPD do not relate so much to the trait itself, but to other traits that characterize an animal that is one year of age. The questions deal with feedlot, carcass, and mature size concerns.

Q 5: I am considering two yearling bulls of the same breed that have almost identical EPD for WW and YW. However, I have seen both bulls and their conformation and frame score are quite different. Isn't visual appraisal still important, and isn't this a limitation of the EPD system for evaluating bulls?

A 5: Visual appraisal is important when you do not have EPDs for all the traits you want to consider in a selection decision. You have to determine what your specific breeding objectives are. The bull with the larger frame score will probably sire calves that will be later maturing. Feedlot calves will grade choice at a heavier weight and replacement females will have a larger mature size. Similarly, if type of muscling is important, you must rely upon your ability to visual appraise bulls for this trait since there is no EPD for muscling.

It should be noted that YW EPD is an indicator of growth to one year of age, weaning weight plus postweaning gain. Frame score is determined by hip height measurement and (depending upon the age of the animal at time of measurement) is related to the slaughter weight at which the animal will grade choice. Both frame score and YW EPD are positively correlated with mature size, but they are not perfectly correlated with this trait.

Q 6: I am considering two yearling bulls that are on a state sponsored bull test. When looking at pedigree estimated YW EPDs on the bulls, bull A is superior to bull B, but bull B is out gaining bull A in the test. What is going on and which is the genetically superior bull?

A 6: Two factors could account for the unexpected performance differences: 1) bull B is actually genetically superior to bull A and/or 2) pre-test management and environmental effects were not removed in the test warm-up period and bull B is still putting on compensatory gain. The end-of-test gain results should be considered and incorporated into an interim EPD (includes pedigree EPD and an estimate for Mendelian sampling) for each bull before making a final decision.

EPD based strictly upon pedigree estimation have low accuracy. This low accuracy could also be compounded by low accuracy EPD in one or more of the parents of these yearling bulls. Another point related to actual genetic merit of each bull is the fact that each received a sample half of the genes for growth from their respective parents. This sampling is not accounted for in a pedigree estimated EPD and could result in a bull being below (or above) to the average genetic merit of its parents.

Q 7: Hasn't the purebred industry gone about far enough in terms of mature size? My cows are getting too big. How do I select bulls using EPDs that will leave replacement heifers of a more moderate size without giving up gain performance in their calves?

A 7: A frame size EPD, in conjunction with the YW EPD, would be the best relative indicator of mature size. However, there is only one breed (American Hereford) that currently publishes an EPD for frame size. You could use the individual bull's frame score in place of the frame size EPD because frame score is highly heritable. In general, the higher the frame size and YW EPD, the larger the expected mature size. But, neither of these EPD are perfectly correlated with mature size. Alternatively, visual appraisal may be the best way for you to select bulls exhibiting the mature size you desire in your herd.

Q 8: Very little carcass information is available on bulls in the various summaries. Can you tell anything about carcass characteristics from the growth EPD values listed?

A 8: To a limited extent. Research has shown that postweaning gain is positively correlated with some carcass traits. The problem is that the correlations are not high enough to expect much progress in carcass characteristics when selecting only for postweaning gain. In general, for time-constant endpoints, faster gaining cattle have larger carcasses, higher percentage retail product, a lower percentage of fat trim and lower marbling levels.

Q 9: Why isn't there an EPD for feedlot efficiency, such as feed conversion?

A 9: Computing an EPD for feed conversion would require individual dry matter intake records be collected on a group of progeny. This is not impossible to do, but is difficult and to expensive for most bull gain testing programs. However, research has shown that postweaning gain and feed conversion (feed/gain) are negatively correlated at around -.7. Therefore, the YW EPD can be effectively used an indicator of feed conversion.

Maternal Milk EPD

The maternal milk EPD is a relatively new trait in the summaries, and there appears to be some confusion about this EPD and how to use it. The following two questions are typical of this confusion.

Q 10: I am confused about the milk EPD value. What is it, and how do I use it. If I want more milk in my cow herd wouldn't it be easier to select a bull from a breed characterized by good milk production?

A 10: The milk EPD for a bull is the expected difference in weaning weight for a daughter's calf that is due strictly to the daughter's milk production. It does not measure the extra amount of milk that the daughter will produce. (It is possible to estimate the amount of milk required to produce a pound of WW and then equate the milk EPD to pounds of daily milk production).

The question on how high, how low, or what an acceptable range in milk EPD for a given herd is not an easy question to answer. However, there are some key considerations that should be made. First, the most desirable amount of milk production in a beef cow is the amount that will allow the calf to achieve its potential for growth to weaning, can be economically obtained, and does not adversely affect the cows ability to reproduce on an annual basis. The environment and amount of cheap feed available to your cow herd are probably the biggest factors to consider when deciding on the acceptable level of milk production.

Second, as with BW EPD, the commercial bull buyer should avoid bulls with extreme values of milk EPD (either low or high). In general, commercial producers should find that bulls within plus or minus one standard deviation of the breed average EPD will keep them out of trouble and produce daughters with acceptable levels of milk production. But, there are definite breed differences with respect to milk production, and this must be taken into account by the bull buyer.

As you have indicated, the easiest way to add (or subtract) milk production may be in choosing the appropriate sire breed.

Q 11: What is the difference between the maternal weaning weight EPD and the maternal milk EPD? Also, how should the maternal WW EPD be used?

A 11: A bull's maternal WW EPD (also referred to as combined maternal or total maternal) is the predictor of his genetic effects on the weaning weight of calves from his daughters. This EPD reflects both the milking ability transmitted to daughters and the direct growth transmitted through daughters. Mathematically, this EPD is computed simply as half the bull's direct WW EPD plus his maternal (milk) EPD. This EPD has no proven application for genetic improvement and can mask deficiencies in milk EPD if not reported in conjunction with the milk EPD. Reported genetic correlations between direct growth to weaning and the maternal milk effect are negative, therefore, using this EPD as a selection tool could further exacerbate an unknown existing deficiency. The maternal WW EPD may have some use to the producer that is selecting between sire groups of replacement heifers for use in a terminal crossbreeding program.

General Questions:

Q 12: How are Embryo Transfer (ET) calves handled with respect to EPD values?

A 12: Performance records of ET calves are never considered in the computation of EPD for either the sire or the donor female. The reason for this is because there is no way to adjust for the influence of the recipient female on the calf's performance records. Similarly, EPD values of the ET animal are only pedigree estimated until such time that the animal has progeny with performance records. The ET animal's own performance record is never included in the computation of EPD values.

Q 13: My cows are all crossbred and with varying percentages from three different breeds. Will this have an effect on sire progeny differences? That is, will the bulls I use still perform according to their EPD values?

A 13: Yes, the bulls will perform according to their EPD provided each is mated to a comparable set of your crossbred cows. Actual weights will probably be improved over the straight bred situation due to heterosis. But, the crossbred females will not change the expected progeny differences between the bulls reflected in their EPD values.

EVALUATING AND REPORTING REPRODUCTIVE TRAITS

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Introduction

The reproductive traits--calving ease, age at puberty, fertility (male and female) and calving date--are of tremendous economic importance in beef production. They are likewise all difficult to measure, report and interpret. The need for, and value of, genetic improvement in these traits is variable, and depends upon the management system, production environment and current performance levels in the herd. The traits are not easily measured on individual animals because they are regularly influenced by interactions among calf, sire and dam (Azzam et al., 1988). Thus, procedures for estimation of genetic merit for these traits will often necessarily involve use of simplifying assumptions and approximations. Interpretation of resulting expected progeny differences (EPD's) will then require recognition of the implications of the assumptions and approximations.

This paper will deal with genetic evaluation of three reproductive traits: calving ease; age at puberty as indicated by scrotal circumference measures in males; and female fertility as measured by calving rates and dates.

Calving Ease

Current procedures for estimation of EPD's for calving ease rely on a subjective categorization of the degree of calving difficulty. The recommended calving ease categories and their numerical scores (BIF, 1986) are:

1 - No difficulty, no assistance

2 - Minor difficulty, some assistance

3 - Major difficulty, usually mechanical assistance

4 - Caesarean section or other surgery

5 - Abnormal presentation.

For EPD estimation, births with a score of 5 are deleted such that the remaining scores represent a continuum of increasing difficulty. These scores are then analyzed and EPD's for calving ease score are obtained for each animal. Prior to reporting, these scores are currently being transformed to ratios so that final EPD's are expressed as a ratio to the mean calving ease score of the population (ASA, 1987; APHA, 1988).

This procedure treats the calving ease score as a continuously-distributed trait and ignores the categorical nature of the subjective scores. Thus, in practice there are only four kinds of births available to categorize individuals for calving ease. This is in contrast to a trait like birth weight for which individuals can be ranked uniquely from lowest to highest.

The most serious implication of the failure to specifically account for the categorical nature of the calving ease score lies in the failure of the current analytical procedures to recognize that the information provided by the calving ease score is dependent upon the frequency distribution of scores in the herd or contemporary group. Thus, calves that are born without assistance in herds with a very low frequency of calving difficulty provide less information for genetic evaluation than do calves that are born without assistance in herds with a relatively high frequency of calving difficulty. This is why information on first-calf calving ease is usually considered to be more useful than information obtained at later calvings; the higher frequency of calving difficulty allows more opportunity to discriminate among the sires.

Explicit consideration of the categorical nature of the calving ease score can be achieved by use of a threshold model (figure 1; Gianola and Foulley, 1983). This model assumes that each animal has a certain likelihood of experiencing calving difficulty at a given calving and that the animals could be ranked from highest to lowest based on their liability to calving difficulty. Thus, an underlying, continuously-distributed trait that is directly associated with calving difficulty is assumed to exist but cannot be directly measured. It may further be assumed that animals that receive calving ease scores of 4 have the highest liability to calving ease, that animals with a score of 3 have the next highest liability, etc. Thus, a one-to-one relationship can be assumed to exist between the underlying liability to calving difficulty and the observed calving ease score.

If the underlying liability distribution is normal, it is possible to estimate the mean value on the underlying distribution that corresponds to each calving ease score group. These mean values then provide a basis for estimation of EPD's for the underlying liability trait. One advantage of the threshold model is that it recognizes that the estimated mean phenotypic value on the liability scale that corresponds to a given calving ease score depends upon the relative frequency of calving difficulty. Figure 2 compares hypothetical calving ease score distributions for 2-yr-old cows (only 50% unassisted) and mature cows (80% unassisted). Estimated phenotypic values for calving ease on the underlying scale (in standard deviation units) corresponding to each calving ease score in 2-yr-olds are:

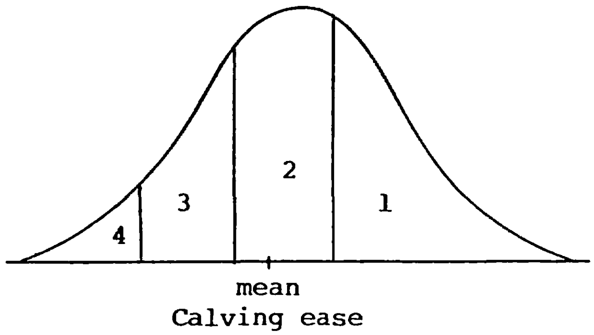

Figure 1. Threshold model relating animals in each calving ease category (corresponding to scores of 1, 2, 3 and 4) to their assumed position on an underlying continuous distribution describing the likelihood that the animal will calve without assistance.

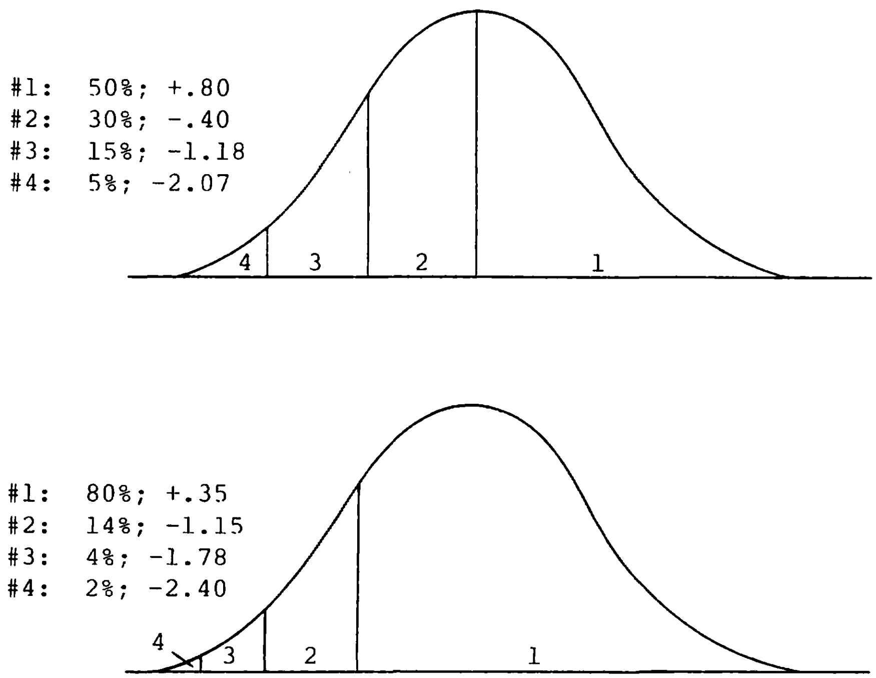

Figure 2. Effect of the distribution of calving ease scores on the mean phenotypic value on the underlying scale for animals in each calving ease class.

1 = +.80; 2 = -.40; 3 = -1.18; 4 = -2.07. Corresponding values for mature cows are: 1 = +.35; 2 = -1.15; 3 = -1.78; 4 = -2.40. Thus, an animal that receives a calving ease score of 2 as a mature cow is estimated to be *much* poorer (value of -1.15 on the underlying scale) than an animal that received a score of 2 as a 2-yr-old (value of -.40). In this example, animals that received a score of 3 as 2-yr-olds would be estimated to be similar on the underlying scale to mature cows that received a score of 2. Thus, animals that have calving difficulty when the overall frequency is low are considered inferior to those that calve with difficulty when the overall frequency is high.

For purposes of reporting, EPD's estimated on the underlying liability scale can be transformed back to the calving ease score scale and expressed as EPD's for percent unassisted (i.e., expected increase or decrease in the frequency of unassisted births associated with use of a given sire). This EPD would be relative to some baseline frequency such as the overall frequency of unassisted births in the breed. A sire could, therefore, have an EPD for unassisted births of +3% in mature cows but of +8% in 2-yr-olds where the frequency of calving difficulty is higher. However, bulls would still be predicted to rank the same in all situations.

Theoretical procedures for ranking sires and for EPD estimation for a threshold model have been presented by Gianola and Foulley (1983). Development of practical procedures for use of the threshold model in sire evaluation for calving ease is underway at Cornell University. Meijering and Gianola (1985) reported that the threshold model is only slightly superior to best linear unbiased prediction (BLUP) when all four response categories occur at reasonable frequencies or when the heritability of the underlying liability trait is low (.05). However, for modest heritabilities ($\geq .20$) or when the frequency of extreme difficulty is very low (as in mature cows), the threshold model may provide enhanced accuracy of EPD estimation.

Calving ease is a complex trait that is influenced by a large number of interacting factors (figure 3). Procedures to evaluate genetic merit for calving ease must necessarily simplify these myriad interactions, but their existence must still be recognized and considered in evaluating, reporting and interpreting EPD's related to calving ease.

Birth weight is unquestionably the major factor influencing calving ease. The genetic correlation between birth weight and calving ease score is high (e.g., .61 ± .09; Cundiff et al., 1986), and the heritability of birth weight is much higher than that of calving ease score (e.g., .46 ± .01 vs .21 ± .10; Cundiff et al., 1986). For this reason, several breed associations have chosen not to report calving ease EPD's; instead, they use birth weight EPD's as their indicator of calving ease. This choice appears quite defensible; however, calving ease EPD's have been useful in large breeds where the risk of calving difficulty may be high in terminal sire crossbreeding programs.

The most complete genetic characterizations of calving ease that are currently available include EPD's for direct and maternal components of birth weight and for direct and maternal components of calving ease. Heritability estimates for direct effects on calving ease range from .07 to .38 (ASA, 1987; Cundiff et al., 1986; APHA, 1988). Heritability estimates for maternal effects on calving ease range from .07 to .18 (ASA, 1987; APHA, 1988; Phillipsson, 1976; Menissier, 1976).

Several factors exist which can influence the relationship between birth weight and calving ease. Gestation length is a factor influencing

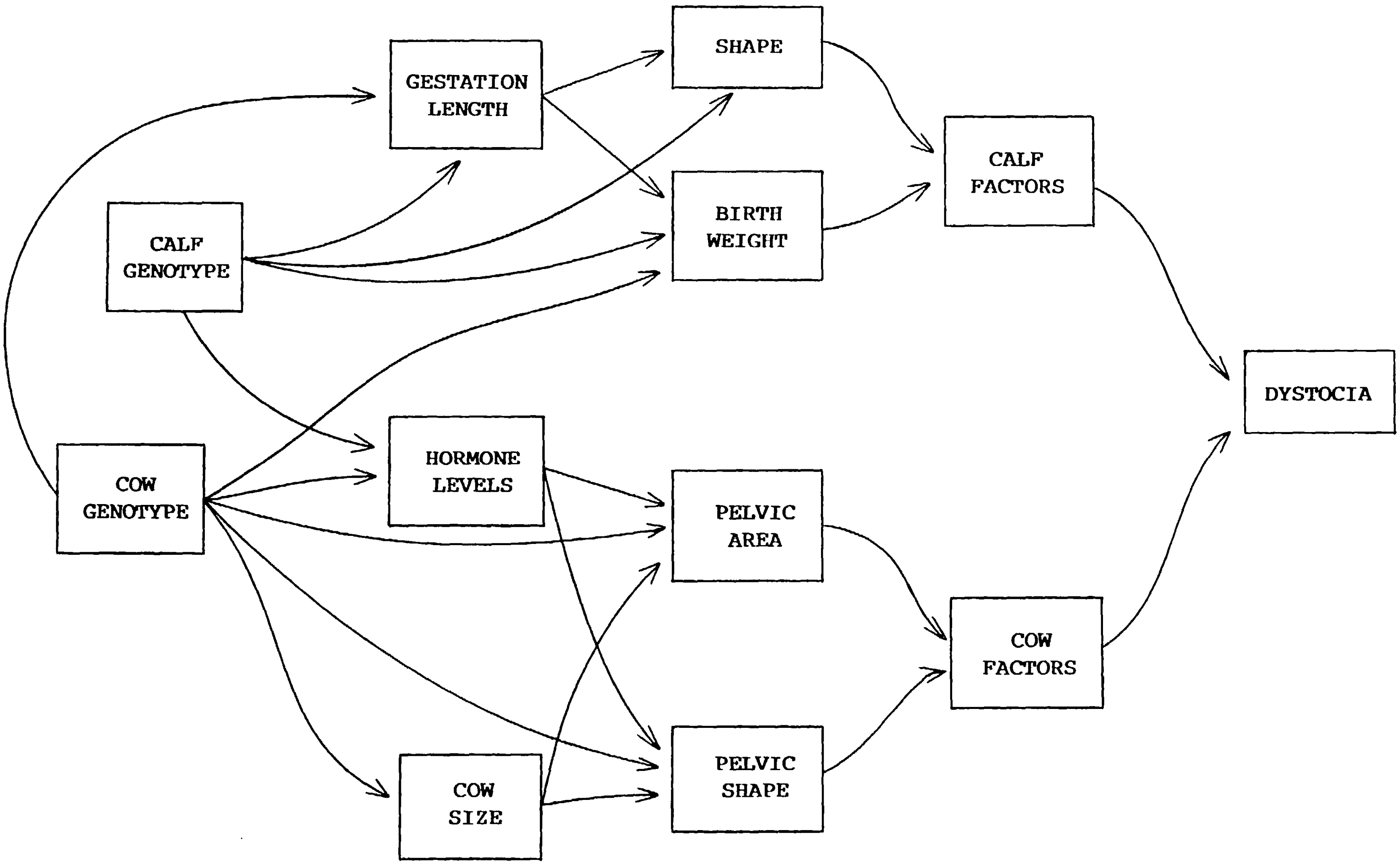

Figure 3. Factors affecting calving difficulty.

birth weight and as such will also influence calving ease. Gestation length appears to be primarily controlled by the genotype of the fetus. The heritability of gestation length as a trait of the calf is high; recently published estimates range from .36 ± .11 to .64 ± .01 (Bourdon and Brinks, 1982; Cundiff et al., 1986; Azzam et al., 1987; Wray et al., 1987). In contrast, the heritability of gestation length as a trait of the cow appears low; published estimates range from .07 ± .04 (Azzam et al., 1987) to .09 (Wray et al., 1987).

The phenotypic correlation between gestation length and birth weight is between .3 and .4 (Bourdon and Brinks, 1982; Cundiff et al., 1986). However, Cundiff et al. (1986) reported that the genetic correlation between short gestation length and calving ease (.25 ± .10) is much smaller than the correlation between light birth weight and calving ease (.61 ± .09). Thus, Bourdon and Brinks (1982) concluded that "selection for growth and moderate birth weight would be more effective [to increasing growth without excessive increase in birth weight] than selection for growth and shorter gestation".

Maternal factors influencing calving ease (figure 3) include maternal effects on gestation length and calf birth weight; overall body size; pelvic area and conformation; and hormone secretion patterns.

Pelvic area is a highly heritable trait that can be measured in both sexes. Recent estimates of the heritability of pelvic area include estimates of .53 ± .14 in yearling heifers (Benyshek and Little, 1982), .68 ± .15 in mature cows (Morrison et al., 1986) and .40 to .68 in yearling Hereford bulls (Nelsen et al., 1986). Genetic correlations between pelvic area and body weight are substantial; estimates include .65 ± .17 in yearling heifers (Benyshek and Little, 1982) and .47 ± .50 in mature cows (Morrison et al., 1986). However, Morrison et al. (1986) concluded that selection for increased pelvic area holding body weight constant would be 90% as effective as single-trait selection for pelvic area.

Increases in pelvic area that simply reflect increases in cow size are likely to be counterproductive in purebred herds. Montiero (1969) studied the interrelationships among cow size, calf size and frequency of calving difficulty in three breeds of dairy cattle. In that study, liability to calving difficulty increased in direct proportion to calf birth weight but was much less sensitive to changes in cow weight, being reduced in proportion to only the .40 power of cow weight. These results led Taylor et al. (1975) to conclude that in pure breeds, "calving difficulties must be expected to be greater for larger breeds". Notter et al. (1978) compared F_1 crossbred cow types differing widely in mature size when all were bred to bulls of the same type for first calving. Cows of larger breed types had larger calves and tended to have more calving difficulty despite their larger size. When data were adjusted to a constant calf birth weight, no differences in calving difficulty were observed among the crossbred types. Lastly, Koch et al. (1982) reported that selection for increased yearling weight in Hereford cattle was accompanied by increased levels of calving difficulty relative to those observed in the control line.

These results suggest the existence of complex interrelationships among cow size, pelvic area and calving ease. Selection for increase in pelvic area ignoring cow size appears likely to produce unpredictable effects on calving difficulty. However, use of restricted selection index techniques to increase pelvic area without changing mature size in maternal breeds or lines appears promising (Morrison et al., 1986). Taylor et al. (1975) suggested that the ratio of pelvic size to the .40 power of body weight may be an appropriate selection criterion to improve calving ease. Thus, data on pelvic area may be useful in certain situations, provided the implications and limitations of such data are kept in perspective.

Recent research suggests that circulating hormone levels at or near the time of calving may influence pelvic area and calving ease. Musah et al. (1986) reported that exogenous administration of relaxin shortly before calving significantly increased pelvic size and extent of cervical dilation. The effect of relaxin was largest in small-framed heifers and smallest in large-framed heifers.

Expected responses to selection for light birth weight and easy calving have been clouded somewhat by an apparent antagonism between direct and maternal effects on calving ease. ASA (1987) reports a genetic correlation between direct and maternal calving ease of -.27. One hypothesis that has been put forth to explain this negative correlation postulates that calving ease sires do indeed produce smaller calves at birth, but that the daughters of these bulls are also smaller at first calving and are thus more liable to calving difficulty because of their small body size. Meijering and Postma (1985) tested this hypothesis by comparing the first calving performance of heifers sired by proven bulls exhibiting either a high or low risk of calving difficulty. Heifers sired by bulls with low risk of calving difficulty were 5.9 lb lighter at birth, had 1.2 d shorter gestations and had 6.9% fewer difficult births than heifers sired by bulls with high risk of calving difficulty. When these heifers calved, those sired by calving ease bulls were 24 lb lighter at 25 mo but also had 1.6 d shorter gestations, 4.0 lb lighter calf birth weights and 7.8% fewer difficult calvings. Thus, no antagonism between direct and maternal calving ease effects was realized in this study. Sires selected for calving ease produced lighter calves; the daughters of these sires were somewhat smaller but also produced lighter calves, thereby limiting their own future calving difficulty.

Puberty and Scrotal Circumference

The age at which an animal reaches puberty represents the minimum age at which that animal can successfully enter the breeding herd. Depending upon the level of nutrition and the breeding of the animals, heifers may be expected to reach puberty between 10 and 18 mo of age. Early puberty is economically desirable in its own right only to the extent that it allows replacement females to be efficiently integrated into the existing management system. In most commercial herds, this means that heifers must reach puberty by 14 to 15 mo in order to be bred to calve first at about 2 yr of age.

Large differences among breed types in age at puberty have been reported (e.g., Laster et al., 1976) and the heritability of age at puberty in heifers is relatively high (.61 ± .18; MacNeil et al., 1984). Thus, single-trait selection for early puberty would likely be quite effective. However, such selection is warranted only if it can reasonably be expected to increase pregnancy rates at first breeding. Laster et al. (1976, 1979) and Gregory et al. (1979) reported large effects of sire breed on age at puberty in crosses produced by mating sires representing a wide range of biological types of Hereford and Angus cows. Sire breed means for age at puberty ranged from 303 to 401 d. However, when these heifers were exposed to breeding beginning at about 420 d of age, no corresponding sire differences in pregnancy rate were observed. Thus, these crossbred cows were all apparently mature enough at the start of breeding that the observed sire breed effects on age at puberty did not affect subsequent pregnancy rates.

The overall effects of genetic differences in age at puberty must thus be assessed in relation to current and potential levels of nutrition and in relation to the current breeding performance of yearling heifers. If prebreeding nutrition is adequate to support near-maximum lean tissue growth rates and if current pregnancy rates are high, then continued selection for rapid postweaning growth and large mature size (if desired) may not have identifiable, negative effects on pregnancy rates in yearling heifers, even though age at puberty will likely increase. However, if prebreeding nutrition is limiting and (or) yearling pregnancy rates are only marginal, then more direct attention on reducing age at puberty may be warranted.

Selection to reduce age at puberty is not straightforward. Age at puberty in females can be measured directly only by repeated palpation of the ovaries (or by repeated assay of circulating hormone levels). Identification of heifers that are, or are not, cycling at the start of breeding, and records on first-calf pregnancy rates are helpful, but become available too late in the animal's life to be optimally useful in selection. Selection against inordinantly large mature body size will act to control increases in age at puberty but must be balanced against the positive effects of large body size on growth rate. Thus, a selection criterion is needed that can be measured relatively early in life, that is directly associated with age at puberty and that can be used in sire selection, since most genetic improvement takes place via sire selection.

Scrotal circumference measures in bulls are a direct indicator of the rate and extent of testicular development and may serve as a useful indicator trait to assess age at puberty in males and related females. The hormonal factors that promote early ovarian development in females are the same as those that promote early testis development in males, and selection for early puberty in one sex will result in corresponding reductions in age at puberty in the other.

Yearling scrotal circumference is a highly heritable trait with an average heritability of about .50 (Coulter et al., 1976; Latimer et al., 1982; Neely et al., 1982; Knights et al., 1984; Bourdon and Brinks, 1986; Nelsen et al., 1986) and has been shown to be strongly related to age at puberty in half-sib females (Brinks et al., 1978). Toelle and Robison (1985) reported desirable genetic correlations between scrotal circumference and age at first breeding (-.32), pregnancy rate (.59) and calving interval (-.21), but undesirable correlations with age at first calving (.26) and postpartum interval (.20). Some authors have suggested that a general positive relationship exists between scrotal circumference in males and reproductive capacity in females. This appears to be true at puberty and the time of first breeding but has not been well documented in older cows.

Use of scrotal circumference measures in selection programs requires consideration of the relationship between body weight and scrotal circumference. Reported genetic correlations between these traits average about .43 (Neely et al., 1982; Knights et al., 1984; Nelsen et al., 1986; Bourdon and Brinks, 1986). Thus, scrotal circumference has a positive relationship to body size that is in contrast to the proposed undesirable genetic relationship between mature size and early puberty. Land et al. (1980), working with sheep, reported that selection for large testis size relative to body weight reduced age at puberty and improved early ovulation rates but also reduced growth rates and ewe weights. Thus, selection for large testis size relative to body weight appears effective but places strong negative pressure on mature size. In contrast, selection for testis size without adjustment for body weight should result in selection of larger-than-average animals but with concurrent culling of those with smaller-than-expected testicles, and will likely be the preferred selection criterion in most situations. Notter et al. (1985) reported that scaling of scrotal circumference measures by the 1/3 power of body weight removed effects of body size among sheep breeds and suggested that this scaling might allow for selection for scrotal circumference independently of body weight.

Cow Fertility

A conspicuous void in current genetic evaluation procedures relates to their failure to consider measures of genetic merit for reproduction and fitness traits. This limitation is most evident in national sire summaries, where animals are often well-categorized for traits related to growth, calving ease and milk production but where no information is provided on the likely fertility of sires' daughters. Thus, selection proceeds on the assumption that differences among sires in the fertility of their daughters are trivial.

Breeding value estimation for reproductive traits is difficult, in part because the expression of reproductive potential is often constrained by the management system. If we first consider the results of a single A.I. breeding within a herd of cows, figure 4 shows that only two kinds of individuals can be identified: those that became pregnant and those that did not. The result thus conforms to the threshold model discussed above for calving ease. A continuous underlying distribution is envisioned that corresponds to the likelihood a cow will conceive. Cows that become pregnant represent the best cows on that underlying scale, and the open cows are the poorest. Procedures described by Gianola and Foulley (1983) can then be used to estimate phenotypic means on the underlying scale for cows that are pregnant ($\bar{P}_p$) and open ($\bar{P}_o$), and these phenotypic measures can be adjusted for heritability to yield estimates of genetic merit for the two groups ($\bar{G}_p$ and $\bar{G}_o$). Thus, breeding value estimation for fertility following a single mating is relatively straightforward.

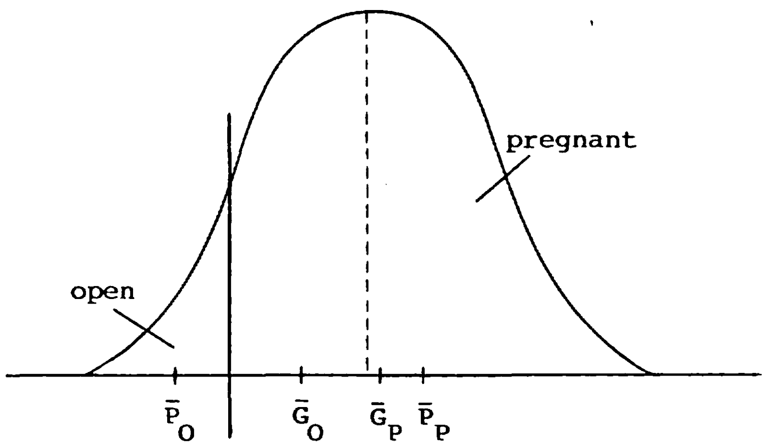

Figure 4. A threshold model representing the two groups of cows (open and pregnant) that can be identified following a single A.I. mating. Phenotypic ($\bar{P}_o$ and $\bar{P}_p$) and genetic ($\bar{G}_o$ and $\bar{G}_p$) values on the underlying scale can be estimated from threshold model theory.

Unfortunately, the reproduction data generated in the real world do not correspond to this simple model. Figure 5 presents a hypothetical result of a 63-d A.I. breeding season. If we begin with 100 cows, perhaps 70 will conceive to the first cycle (21 d) of breeding. These cows will presumably be above average in genetic merit for fertility, whereas the remaining 30 open cows should be below average. If the open cows are then exposed to

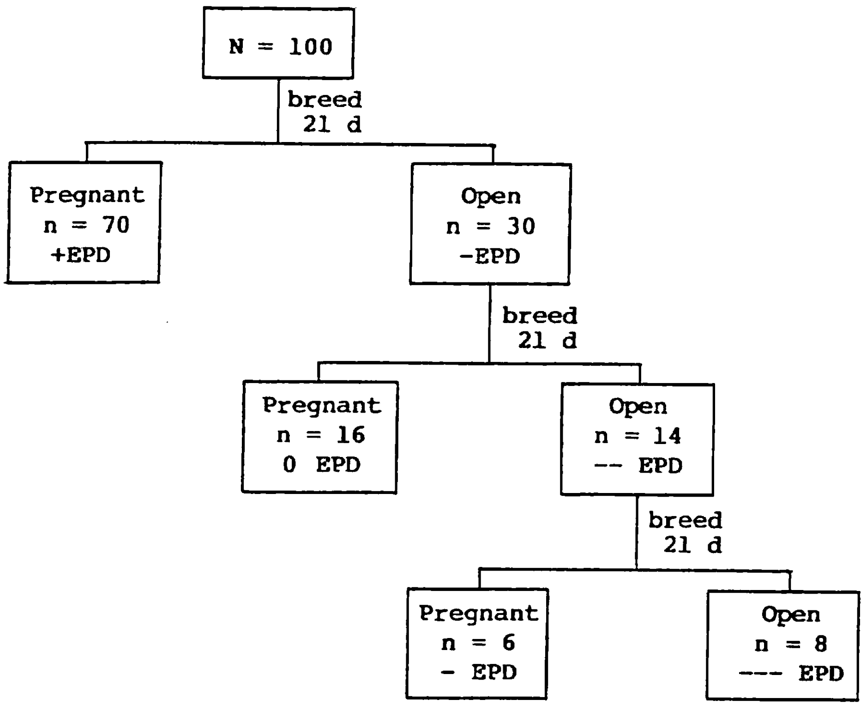

Figure 5. Schematic representation of the groups of cows that can be identified following a 63-d breeding season. Numbers are used as examples only.

another cycle of breeding, some will conceive while others remain open, providing an additional opportunity to differentiate among the genetic merit of the original 30 open cows. Following a third cycle of breeding, one is left with the animals that finally did conceive (the best of a bad lot) and those that remained open. The challenge is to translate the qualitative (+ or -) characterizations in figure 5 into quantitative data that can be used to estimate EPD's. Although the situation is more complex than the simple threshold model shown in figure 4, Notter and Johnson (1987) have described procedures to estimate EPD's for fertility in this situation, provided breeding dates are known.

With pasture breeding, no theoretically satisfying procedure for estimation of EPD's for fertility has been identified (Notter and Johnson, 1988).

In this case, the data that is available at calving are shown in figure 6; we have a distribution of calving dates plus a (hopefully) small group of cows that did not calve. The calving date information can be used to discriminate between cows that conceived early or late in the season, but is not a truly continuous trait, since the 21-d estrous cycle dictates that many of the cows calving within each 21-d period are expected to be genetically similar. Still, normal variation in gestation length and in duration of the estrous cycle suggests that an essentially continuous relationship between calving date and genetic merit for fertility may exist (Notter and Johnson, 1988).

Use of calving date as a measure of female reproductive merit is attractive, but optimal use of available data requires that information on open cows also be included in the evaluation. If data on open cows are ignored, the result will be to ignore the most genetically inferior (and, therefore, potentially most informative) animals. If sires differ markedly in the frequency of open daughters, consideration of open cows may be required to accurately estimate true sire differences in daughters' fertility. Notter and Johnson (1988) suggested that open cows be included in the evaluation by assuming that these cows would have calved if given enough time, and that the theory of the threshold model be used to estimate a projected calving date for the open cows. Thus (figure 7), cows that calve are evaluated on their observed calving date whereas open cows are all assigned a calving date value indicative of the mean projected calving date of the open cows in an unrestricted breeding season. All animals are, therefore, evaluated on the same scale.

Heritability estimates for calving date (ignoring open cows) range

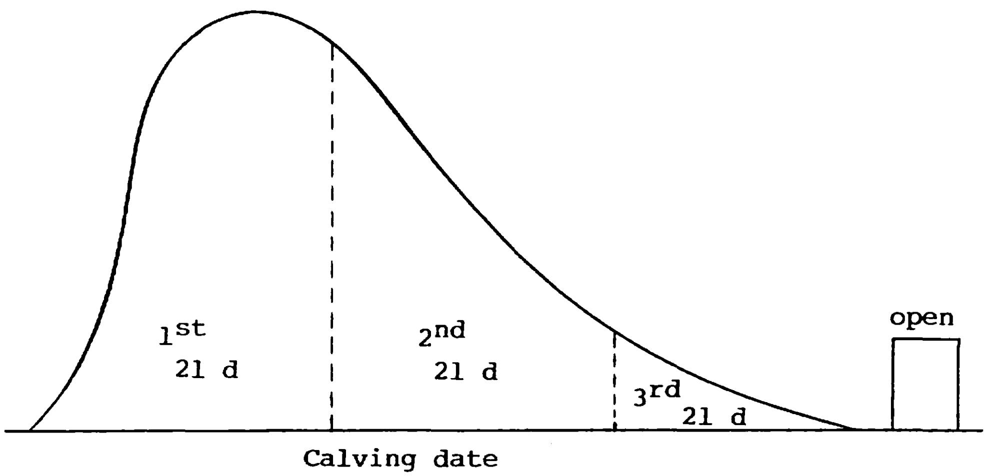

Figure 6. Calving data. Cows that do calve produce a continuous (but not usually normal) distribution of calving dates, even though the animals calving within a given 21-d period are expected to be genetically similar. The calving date distribution is augmented by information on the open cows.

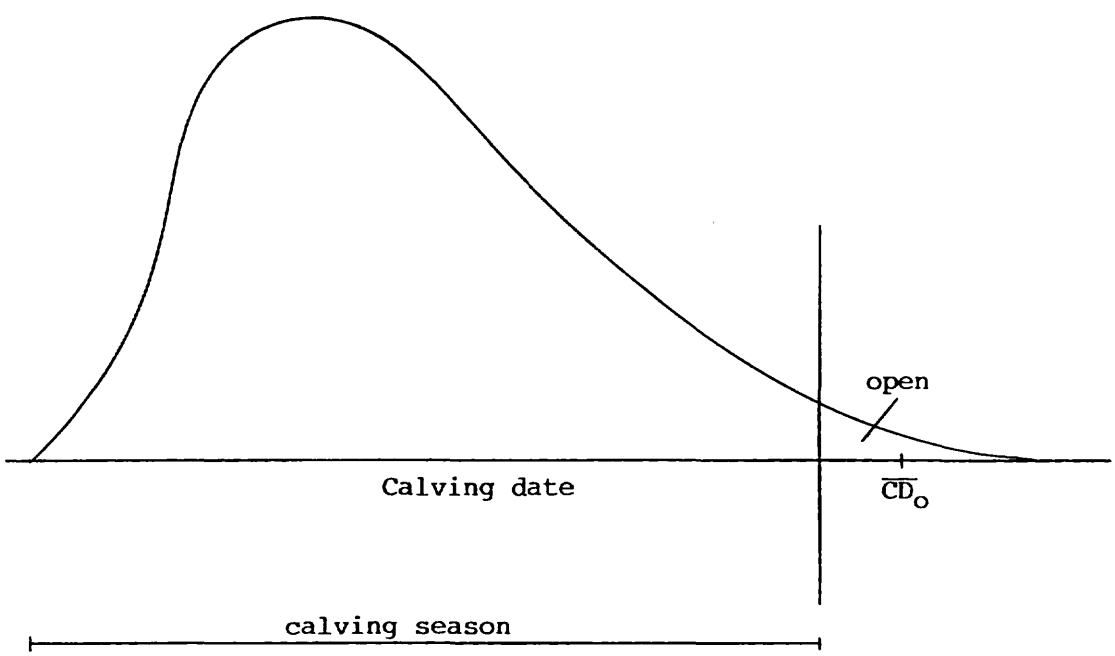

Figure 7. Resulting distribution of actual and predicted calving dates obtained by assuming that open cows would eventually have conceived. The projected mean calving date for open cows ($\overline{CD}_O$) is estimated from their frequency and allows all animals to be evaluated on the same scale.

from .02 to .17 (Azzam et al., 1987; Meacham and Notter, 1987; L. G. Bettison, unpublished data). Comparable values for repeatability range from .11 to .25 (Bourdon and Brinks, 1983; Meacham and Notter, 1987; D. K. Aaron, unpublished data). Since these genetic parameter estimates do not consider open cows, they are expected to be biased downward, thus suggesting that useful amounts of genetic variation for female fertility may exist.

As shown in figure 5, reproduction data should not be thought of as the result of a single event (i.e., a breeding). Instead, it is the result of a process (i.e., a breeding season). Thus, evaluation of genetic merit for reproduction requires information on the complete reproductive history of each animal. That is, we need to know the reproductive performance of each animal in each year. Our current beef performance programs are conducted on a 'calf-record' basis; data are regularly reported only on cows that calve. This is in contrast to an inventory-based system such as that adopted by the National Sheep Improvement Program (NSIP, 1987), and which is designed to account for the performance of each female in each year. It appears likely that comprehensive evaluation of reproduction and fitness traits in cattle will require implementation of such an inventory-based system.

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EVALUATING AND REPORTING CARCASS TRAITS

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At present, diet conscious consumers are exerting considerable pressure on the beef industry. Consumers continually indicate they are concerned about, and in fact, will not tolerate fat associated with red meat products (Breidenstein, 1988). This has resulted in many retailers trimming various cuts of beef to 1/4 inch of outside fat. It is probably conservative to estimate the industry produces an excess of 500 million pounds of fat each year for those carcasses with yield grades above two. This excess fat represents the energy in more than a million yield grade 2 carcasses weighing 650 pounds. However, because the consumer is also concerned about palatability, the industry presently seems to have no alternative except to feed beef cattle for more than an optimum length of time in order to provide some assurance of "quality". In addition to excess fat produced in the 12.1 billion pounds of graded beef, there is considerable inefficiency in the production of the 6.7 billion pounds of nongraded or no-roll beef. No-rolls or nongraded beef represented 35.7% of the steers and heifers slaughtered in 1987. Most no-rolls are either yield grade 4s or in the Select quality grade category. Conservative comparisons of average prices in 1987 for yield grade 3s versus 4s within the Choice grade and for Choice versus Select grades within yield grade 3 indicates these no-roll carcasses would have had an added value of $578 million had they been in the Choice, yield grade 3 category. It is obvious feeding and management alone cannot solve this inefficiency problem in the beef industry. The solution will require genetic manipulation of the raw product utilized by the packing and retail segments of the industry.

Genetic manipulation available to the industry is either crossbreeding or selection; and both will be required for an efficient industry. Selection should be considered as a method of controlling and utilizing within breed variability which will subsequently increase uniformity of carcass product from crossbred cattle. Selection will have an effect on growth and carcass product because these traits have moderate to high heritabilities. Crossbreeding will aid the efficiency of production primarily through hybrid vigor for reproduction. Producers also find crossbreeding useful because they can select breeds which complement each other for various production and carcass characteristics. Crossbreeding and selection can augment each other and produce a superior product. In general, commercial producers must have assurances that selection of bulls within breeds provides germ plasm which will actually enhance the beneficial effects of crossbreeding rather than reduce or perhaps negate such effects.

The accurate prediction of genetic values for carcass characteristics of economic importance to the beef industry would provide the necessary stimulus for an added value marketing system. Accurate carcass trait genetic values within a breed would allow commercial producers to develop breeding programs which would assure uniformity of a specification product. The ability to accurately predict characteristics at the production level of the segmented beef industry would allow for a more orderly and fair marketing system for beef. If commercial producers know specifications will be met by the germ plasm they are buying, retained ownership will become an economic force resulting in cattle being marketed routinely on grade and yield. Identifying germplasm which can produce *uniformity* of specified products would certainly enhance contract marketing.

If accurate genetic values are not developed for carcass attributes it seems certain that the industry will continue to set prices based on averages and move toward even more inefficiency. Some breeds are already being cast as problems in the packing industry when in reality there are sires in all breeds which can produce progeny meeting specifications for various beef products. Consistent quality of brand name products will be impossible to achieve at a competitive price without identification of germplasm within breeds that can assure such quality.

In general, the possibility exists to develop genetic values in the form of expected progeny differences on yearling animals for both growth and carcass characteristics. This would allow commercial producers the opportunity to buy bulls which could assure the production of live cattle specifically for brand name beef products.

Genetic Parameters. There is considerable genetic variability within breeds for carcass characteristics. The following heritability summary was adapted from Koch et. al. (1982) and includes two recent studies involving field data (Wilson, 1987 and Benyshek et al. 1988). Several breeds are represented in the summary; however, the majority of the estimates are from British breeds. It is important that good estimates of heritability for carcass traits be obtained for Continental, Brahman and Brahman derivative breeds. Studies should be implemented immediately by these breeds if they are to expand their national genetic evaluation programs to include carcass traits.

Table 1. Heritability Estimates From Several Literature Sources

	Literature source cited[a]										
	1	2	3	4	5	6	7	8	9[d]	10[e]	Avg
Carcass wt.	.57	.39	.56			.68	.54	.43		.19	.48
Retail Product											
Weight			.64		.38	.38	.55	.58			.51
Percentage		.40	.28[b]		.66[b]		.49[b]	.63			.49
Fat trim wt.			.46	.50	.39	.94		.47			.55
Fat trim %								.57			.57
Bone wt.			.38			.56		.57			.50
Bone %								.53			.53
Kidney fat wt.				.72				.77			.75
Kidney fat %								.83			.83
Fat thickness	.24	.43	.50	.43	.57	.68	.50	.41	.31(.27)	.46	.43
Ribeye area	.26	.73	.41	.40	.25	.28	.45	.56	.32(.26)	.47	.40
Marbling	.17[c]	.62[c]	.31	.73	.31	.34	.56	.40	.29(.40)	.38	.41
Warner-Bratzler Shear								.31			.31

[a]Source (1) Shelley et al. (1963); (2) Cundiff et al. (1964); (3) Cundiff et al. (1969, 1971); (4) Brackelsberg et al. (1971); (5) Dinkel and Busch (1973); (6) Koch (1978); (7) Benyshek (1981); (8) Koch et al. (1982); (9) Wilson (1987) and (10) Benyshek et al (1988).

[b]Cutability: estimated percentage of retail product from round, loin rib and chuck.

[c]USDA quality grade reported instead of marbling score.

[d]Two analyses, first entry sires whose progeny carcass weights averaged <685 lbs. and second entry (in parenthesis) sires whose progeny carcass weights averaged $\geq$ 685 lbs.

[e]From data compiled on steers slaughtered on a weight constant basis (approx. 1,100 lb).

Three traits: fat thickness, ribeye area and marbling score will probably receive the most attention in selection programs. All three traits are moderate in heritability and could be changed significantly in a short period of time with intense selection.

As the industry moves toward selection programs for net merit, multiple trait selection will take precedence over conventional single trait selection programs. If multiple trait selection programs are to be successful, it will be necessary to understand the phenotypic, genetic and environmental relationships among an array of performance characteristics.

These relationships will prove useful in predicting carcass trait genetic values for animals without having to slaughter the animals. Obviously, this is important for purebred breeders. These relationships can be used to improve the accuracy of prediction on difficult to measure traits such as marbling or tenderness. There may be antagonistic relationships which if not accounted for in the selection program, may result in decreased overall efficiency. As an example, suppose there is a negative relationship between ribeye area and reproductive efficiency. If this were true, selecting for ribeye area without considering the negative relationship with reproduction could result in a decrease in calf crop percentage, and thus, a reduction in overall net merit. Very few of these relationships are currently known with enough precision to make general recommendations to the beef industry.

The following three tables summarize from several sources phenotypic, genetic and environmental correlations among some important growth and carcass characteristics.

Table 2. Phenotypic Correlations Between Performance Characteristics From Several Literature Sources[a]

Item[b]	Source	ADG to weaning	ADG in feedlot	Carcass wt.	Fat thickness	Rib eye area	Marbling	Warner-Bratzler shear
Birth wt.	1)	.12	.32	.41	-.07	.17	-.02	.05
	2)		.14	-.10	-.19	-.01	-.13	
ADG to weaning	1)		.11	.61	.31	.25	.10	.00
Weaning wt.	2)		.16	.01	-.03	.05	-.04	
	3)		.70	.67	-.25	.05	-.21	.06
ADG feedlot	1)			.72	.17	.32	.07	.02
	2)			.02	.03	-.07	-.03	
	3)			.96	-.32	.09	-.24	.03
Carcass wt[d]	1)				.36	.43	.13	.00
	2)				.06	-.02	.00	
	3)				-.35	.18	-.21	.05
Fat thickness	1)					-.15	.24	-.01
	2)					-.25	.16	
	3)					-.30	.17	-.19
Ribeye area	1)						.03	-.02
	2)						-.04	
	3)						-.15	-.06
Marbling	1)							-.12
	3)							-.27

[a]Source (1) Koch et al. (1982) (2) Benyshek et al. (1988) and (3) Wilson et al. (1976).

[b]Source 3, Wilson et al. (1976) reported slaughter weight/d and carcass weight/d. Source 2 results reported on a slaughter weight constant basis.

[c]Source 2 ADG weaning to yearling.

[d]Source 1 results reported for cold side weight.

Table 3. Genetic Correlations Between Performance Characteristics From Several Literature Sources[a]

Item[b]	Source	ADG to weaning	ADG in feedlot	Carcass wt.	Fat thickness	Rib eye area	Marbling	Warner-Bratzler shear
Birth wt.	1)	.28	.61	.60	-.27	.31	.31	-.01
	2)		.32	-.40	-.52	.03	-.40	
ADG to weaning	1)		.49	.73	.04	.49	.31	-.05
Weaning wt	2)		.45	-.05	-.40	-.09	-.03	
	3)		.77	.52	-.12	-.39	-.85	-.83
ADG Feedlot[c]	1)			.89	.05	.34	.15	.06
	2)			-.16	-.15	-.24	-.25	
	3)			1.00	-.38	-.16	-.88	.57
Carcass wt[d]	1)				.08	.44	.25	.00
	2)				.04	-.07	.35	
	3)				-.42	-.06	-.19	.29
Fat thickness	1)					-.44	.16	.26
	2)					-.44	.05	
	3)					-.47	.37	-.29
	4)					-.40	.08	
						(-.44)	(-.30)	
Ribeye area	1)						-.14	-.28
	2)						.06	
	3)						-.38	
	4)						-.05	
							(-.08)	
Marbling	1)							-.25
	3)							-.36

[a]Source (1) Koch et al. (1982); (2) Benyshek et al. (1988); (3) Wilson et al. (1976) and (4) Wilson (1988).

[b]Source 2 results reported on a slaughter weight constant basis. Source 3 reported slaughter weight/d and carcass weight/d. Source 4 reported two analyses, first entry sires whose progeny carcass weight averaged <685 lb and entry two (in parenthesis) for sires whose progeny averaged $\geq$ 685.

[c]Source 2 ADG weaning to yearling.

[d]Source 1 results reported for cold side weight.

Table 4. Environmental Correlations Between Performance Characteristics From Several Literature Sources[a]

Item[b]	Source	ADG to weaning	ADG in feedlot	Carcass wt.	Fat thickness	Rib eye area	Marbling	Warner-Bratzler shear
Birth wt.	1)	.10	.04	.26	.08	.04	-.25	.08
	2)		.08	.00	-.06	-.04	-.03	
ADG to weaning	1)		.03	.67	.41	.24	.07	.01
Weaning wt.	2)		-.13	.03	.10	.10	-.05	
ADG Feedlot[c]	1)			.57	.28	.30	.00	-.01
	2)			.06	.13	.05	.07	
Carcass wt[d]	1)				.56	.42	.04	.00
	2)				.07	.00	-.13	
Fat thickness	1)					.11	.29	-.16
	2)					-.09	.24	
Ribeye area	1)						.18	.17
	2)						-.11	
Marbling	1)							-.05

[a]Source (1) Koch et al. (1982) and (2) Benyshek et al. (1988).
[b]Source 2 results reported on a slaughter weight constant basis.
[c]Source 2 ADG weaning to yearling.
[d]Source 1 results reported for cold side weight.

In general, table 2 shows the phenotypic relationships among carcass characteristics to be small. The table also shows small phenotypic relationships between carcass traits and live animal growth traits. The magnitude of these relationships is the reason today's live animal specifications fall short when trying to predict carcass merit. This inaccurate prediction results in over 1/3 of the animals slaughtered being nongraded no-rolls.

Table 3 indicates some carcass trait genetic relationships, which if accounted for in selection programs could be beneficial to economic beef production. For example, the negative relationship between fat thickness and rib eye area is beneficial. Selection for rib eye area or selection against fat thickness will result in increased carcass merit.

Results from studies concerning the genetic relationship of marbling to other carcass and production traits have been varied and somewhat inconclusive (Table 3). These studies indicate it is possible that fat thickness and marbling could be independent. If this is true, it would be possible to reduce outside carcass fat and increase or at least not deteriorate marbling.

Environmental correlations (Table 4) reveal relationships between traits which are caused by environmental effects on those traits. None of the correlations in table 4 are very large which indicates producers may be able to vary environmental conditions and increase efficiency. For example, the environmental correlation between fat thickness and marbling is positive but small in magnitude. This relationship indicates that the industry may be in error using its current procedure of feeding cattle for a longer period of time to ensure marbling once those cattle reach a certain fat thickness. The effect of days on feed on fat thickness and marbling needs further investigation with cattle of known genetic background.

Generally, the few estimates of genetic parameters available are from British breeds. It is important that precise estimates become available for other breeds if these traits are to be considered in national genetic evaluation programs.

As the purebred industry expands evaluation procedures to include carcass characteristics, it may become necessary to look at new traits which may be better indicators of carcass attributes. It may mean expressing currently measured production traits in some other manner. For example, at the University of Georgia an analysis of data from the American Hereford Association (AHA) designed carcass evaluation program examined relative growth rate (Fitzhugh and Taylor, 1971) as an indicator of genetic merit for marbling. This carcass data from AHA was obtained on a weight constant basis (ie. the steers were slaughtered when they reached a weight of 1,190 lb). The 2,411 carcass records represented 137 sires which were connected across weaning and slaughter contemporary groups. Relative growth rate (RGR) was computed as the natural log of final weight minus the natural log of on-test weight divided by days on feed. Relative growth rate is average daily gain relative to body weight. Results indicated that RGR and test average daily gain were much the same trait when the end point is weight constant (r_g between RGR and Test ADG = .92). Neither RGR or Test ADG had a strong relationship with fat thickness or rib eye area. However, both RGR and Test ADG were highly related to marbling score in these data (genetic correlation = .60 and .64, respectively). Both RGR and Test ADG under weight constant end point conditions appeared to be good genetic indicators of marbling. The two traits had very small phenotypic and environmental correlations with marbling, rib eye area and fat thickness. If these genetic correlations are accurate, testing bulls to a weight rather than to an age may be beneficial in finding bulls which would sire progeny with increased marbling. These results need further validation including other breeds.

<u>Multiple trait analysis of simulated carcass data</u>. Carcass data is difficult and expensive to gather. Thus many animals, particularly breeding animals, will lack records for such traits if the procedure requires sacrificing the individual. It is likely that only a few animals in the breeding population will have carcass records even if techniques like ultrasound measuring become readily available. Therefore, multiple trait mixed model procedures will have to be used in beef cattle national genetic evaluation programs if accurate evaluations are to be obtained on a population wide basis.

To examine the feasibility of incorporating carcass characteristics into a multiple trait reduced animal model analysis, a preliminary simulation study was conducted at the University of Georgia (Johnson et al., 1988). Data were generated using the beef cattle genetic simulation program (Willham and Thomson, 1970). Data consisted of 4,696 weaning weight and feedlot gain observations and 999 carcass product observations from 11 herds over nine calf crops. Weaning and gain records were from progeny produced by 111 sires and 1,183 dams. Only 80 sires and 484 dams produced progeny with carcass information.

Initial AI bull selection was based on above average actual yearling weight breeding value; however, the best bulls were intentionally not selected so the population mean did not increase too quickly. Subsequent choices of new AI bulls, herd bulls and replacement heifers was based on above average yearling weight estimated breeding value (EBV) computed by the program using selection index methods. This is similar to selection schemes practiced in the industry at the present time.

AI bulls were used across 10 herds to connect the data set. Sons of these AI bulls were used in the eleventh herd. Three AI bulls were initially selected. One bull was used across all 10 herds and replaced with a son after four calf crops. The other two were each used in a different subset of five herds for two calf crops. They were then exchanged for one calf crop. At this time they were replaced with sons who were used for two calf crops. Sons were then switched to the herds in which their sires were initially used for a calf crop and then replaced by sons.

Each herd consisted of two AI sires, two herd bulls and 50 cows. Base generation cows were replaced as quickly as possible. Most replacements were allowed to remain until the end of the simulation, giving an average of four progeny with at least weaning and gain records and two progeny with carcass information per dam.

Two different slaughtering schemes were used. Progeny in six herds were slaughtered randomly, but in the other five herds offspring of cows with below average yearling weight EBVs were slaughtered.

Most genetic parameters used to simulate the data were unchanged from the original simulation program. These included the genetic correlation between weaning weight direct and feedlot gain direct of .25. However, the program was modified to include a genetic correlation of -.30 between weaning weight direct and weaning weight maternal. Three different genetic correlations between feedlot gain and carcass product were used: .15, .30 and .50.

After all the data were simulated, there were three populations identical except for carcass product. Three data sets for each level of gain-carcass correlation were derived for analysis. Data set 1 (DS1) contained all of the data. Data set 2 (DS2) contained carcass information on those animals with below average feedlot gain since those with above average gain were retained for breeding and could not produce a carcass record. Individuals in data set 3 (DS3) were selected at weaning. Those in the upper 75% of the population went on to produce feedlot gain and carcass records, while the lower 25% were culled.

All relevant single trait and multiple trait (two and three trait) reduced animal model analyses were performed on each data set for each degree of gain-carcass correlation. Animals always had weaning weight reported. If they had a carcass record, they also had a feedlot gain record. This hierarchical arrangement simplifies the two- and three-trait multiple trait RAM analysis.

Weaning weight direct, weaning maternal and feedlot gain predictions were little affected by (a) type of analysis (single versus multiple trait), (b) selection for slaughter scheme or (c) degree of genetic correlation between gain and carcass product. Table 5 contains the rank correlations between carcass predictions and true breeding values for sires. For lower genetic correlations, single trait analyses produced predictions with accuracy similar to multiple trait analyses for sires with progeny. However with the higher genetic correlation of .5, the multiple trait analysis was superior in accuracy, particularly when selection practiced was on the basis of the correlated trait (DS2). Even predictions from the multiple trait analysis for sires whose progeny did not have carcass records were more accurate than those sires that had progeny in the single trait analysis.

TABLE 5. CARCASS PRODUCT RANK CORRELATION WITH TRUE EPD FOR SIRES

	+.15			+.30			+.50		
	DS1[1]	DS2	DS3	DS1	DS2	DS3	DS1	DS2	DS3
All bulls									
ST C[2]	.73	.53	.66	.70	.52	.63	.64	.39	.62
MT G-C[2]	.62	.48	.58	.64	.50	.57	.69	.58	.68
MT W-G-C	.63	.50	.58	.65	.52	.59	.71	.62	.69
Bulls with progeny and carcass records	N = 80	N = 77	N = 76	N = 80	N = 77	N = 76	N = 80	N = 77	N = 76
MT G-C	.72	.52	.67	.68	.51	.64	.68	.50	.69
MT W-G-C	.72	.54	.68	.69	.53	.65	.71	.56	.72
Bulls with progeny without carcass records	N = 31	N = 34	N = 35	N = 31	N = 34	N = 35	N = 31	N = 34	N = 35
MT G-C	.41	.35	.37	.46	.32	.35	.62	.48	.50
MT W-G-C	.42	.37	.39	.47	.30	.37	.63	.50	.51

[1]See text for description of DS1, DS2 and DS3.

[2]ST = single trait, MT = multiple trait, C = carcass product, G = gain and W = weaning weight. It should be noted that in the ST analysis all bulls had progeny with carcass records.

Generally, if the degree of genetic association is high between the characteristics of concern in a selection program multiple trait prediction procedures will increase the accuracy of prediction and reduce the cost of evaluation for expensive to measure traits.

The industry is accepting, at a rapid pace, breed association sponsored national genetic evaluation programs. It is important to incorporate new traits of economic importance as rapidly as possible into National Cattle Evaluation so the industry can take full advantage of the genetic variability available from the diverse gene pool now found in the United States.

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MEASURING, UNDERSTANDING AND USING CORRELATED RESPONSES

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The objective of this paper is to briefly review the basic principles of selection with emphasis on what happens when traits are correlated genetically, ie., when some of the same genes affect more than one trait. As we will see this can help us in our selection programs or it can make life interesting by *complicating* a breeding program.

In a selection scheme we are trying to increase the frequency of desirable genes; those that will influence the trait in the desired direction. This requires identifying animals which possess those genes and using them in a breeding program. Our most useful tools in this regard are EPD's which summarize as much information as possible.

The basic formula for predicting response to selection is:

$$\text{Response} = \text{accuracy} \times \text{intensity} \times \sigma_g \,/\, \text{generation interval.}$$

Accuracy refers to how well we can rank animals genetically for selection, intensity to what fraction of the candidates for selection are kept for breeeding, σ_g measures how much genetic variation exists for the trait and generation interval to how rapidly the population is replaced.

This response is due to changing the genetic make up of the population by replacing less desired genes with more favorable ones. If the genes affect not just the trait under direct selection, but others as well, these secondary traits will change as well. These changes are called <u>correlated responses</u>.

The degree to which common genes determine two different traits is measured by the <u>genetic correlation</u>, r_g. Genetic correlations vary between -1 and +1. If $r_g = 0$, the traits are uncorrelated; different genes influence the two traits. In this case, for example, a sire's EPD for one trait tells us nothing about his EPD for the second trait. At the other extreme, r_g of ± 1 means the two "traits" are really the same trait genetically although the scales of measurement might be different and they might even have different heritabilities if the environment affects them differently. Genetic correlations are rarely perfect, however.

If the sign of r_g is positive then animals' breeding values (BV) for the two traits <u>tend</u> to vary together: both positive or both negative. With a negative r_g, the <u>tendency</u> will be for animals to have one BV positive and the other negative. The absolute value of r_g indicates the degree of commonality of genes influencing the two traits and will indicate the strength of the tendencies referred to. Perhaps the most important point to keep in mind that when two traits are said to be genetically correlated this means that $r_g \neq 0$; it seldom means that r_g is very close to ± 1. Genetic correlations indicate general tendencies but exceptions will exist.

The importance of r_g can be seen from a simple formula for correlated response:

correlated response(trait 2) = $r_g \times (\sigma_{g2}/\sigma_{g1}) \times$ direct response(trait 1).

The ratio σ_{g2}/σ_{g1} indicates the relative amount of genetic variation in the two traits (and it also changes the scale of measurement). The important term is r_g; if it isn't zero, then the seconc trait will change as we select for change in the first trait. The sign of r_g determines whether the correlated response is in the same or in opposite direction to the direct response.

There are two points about correlated respose that are important to a breeding program. The first of these is that selection will change correlated traits; these changes are not always in a favorable direction. The second is that sometimes a correlated response can be greater than if we selected for a trait directly. Consequently, sometimes indirect selection is the most efficient means of obtaining our breeding objectives. Indirect selection is when we select for secondary trait to realize a correlated response in a primary trait. These two situations will be discussed separately.

Circumstances favoring indirect selection are often technical, ie., when direct selection is not very effective because of technical reasons. A trait may be difficult to measure very precisely hence the accuracy of direct selection is low. An example of this might be reproductive traits which are difficult to measure objectively. The attention given by some breeders to scrotal circumference is an attempt to use indirect selection to improve reproductive performance; scrotal circumference per se has little economic value. Another situation is when the trait is simply very costly to measure. Consequently information can be obtained on relatively few animals. This will prohibit very intense selection. An example of this might be carcass traits. Indirect selection based on other more easily measured traits may provide a more efficient means of improving carcass attributes. Hence, eg., the interest in ultrasonic measurements taken on yearling bulls.

Selection for certain trait(s) will result in change in other genetically correlated traits. This can either help us or hinder us in realizing our breeding objectives. If the correlation is "favorable" , ie., a positive genetic correlation if an increase in both traits is desired, then single trait selection will improve both traits though perhaps not at maximal rates. An example is weaning and yearling weights; selection for either will increase both.

Of more concern is when the genetic correlation is unfavorable. The correlated response will be in the undesired direction. An example might be birth weight which is quite highly and positively correlated to weaning and yearling weight. Selection for the latter will tend to increase birth weights and attendant calving difficulty. Another example is the direct and maternal components of calving ease. Ideally we would like to select sires whose progeny are born without assistance and whose daughters will calve easily. Unfortunately, there is a rather large negative genetic correlation between these two traits. Sires that excell at both are rare.

However, genetic correlations are seldom perfect, ie., ± 1, and they indicate what is likely to happen on average. Because they are not perfect, there are animals which are exceptions to the rules. The challenge to breeders is to identify the true exceptions.

This is when having EPDs on a number of traits can be most valuable and, in particular, EPDs calculated from a multiple trait analysis. In contrast to single trait EPDs, which are calculated from data on a single trait, these are calculated simultaneously utilizing data on a number of traits. The genetic correlations are incorporated into the analysis. Because they use more information, they are more accurate even for single trait selection. Equally important, however, if our objective is to identify the exceptions, is that they provide protection against false conclusions due to limited information. With little information multiple trait EPDs tend to follow the pattern of the r_g's but as information accumulates the effect of the r_g's built into the analysis diminishes. Thus with a multiple trait analysis, we can have more confidence that an animal with a desired, but unusual, pattern to its EPDs is the true exception we are looking for.

AVAILABILITY OF GENETIC PREDICTIONS FROM BREED ASSOCIATIONS

The following is a summary of a survey completed by several beef breed associations in April 1988. The purpose of this summary is to provide a guide to extension specialists and other interested parties who may be interested in obtaining genetic predictions from breed associations. Since breed association performance programs are constantly evolving, questions about the availability of specific information should be directed to the breed association. A list of the names, addresses and phone numbers of the contact people for each association that participated in the survey is on page 4.

	ANGUS	BEEF-MASTER	BRAHMAN	BRANGUS	CHAROLAIS	GELBVIEH	HEREFORD	LIMOUSIN	POLLED HEREFORD	RED ANGUS	SALERS	SHORTHORN	SIMMENTAL	SOUTH DEVON	TARENTAISE
1. EPDs are available for:															
Sires	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cows	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Non-parents	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No
2. Where are SIRE EPDs made available?															
Sire Summary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specified criteria lists	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No
Perf. registration certificate	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	Yes	No	Yes
Performance pedigree	Yes	No	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No
Micro-computer diskette	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Herd performance report	Yes	No	No	No	No	No	Yes	Yes	Yes	No	No	No	No	No	No
Individual requests (other than above)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
3. Where are COW EPDs made available?															
Herd performance reports	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No
Specified criteria lists	Yes	No	No	Yes	No	No	Yes	No	Yes	Yes	No	No	No	No	No
Perf. registration certificate	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	Yes	No	Yes
Performance pedigree	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Individual requests (other than above)	Yes	No	No	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Yes owners	No	Yes

	ANGUS	BEEF-MASTER	BRAHMAN	BRANGUS	CHAROLAIS	GELBVIEH	HEREFORD	LIMOUSIN	POLLED HEREFORD	RED ANGUS	SALERS	SHORTHORN	SIMMENTAL	SOUTH DEVON	TARENTAISE
4. Where are NON-PARENT EPDs made available?															
Perf. registration certificate	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	Yes	No	No
Performance pedigree	Yes	No	No	No	No	No	No	No	Yes	Yes	No	No	Yes	No	No
Specified criteria lists	Yes	No	No	Yes	No	No	Yes	No	Yes	No	No	No	No	No	No
Herd performance reports	Yes	No	No	Yes	No	No	Yes	Yes	Yes	No	No	No	Yes	No	No
Individual requests (other than above)	Yes	No	No	Yes	No	No	Yes	Yes	No	No	No	Yes	Yes owners	No	No
5. Other available programs/reports															
Planned mating reports	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No
Within-herd genetic trend	Yes	No	No	Yes	No	No	Yes	Yes	No	No	No	No	No	No	No
Micro computer sire sorting software	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
6. Which are available to non-owners?															
Performance pedigrees	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No
Breeder cow herd summary	Yes	No	No	Yes	No	No	Yes	No	No	No	No	No	No	No	No
Non-parent herd reports	Yes	No	No	Yes	No	No	Yes	No	No	No	No	No	No	No	No
Specified criteria lists	Yes	No	No	No	No	No	Yes	Yes	Yes	No	No	No	Yes	No	No
Sire Summary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Availability of complimentary sire summaries to:															
Extension Specialists	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commercial cattlemen	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Agents	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NOTE: The American Chianina Assn., American Maine Anjou Assn., and the Santa Gertrudis Breeders International indicated that they are currently evaluating their data bases and plan to generate Sire Summaries in the near future. The Beefmaster Sire Summary will be available July, '88. EBVs (Estimated Breeding Values) are available from Maine Anjou, Salers and South Devon.

8. What is the best way for extension specialists to obtain EPDs on yearling bulls for central test station reports/sales and other performance sales?

American Angus Association - Submit a list of registration numbers to the AAA office and request a listing or individual performance pedigrees. Charge: $10 per list, $2 per performance pedigree.

American Hereford Association - Submit a list to the AHA office and EPDs will be provided at no charge.

American Polled Hereford Association - Provide a list of registration numbers to the APHA and performance pedigrees will be provided at no charge.

American Shorthorn Association - Submit a list of registration numbers to the ASA and EPDs will be provided at no charge.

American Simmental Association - EPDs must be obtained from bull owners.

International Brangus Breeders Association - Submit a list of EPDs to the IBBA and they will be provided at no charge.

North American Limousin Foundation - Submit a list of registration numbers to the NALF and EPDs will be provided at no charge.

9. How does one get on a breed association Sire Summary mailing list?

All breed associations that provide sire summaries have indicated that extension specialists, commercial cattlemen and county agents may obtain sire summaries at no charge by contacting the association.

10. Availability of educational material from breed associations?

American Angus Association - Sire Summary explanation booklet, reprints of articles, BIF Fact Sheets and assorted literature, no charge.

American Hereford Association - Sire Summary video tape, no charge. EPD summary tables, no charge.

American Polled Hereford Association - Reprints of educational articles, no charge. Birth year EPD summary tables, no charge. Sire Summary slide set, charge $25.

American Salers Association - Reprints of educational articles on the use of the sire summary, no charge.

American Simmental Association - Video tape "Using EPDs for Sire Selection" - 1 complimentary copy availabe to each state beef cattle extension specialist. Additional copies $10 each.

American Tarentaise Association - Sire Summary brochures, first one free, thereafter 85¢ each.

North American Limousin Foundation - Performance section of the breeders' manual, no charge. Selection brochure (in production), no charge.

American Angus Association
John Crouch
3201 Frederick Blvd.
St. Joseph, MO 64501
(816) 233-3101

American Brahman Breeders Assn.
Wendell Schronk
1313 La Concha Lane
Houston, TX 77054
(713) 795-4444

American Chianina Association
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P.O. Box 890
Platte City, MO 64079
(816) 431-2808

American Gelbvieh Association
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American International Charolais Association
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American Salers Association
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American Simmental Association Inc.
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American Tarentaise Association
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Red Angus Association of America
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Denton, TX 76201
(817) 387-3502

Santa Gertrudis Breeders International
W.M. Warren
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WHAT IS BEING DONE AND WHAT IS NEEDED IN SPECIFICATION PROGRAMS

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The cattle industry was sailing along in the 1970s, thinking the world would never end--beef was the "perfect product"; everyone wanted to buy it; everyone wanted to eat it. In 1976, 94.4 pounds of beef was being sold at retail outlets per person in the U.S.A. But, then, the wheels fell off the wagon. All of a sudden, something was wrong with beef as a food. Between 1976 and 1983, retail beef-cuts weight per capita declined nearly 16 pounds (from 94.4 lb. in 1976, to 78.7 lb. in 1983); before the decline could be halted 9 more pounds would be lost (70.0 lb. in 1987).

Though cyclical trends in cattle numbers and beef supplies are well-documented, this decline went too far--too fast. What happened? First, a boycott by consumers who protested its high cost; then, a flurry of reports (prompted by Senator McGovern's Select Committee on Diet/Health and aided by activities of Assistant USDA Secretary Carol Tucker Foreman) claimed that beef was unhealthful--too high in calories, cholesterol and fatty acids. Beef consumption was implied to be causative of heart disease and cancer, and its percentage of calories from fat was blamed--in part-- for widespread obesity in the U.S. populace. It became clear that beef must be repositioned in the diet and its chemical composition changed, if its consumption in desired quantity was to be reconciled with recommendations by health professionals.

Too little was done until 1982 when began the first phase of the National Household Beef Consumer Study (NHBCS) and its sequel--the National Retail Beef Consumer Study (NRBCS). Results of those studies, funded by the beef industry and conducted by the Texas Agricultural Experiment Station, were released in January, 1986 at the annual convention of the National Cattlemen's Association (NCA) and consisted of two primary conclusions: (a) two "qualities" of beef were needed to satisfy desires of the retail-beef consuming public--Choice, for those most interested in "taste appeal" and Good (identified as "Select" in that study), for those most interested in "lean appeal", and (b) fat must be removed, especially

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around the external borders, from beef, if diet/health image (lower calories; less cholesterol) was to be improved and if sales increases were to occur.

The news was a bombshell; two weeks after release of the results of the NRBCS, the Kroger Company announced plans to leave no more than 1/4-inch of external fat on its retail beef cuts. In quick succession, Safeway Stores, Inc. declared its "War on fat"; Excel Corporation began its Perfect Trim program (saying to retailers "You can't sell fat, so we won't ship fat") and need was recognized to remove external fat from carcasses on the slaughter/dressing floor (the so-called "hot-fat trimming" procedure). If carcasses were hot-fat trimmed, external fat in excess of 1/4-inch would no longer help to increase the dressing percentage (the ratio of carcass weight to live-animal weight); as a result, the logic at the price-determination interface between feedlot operators and packers would change since--in its eventual chronology--all subcutaneous fat in excess of 1/4-inch on the carcass would be removed physically before carcass weight (and dressing percentage) was determined.

Research was conducted (again funded by the beef industry and performed by the Texas Agricultural Experiment Station) that established the technical feasibility of the procedure and the NCA and American Meat Institute (AMI) petitioned the United States Department of Agriculture (USDA) to "uncouple" beef yield and quality grades to make hot-fat trimming possible from the regulatory standpoint. In 1988, USDA proposed such "uncoupling" and--at this writing--that proposal remains in its public-hearing phase.

Meanwhile, 81% of U.S. citizens (according to studies conducted by the American Meat Institute and the Beef Industry Council) were trimming away all or some of the border fat from cooked beef before consuming it, 86% of U.S. food retailers (according to studies by St. Joseph University, funded by AMI) were leaving no more than 1/4-inch of external fat on beef cuts, and health professionals were admitting that drastic reductions in consumption of calories (from 480, to 134) and milligrams of cholesterol (from 120, to 60) occurred if none of the 1/2-inch of the border fat surrounding a beef steak weighing 5.3 ounces (before trimming and cooking) was ingested (based on studies by the Texas Agricultural Experiment Station).

Attempts by the beef industry to convince the U.S. Departments of Agriculture (USDA) and of Health and Human Services (USDHHS) that existing food consumption data (and recommendations to the public therefrom) were in error because beef cuts at retail now had 1/4-inch, rather than 1/2-inch, of border fat were not successful. To determine whether the St. Joseph University data (which said that the national average for fat thickness on retail beef was now 1/4-inch) could be substantiated, the USDA, NCA and BIC sponsored the National Beef Market Basket Study (NBMBS).

Conducted by Dr. Jeff Savell and Dr. Russell Cross of the Texas Agricultural Experiment Station, the NBMBS investigation involved measuring of the fatness of retail cuts followed by purchase of a prescribed list of retail beef items from 50 supermarkets in 12 cities (Seattle, Denver, Los Angeles, Dallas, Houston, Chicago, Detroit, Atlanta, Tampa, New York, Philadelphia, Washington, DC) and subsequent measurements of physical and chemical fatness. Results of the NBMBS revealed that the average border-fat thickness of beef cuts in the U.S. was .11 inch (closer to 1/8-inch than to the presumed 1/4-inch) and that there was, in 1988, 27% less trimmable fat in the nation's collective retail case than had been there in 1986. It is clear that beef has "lost most of its ugly fat"--unfortunately, though, all of the loss has been occasioned by use of a knife (trimming away the excess portions).

The beef industry must now consider "the pros vs. the cons" of further reductions in the fatness of its products; to do that, correctly, necessitates consideration of the primary industry targets in terms of quality-levels in beef. Inasmuch as "quality" in cooked beef steaks/roasts is best defined in terms of their flavor, juiciness and tenderness when eaten, U.S.D.A. quality grade--and especially its component, marbling (percent of muscle as intramuscular fat)--usefully predicts degree and repeatability of palatability performance. I believe there are three primary targets for qualities of beef: (a) Very High Quality--Average Choice or higher-grade beef best fits the need for high and consistent palatability performance for sale to the hotel/restaurant/institution (HRI) and food-service (FS) trades and for sale to supermarkets that wish to feature very high quality beef, (b) Intermediate Quality--Low Choice or higher-grade beef fulfills demand for parts of the HRI and FS trades and fits almost perfectly the desires of retail supermarket customers who emphasize palatability ("taste", in their vernacular), and (c) Acceptable Quality--Low Select or higher-grade beef appeals to retail supermarket customers who emphasize cutability ("leanness", in their vernacular) and who rank leanness over taste to achieve a reduction in calories.

Importance of "taste" (actually--flavor, juiciness, tenderness or overall palatability) in beef-purchase decisions has been amply demonstrated by studies of the Texas Department of Agriculture (TDA) and the Safeway Nutrition Awareness Program (SNAP). TDA determined relative importance of numerous factors as they were used by restaurant patrons in deciding which food to purchase and eat; "taste" was the deciding factor in 58.8% of such decisions, far surpassing calories (4.4%), cost (5.5%), convenience (11.6%) or diet/health (20.0%) concerns. Retail consumers, also, emphasize "taste" over diet/health/nutrition concerns in making food purchasing decisions, based on analyses of impact of components in the SNAP by supermarket officials.

Obviously, the desire is for the beef offered for sale to satisfy HRI and FS patrons and to "woo 'em, wow 'em and win 'em" in the supermarket trade. To achieve these aims while progressively leaning-up the product, requires that special attention be paid to not proceeding too far in the fat-reduction process. Drs. Savell and Cross of the Texas Agricultural Experiment Station spoke eloquently to that issue in their 1988 report commissioned by the National Academy of Sciences; their extensive evaluation of the scientific literature on the subject of intramuscular fatness relationships to palatability (the so-called "Window of Acceptability") revealed that beef dare not dip below the level of 3% intramuscular fat (equivalent to "minimum Slight" marbling--which is the bottom of the U.S. Select grade), if consumer expectations are to be met. It is the "Waste Fat" (fat along borders and in the seams between muscles) and not the "Taste Fat" (fat inside the muscle), that must be reduced/removed.

Further clarity regarding quality grades for beef issued from analyses of the NRBCS. Though many in industry and the scientific community argued forcefully for the combining into one grade of the Choice and Good grades of beef--as recently as 1985--the NRBCS demonstrated need for two separate grades--one grade ("Choice") for consumers emphasizing "taste appeal" and another grade ("Good"--but preferably renamed "Select") for consumers emphasizing "lean appeal". To blend together the two kinds of beef would be analogous to bottling and offering Classic Coke only as a mixture with Diet Coke--neither sub-population of consumers could find the exact target of their personal-purchase preference. On November 23, 1987 the USDA officially changed the name of the Good grade to Select, thereby making possible the merchandising and promotion of a "new kind" of beef for health-conscious consumers. Resulting then, for cattle producers to strive for, are sets of production and/or carcass targets, identified, for example, according to my personal preference as (I) Very High Quality Beef (Average Choice to High Prime), (II) Intermediate Quality Beef (Low Choice) and (III) Acceptable Quality Beef (Low Select to High Select), or identified by the Excel Corporation as (a) "Quality Beef" (Average Choice to High Prime), (b) "Retail Store Beef" (Low Choice) and (c) "Lean/Lite Beef" (Low Select to High Select) or identified by the NCA as (1) "Very High Quality Beef" (High Choice to Low Prime), (2) "Retail Store Beef" (High Select to Low Choice) and (3) Lean/Lite Beef" (Low Standard to Low Select).

Those are the targets; now comes the hard part. The consensus is that the fat must go; now, how do we do it. The old--and the current--way is to trim the fat away with a knife; the new way must be to breed it or feed it away (that is, don't put it on in the first place).

The genetics of leanness is such that it is a moderately heritable trait, for which we can select both within and between breeds, and that actual leanness of a given animal is the result of a feed X animal interaction. Dr. Bill Turner of Texas A&M University believes that important, too, is the fact that leanness in beef cattle is associated with other critical animal productivity characters--cow size, calving ease and ability to rebreed. Obviously, then, the best bet in using genetics of the commercial cow-herd to achieve desired carcass targets lies in the principle "Match the cow to the environment, match the bull to the endpoint, so the offspring will dominate at the marketplace."

Mamas are important! Cows are expected to produce a calf, every year, irrespective of ambient temperature, relative humidity and supply of feedstuffs. Experience and intuition assure producers that the ideal cow for South Texas is not identical (in genotype or phenotype) to that considered best in Alaska, California, Wyoming, Indiana or Massachusetts--or, for that matter, even in North Texas or East Texas. In South Texas, ability to tolerate high humidity/temperature conditions and ability to match milk production to incumbent feed supplies so as not to excessively deplete body fat-stores are needed to assure that the cow will cycle, breed, ovulate, carry--to term--and wean one calf every 365 days. On Colorado's Western Slope, the ideal cow must--too--do these same things while simultaneously retaining enough "condition" (fat stores, especially in the subcutaneous depots) to keep her alive in even the harshest of winters. In regions of Kentucky, a bigger, heavier milking cow may be ideal because shortages of feed and extremes of weather are less likely to impinge upon her environment. An oft-quoted phrase "all the cattlemen has to market is his grass" denies that, in certain years and certain geographic regions, conditions (drouth, for example) may be such that he has nothing to market--not even grass.

Targets, of production and of carcass types, are now (in 1988) easy to identify; to reach the target market with a bullseye--every time--is not quite so simple. To assure that the target is visible and the bullseye apparent, research is presently underway at TAES to determine "value differences" (differences between fat vs. lean cattle of the same USDA quality grade) among live cattle (in studies supported by the Con-Agra Corporation and the USDA) and among carcasses (in studies supported by BIC and NCA). Additional TAES studies seek to improve the price-discovery processes so that cow-calf producers, stocker operators, cattle feeders, beef packers and meat retailers have equal access to supply/demand/value/ price information prior to the time "a trade" is consummated. To do that, Dr. Bill Mies of Texas A&M University believes it would be helpful if the Chicago Mercantile Exchange instituted trading in contracts for boxed beef to augment price-discovery mechanisms presently partially supplied by trading of contracts for feeder cattle and for fed cattle.

Because of the present (in 1988) short-supplies of feeder cattle and of slaughter cattle there will be little price/value differentiation among live animals or carcasses until the supply situation is corrected. Knowledgeable market analysts project that three to five years will be needed to rectify supply/demand imbalances. That period provides an enormous "window of opportunity" for those in the beef cattle industry to adjust; that is, to change the genotype/phenotype of feeder and fed cattle so they more closely coincide with carcass and retail product targets. By approximately 1992, it is likely that systems of premiums/discounts (actually, of value determinations based on differences in cutability) will exist and be employed by both feedlot operators and meat packers; the Excel Corporation has them now, Con-Agra Corporation will have them shortly.

That being the case, "bull power" will be needed. Required to accomplish such need will be purebred bull specifications to meet industry needs in terms of carcasses and retail products. "Bull power" exists presently among breeds. Examples of "targeted breeds for targeted needs" include the "Certified Angus Beef" program (for high quality beef) and the "Lean on Limousin" program (for lean beef). Heritability estimates are moderate to high for most of the quality/palatability/cutability traits of beef (USDA quality grade, .50; marbling score, .50; tenderness, .65; ribeye area, .70; carcass fat thickness, .40; USDA yield grade, .45). For at least one of these traits--marbling score--there is a working hypothesis regarding the physiological mechanisms by which differences exist between cattle of different breeds. Cattle differ in the predominant type of fibers--red vs. white --in their ribeye muscles. Red muscle fibers use fatty acids as a primary source of muscle contraction/relaxation energy while white muscle fibers do not (their source of energy is largely blood/muscle sugars--glucose and glycogen). Those breeds of cattle (e.g., Jersey, Longhorn, Angus, Shorthorn) with predominantly red muscle fibers are more likely to store fatty acids in intramuscular depots (as marbling) dispersed among their muscle fibers than other breeds of cattle (e.g., Charolais, Maine-Anjou, Limousin, Gelbvieh) that have predominantly white muscle fibers. Cattle with predominantly white muscle fibers have much less need for a nearby supply of fatty acids to serve as a source of energy for muscle work and, thus, deposit less marbling in their ribeyes. Because white muscle fibers are substantially larger in diameter--on average--than are red muscle fibers, those breeds of cattle with predominantly white muscle fibers have larger ribeye areas (all other traits held constant) leading to the well-known apparent genetic antagonism between muscling and marbling in beef cattle.

Although announcement by the Excel Corporation in 1987 that they would "name names" (identify specific breeds) of cattle that would vs. would not work in their block-beef programs created fear that a "breed beauty contest" might ensue, it should be obvious that there is tremendous variability in all endpoint-product traits among cattle of the same breed. Changes in the Angus breed--from large and fat (in 1912), to short and fat (in 1953), to large and lean (in 1988)--provides ample evidence of the effectiveness of within-breed selection pressure to make the breed's market animals fit real or perceived demands of then-existent buyers of cattle, carcasses or meat. Within reason, similar success can be realized within other cattle breeds but progress would be slow and long periods of time might be required. Research conducted in 1988 at the U.S. Meat Animal Research Center (Clay Center, NE) suggests that, within a breed, to improve tenderness (by decreasing Warner/Bratzler Shear Force by 1 kilogram) through selection for marbling would require 78 years of single-trait selection, and--because of the genetic antagonism involved --retail product would decrease 10 percent. Obviously, a shorter-term solution might rest in careful capitalization on crossbreeding.

As attempts are made to target for production of cattle with the desired quality and yield grades, it is important to know both where we now are and where we are headed. At present, the U.S. block-beef supply consists nominally of 2% Prime, 50% Choice, 30% Select and 18% Standard; my personal crystal ball says we will eventually need 5% Prime, 75% Choice, 20% Select and no carcasses that grade Standard. My rationale is based on the facts that in the latest year (1985) for which we have complete data, supermarket-members of the Food Marketing Institute sold 0.7% Prime, 75.9% Choice, 0.7% Good (now Select) and 22.8% ungraded ("No-Roll" --a mixture of primarily, but not exclusively, Good and Standard beef) and that the vast majority of HRI and FS beef is of the Prime and Choice grades.

At present, the U.S. block-beef supply consists nominally of 5% Yield Grade 1, 46% Yield Grade 2, 42% Yield Grade 3, 5% Yield Grade 4 and 2% Yield Grade 5; my crystal ball says we will eventually need 20% Yield Grade 1, 80% Yield Grade 2 and no carcasses of Yield Grades 3, 4 or 5. My rationale is based on the fact that while beef carcasses of Yield Grades 4 and 5 contain 39.1% and 43.7%, respectively, of separable fat (based on USDA/TAES cutability data) and are admitted by all to be far too fat, carcasses of Yield Grade 3 (with 34.9% separable fat) are also too fat to be considered acceptable to the supermarket trade. There are those in industry who believe that intermuscular ("seam") fat becomes excessive at the Yield Grade 2.5/2.6 juncture; if that is the case, even the upper (fatter) half of Yield Grade 2 will be unacceptable in the near-term.

As a particular breed seeks to resolve issues of which carcass targets (quality or yield grades) to strive for, I can imagine no scenario in which the industry wants or needs carcasses of the Standard Quality Grade or of the No. 4 Yield Grade. All breeds must do everything possible to eliminate lines/strains of cattle that will not (after 100 or so days of high-concentrate feeding) deposit at least Slight-minus amounts of marbling (the minimum required to qualify for the Select grade). The only argument for meat-packer reluctance to identify "Select" carcasses--and a valid one, from the packer's standpoint--is that it is presently advantageous to all concerned to mix the Selects and Standards so that the latter can be effectively merchandised. Unfortunately, as long as the packer mixes carcasses to create a "No-Roll" category, the beef industry will continue to produce Standard and Y-4 and Y-5 carcasses--to the net detriment of the industry as a whole.

TAES research data demonstrates that beef from Standard carcasses is considerably less palatable--on average--and far more variable in flavor, juiciness and tenderness--in the composite--than beef from Select carcasses; as a result, "No-Roll" beef is not very dependable in eating satisfaction. The best way for the cattle industry to preclude the necessity to mix together some "pretty good" and some "pretty bad" beef just to get rid of the "pretty bad" beef is to not produce the latter. Elimination of such beef from the supply would also make it possible for retailers (for example, Safeway Stores) to obtain beef officially identified (by the USDA) as "Select" from more suppliers and in greater supply. In this manner only--if beef of the Select grade is supplied and enough trades of it can be verified--will the industry ever determine whether or not such beef will command sufficient market-share to make the Select grade a reasonable breed-selection objective and target.

Elimination of Yield Grade 4, and eventually of Yield Grade 3, carcasses from the nation's beef coolers will ultimately require combined efforts of the seedstock industry and of feedlot operators. Economic operation of a feedlot requires that the feeder have sufficient time-latitude to effect an advantageous trade on each pen of cattle. If genetics are such that they dictate the time-course (inasmuch as two additional weeks of feeding would cause the cattle to cross over a Yield-Grade line) of the trade, the feedlot operator is left in the lurch. Dr. John Edwards of Texas A&M University has said that cattle with superior muscling are most amenable to further feeding beyond the point they would normally first appear on the "show list", because additional external fatness is partially offset (in determining ultimate Yield Grade) by concurrent increases--with further feeding--in ribeye area. Increased propensity for muscle growth is then a reasonable breed-selection objective and target.

Picking the right sire, for seedstock-generation or commercial-production purposes, will necessitate collection of meaningful carcass information from his progeny or--perhaps--use of ultrasound, or more advanced electronic technology and visual appraisal to evaluate the bull directly. Sire summaries presently available for bulls of most breeds do not include Expected Progeny Differences (EPDs) for carcass traits; that for the Angus breed is a notable exception. The 1986 Angus Sire Summary includes EPDs and Accuracies for fat thickness, marbling and ribeye area. Though possibility exists for development of a "National Sire Summary for Carcass Traits," it seems more likely that each breed must decide the merits (relative to time and cost requirements) of collecting and summarizing such data.

As the "cow that matches the environment" is mated to the "bull that matches the endpoint" to produce "offspring that will dominate at the marketplace," principles of selective breeding and complementarity apply to both purebreeding and crossbreeding. "Complementarity" as I describe it here involves the following procedure: (1) identify the genotype of the female needed to operate in the prevailing environment (temperature; humidity; feed supply), (2) characterize the end-product (beef Quality/Yield Grades) of the female's genotype, (3) determine the targeted end-point (beef Quality/Yield Grades), and (4) select a bull of a genotype that maximizes probability of producing feeder cattle of the desired kind. Examples of complementarity using crossbreeding are as follows: (A) if the optimum cow is a 900 lb. "Black-Baldy" and the target market is 40:60, Choice and Select, and 60:40, Yield Grade 2 and Yield Grade 3--then the terminal sire might be Charolais, or (B) if the optimum cow is an 1100 lb. Brahman-Hereford and the target market is 50:50, Choice and Select, and 50:50, Yield Grade 2 and Yield Grade 3--then the terminal sire might be Angus.

If the desire is to pure-breed, selective mating within a breed would consist of the following: (1) characterize the genotype of the cow herd, in terms of Quality/Yield Grades, (2) select the end-product target in terms of Quality/Yield

Grades, and (3) use bulls of the correct genotype, in terms of Quality/Yield Grades, to complement the genotype of the cow herd.

As all of this is accomplished, the industry must be absolutely certain that its eyes are fixed on the appropriate carcass targets. It is axiomatic that cattlemen are haunted by time risk; cattle producers can't make the most effective long-range decisions until it is certain what the consumer wants. From present vantage (mid-1988), it seems likely that "M&M's"--muscling and marbling--are the traits upon which to concentrate in describing the product-endpoint target. (To that we could add a third "M"--"Mothering/Maternity"--to describe the production objective.)

On the shoulders of the seedstock producer falls much of the burden for improving the genotype of the nation's cowherd and bull stud. In time, cloning and genetic engineering may make possible the creation of transgenically created and near-perfect breeding cattle. Until such time, responsibilities for making the most of that with which the industry must work, rests equally upon seedstock producers, cow/calf producers and feedlot operators. Dr. Russell Cross of the Texas Agricultural Experiment Station says it appears doubtful that we will see much change at the packer level until the retailer sends the correct signals regarding value-differences, among carcasses/cuts of the same USDA quality grade, associated with differences in cutability. Progress will pick up steam when the retailer signals the packer, the packer signals the feeder, and the feeder makes his wants and wishes known to the producer--with price.

Seedstock producers need now (because it will take so long to make substantive genetic changes in marbling, muscling and fattening propensities) to begin the complicated task of simultaneously selecting for what appear to be negatively correlated traits--leanness and marbling. Dr. Jim Sanders of the Texas Agricultural Experiment Station believes that genetic evaluation will be difficult if leanness and marbling are considered as separate characters, and that genetic evaluation and selection would be simpler if degree of marbling at a given level of external fatness (i.e., fat distribution) is the character of concern.

For the present, producers can take comfort from the fact that the beef industry has changed the face of its future by making revolutionary--not evolutionary--changes in the fatness of beef products as they appear at the retail market. Be encouraged also that by recommending to all that they eat the <u>red</u> (muscle) and not the <u>white</u> (fat), they can <u>have their cake</u> (enjoy beef's great taste) <u>and eat it too</u> (without fear of diet/health/nutrition consequences).

Live Animal Evaluation for the Determination of Carcass Traits

by

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Finally, the beef industry is becoming almost universally concerned about the composition of its product. Breeders, feeders, packers, retailers and consumers are suddenly concerned for either profits and/or health. Unfortunately, we are being offered solutions to the problem of excess fat that are not based on fact and in some cases are in conflict with efficiency of production.

The evidence is overwhelming in support of genetic change of our cattle population as the only practical solution to uniform size, cutability, tenderness, juiciness and flavor. A great many people believe that they should "background" the cattle on pasture or high roughage diets for 120 to 180 days and then place them in the feedlot on high concentrate diets. They claim that this procedure gives lower cost of gains and leaner, higher cutability carcasses. However, research data support the practice of placing calves directly in the feedlot at weaning on high concentrate diets and taking them to the choice grade in the shortest possible time. This procedure results in a reduction in interest cost, shorter production time, less total body maintenance, more efficient feed conversion and lower total feed requirements. The genetic potential of the cattle dictates their carcass composition at any weight regardless of whether they reach that weight in a short or long period of time.

Ridenour (1982) fed a large number of similar steers on 5 different planes of nutrition and slaughtered each steer as they reached 500 kg live weight. No significant differences were noted in fat thickness, skeletal maturity, lean maturity, conformation, USDA quality grade or USDA yield grade. Similarly, Szulc (1979) fed young bulls on two planes of nutrition. The low plane required 373, 577 and 800 days to reach live weights of 300, 450 and 600 kg respectively while the high nutritional plane reached those weights in 303, 468 and 682 days. Carcass weight, dressing percentage, carcass composition, chemical composition and physico-chemical properties of meat were not affected by diet. These data strongly suggest that genetic potential is the overriding factor here but both studies are vulnerable since they are based on the assumption that the cattle were genetically the same. Winchester (1955, 1956, 1967) working with identical twins reported similar data, with even more drastic reduction in energy intake by the twin on a low nutritional plane. Robbins (1988) working with identical twins, resulting from the embryo splitting technique at Texas Tech University, removed the calves from their recipient mothers at 3 days of age and treated them alike until they were 200 days old. At that time one member of each twin set was placed on a high concentrate diet and its mate fed to gain at a slower rate of gain. When the "high energy" twin was estimated to have a slaughter grade of low choice it was slaughtered and carcass data recorded. At that time his mate was switched to the high energy diet and slaughtered when it reached the weight at which its mate was killed. Performance, live measurements and carcass characteristics are shown in Tables 1,2,3 and 4. Since there were no statistically significant differences in these twins when slaughtered at the same weight as their mates, one can only conclude that the sire and dam, or in other words, the genetics of the calf determines his carcass characteristics at a certain weight.

Your conclusion must be - if you want to change the carcasses of cattle, you must change them genetically.

Now, in order to change the cattle genetically we must practice selection. In order to do this effectively we must <u>accumulate</u> and <u>use</u> a <u>complete-- and accurate</u> set of performance records. To accomplish this you must shorten your calving season, maintain uniform nutrition and management and thereby compare the cattle under the same conditions, at the same age, at the same time and at the same place and then <u>use the records</u> in selection. The procedure in <u>performance selection</u> not performance testing.

Such records can be combined in your breed associations' record systems to generate the genetic values (Expected Progeny Differences) on both males and females with and without progeny.

The extent of the mathematical model and the magnitude of the calculations necessary to accomplish these data are difficult for some of us to comprehend but they work. You must believe and use them.

Now, in order to change the genetic potential of our cattle for carcass composition we must be able to evaluate the cattle for composition as well as weight. Are the cattle composed of fat or muscle? Herein lies our problem - we have a great many breeders and/or judges that cannot accurately evaluate cattle for composition. A case in point is our obsession with frame size. During the past few years almost all breeds have made a great effort and a successful one to increase the frame size of their cattle.

There are three major problems with this desire to increase the height of cattle:

1. Height at the withers or hips is not an accurate measure of skeletal size. Measurements across movable joints are not accurate since slope of shoulder, angle at the stifle and hock can effect such measurements greatly. See Figures I, II, and III. These three skeletons are identical in size.

2. Skeletal size is not a measure of potential for reproductive efficiency, growth rate or carcass desirability. In fact, selection for increased length of the long bones, or length of leg if you will, is selection for late sexual maturity.

3. Skeletal size (frame size) is not a measure of carcass composition or yield of edible portion.

I want you to look at the data from three steers in Table 5. Their weight is very different but their skeletons are practically identical in size, which is,of course, their frame size. Now examine the dissection data in Table 6. Not only were their skeletons identical in linear measurements, but their skeletons weighed the same. However, here the similarity stops. Note the tremendous difference in muscle in total weight and as a percentage of the carcass of the #1 steer. This gives a muscle:bone ratio of just twice as much for the heavily muscled steer as is the case with the thinly muscled one. Fat varies only a little in this case but keep in mind that it would be easy to put together a large group of steers with identical skeletons that vary widely in fat and muscle composition. Table 7 lists the conventional carcass measurements. These tables make two major points.

1. The Yield Grade formula ranked these three steers essentially the same, which is obviously in error. This is because the formula was constructed with conventional British breeds which did not offer the range in muscling we have in the U.S. It under evaluates the heavily muscled #1 steer, over evaluates the thinly muscled #3 steer and does a good job on #2.

2. The frame size or skeletal size of these steers had nothing to do with desirability of their carcasses.

I would hope that your conclusion would be something like mine which simply stated is: <u>Why anyone would use frame size in the evaluation of cattle for composition is beyond me</u>. Yet, that is exactly what takes place in the majority of showings in the U.S. - they put the tall ones up. Think what this means. Most steers are shown by weight and most of them have been fed and managed in such a way that they are not excessively fat. Therefore, placing the tall, big framed steers up in class and the small framed ones down means that selection was against muscle or meat which makes no sense at all in the beef production business. The placing of the tall ones of the same weight on top of the class further complicates the situation. Large framed cattle mature later which fact decreases the chances of the large framed steer making the choice grade.

What is the value of frame size?

Skeletal growth or bone formation in growing animal takes priority for nutrients over fat deposition and even maximum muscle growth. Therefore, regardless of plane of nutrition, if we compare animals at the same age and sex, their frame size has probably increased according to genetic potential and is a good measure of what their mature frame size will be. When compared at the same age, the larger the frame the larger it will be at maturity and the longer it will take to reach that point. Also, we know that as an animal approaches maturity, he begins to deposit fat in the muscle, which is the marbling that puts him in the choice grade. This is the very basis for the U.S.D.A. Feeder Grades which separate cattle into large, medium and small frame sizes. If cattle of the same age are sorted into uniform frame size groups, each frame size will reach the choice grade after a different length of time on feed. The larger the frame size, the longer the feeding period required to reach slaughter condition.

Of course, this same principle works on breeding cattle and if they are compared at the same age and are of the same sex, the larger framed animals will be larger at maturity and likewise require longer to reach maturity. Therefore, if your only goal is size at maturity, go for frame size. Remember, frame size tells you nothing about the composition of the carcass, growth rate or reproduction efficiency.

Muscling

So much for frame size - now we must concern ourselves with what is on the frame. We often hear the remark, "I like a lot of length and elevation in my cattle because it gives me more space to hang muscle." This is parallel to doing business with a big bank in the hope that your cash deposits will increase accordingly. If you want to evaluate cattle for muscling, you must measure the muscle.

That Long, Smooth Muscle

We also hear a great deal about the "kind" of muscle on cattle and the favorite terms are "the right kind of muscle" or "that good, long, smooth muscle". Fortunately, there is only one "kind" of muscle. It is composed of muscle fibers bundled together by connective tissue and attached by connective tissue and tendons to other muscles and to the skeleton. The "length" of the muscles is determined by the size of the skeleton since each muscle is attached to the skeleton at the identical spot in all cattle. Therefore, cattle of equal frame size have the same length of muscle. "Smooth Muscle" is a term used to describe cattle that have a layer of subcutaneous fat or are thinly muscled, or both.

Don't Fear Muscle

Muscle is beef and beef is our business. It makes no sense to select against the growth and development of muscle. This fear of muscle has developed through the use of large breeds and strains of bulls on smaller breeds and strains of females together with the occurrence of the "double muscled" gene. Obviously, the gene for double muscling is a detrimental one and must be avoided. However, if you select for muscle in a population where this gene does not occur, you can increase muscling and there is no double muscling. If you select for muscle in a population that does carry the gene you can identify it and eliminate it.

How to Measure Muscle

To select for muscle, we must identify degree of muscling in live animals. Here, again, we are fortunate in that numerous research reports show a constant proportion between muscles among all breeds and types of cattle. This fact allows us to observe the degree of muscling in an exposed area of the animal's body and use it as a measure of total muscle mass. This can be done visually by simply keeping in mind a few basic facts of anatomy.

There are other methods of measuring musclings such as dilution techniques, ultrasound measurements and of course magnetic response. However, each of these methods has serious shortcomings such as time required, cost, measurement at only one site and inaccuracy. Regardless of which method we select the data is illegitimate unless the cattle are compared at the same age, sex and have been treated alike.

Conclusions

When it is all said and done, there are only four measures of production worthy of consideration in evaluating beef cattle. They are:

Reproductive Efficiency
Increase in Weight per Unit of Feed
Composition
Longevity

I submit that there are no criteria that measure the efficiency of production of palatable, wholesome, healthful beef that are not covered by the above. therefore, our goal must be a combination of genetic material that gives us maximum productivity in each of these traits. There are two ways to accomplish this:

1. The development of a super breed or strain which is the answer to everyone's prayer and takes over the world.

2. The development of identification of several breeds or strains each of which excels in certain areas of productivity and with genetic potentials that allow their complimentary combination in such a way as to maximize the efficient production of a superior product under a specific environment.

Unfortunately, the development of a super, all excelling breed is very unlikely. For example, the ideal mother cow on the range must have the ability to store fat in the good times in order to survive the blizzard and the drought. This is in conflict with desirable carcass composition. Likewise, maximum performance in growth rate and composition is in conflict with reproductive efficiency etc..

This leaves us with crossbreeding. Not crossbreeding for the sake of crossbreeding, but the crossing of strains that are complimentary and compatible. In addition to complimentary we are interested in heterosis. We define heterosis as the improvement in performance of a trait above the average of the parent stock. This means that we can improve performance in some traits with heterosis but the major determinant of level of productivity is the excellence of the animals that are crossed. If we cross junk with junk we get more junk that is slightly improved. Therefore, we as beef cattle breeders must decide why our breed or strain is to contribute and establish selection criteria toward that end. Some breeds must excel in maternal traits, some in growth and composition, some in heat tolerance etc..

WHAT NOW?

What greater accomplishment can a man have than the molding of living flesh and blood into a functional form that his mind has conceived. We have only to look to the past for a dramatic illustration of the diverse forms possible. From the first wild ox (Bos primigenius) of Europe, whose fossils indicate a frame of 72 inches at the shoulder, through the entire array of Bos Taurus and Bos Indicus breeds available to us today, we have almost unlimited variation in color, form and function. Incidentally, that first wild ox that stood 6 feet at the shoulder might be likened to some cattle of present vintage in both frame size and disposition. So we have come full circle.

The question before us, however, is not where we have been but where we are going. We have the germplasm and the tools to breed superior producing cattle. Let's get on with it.

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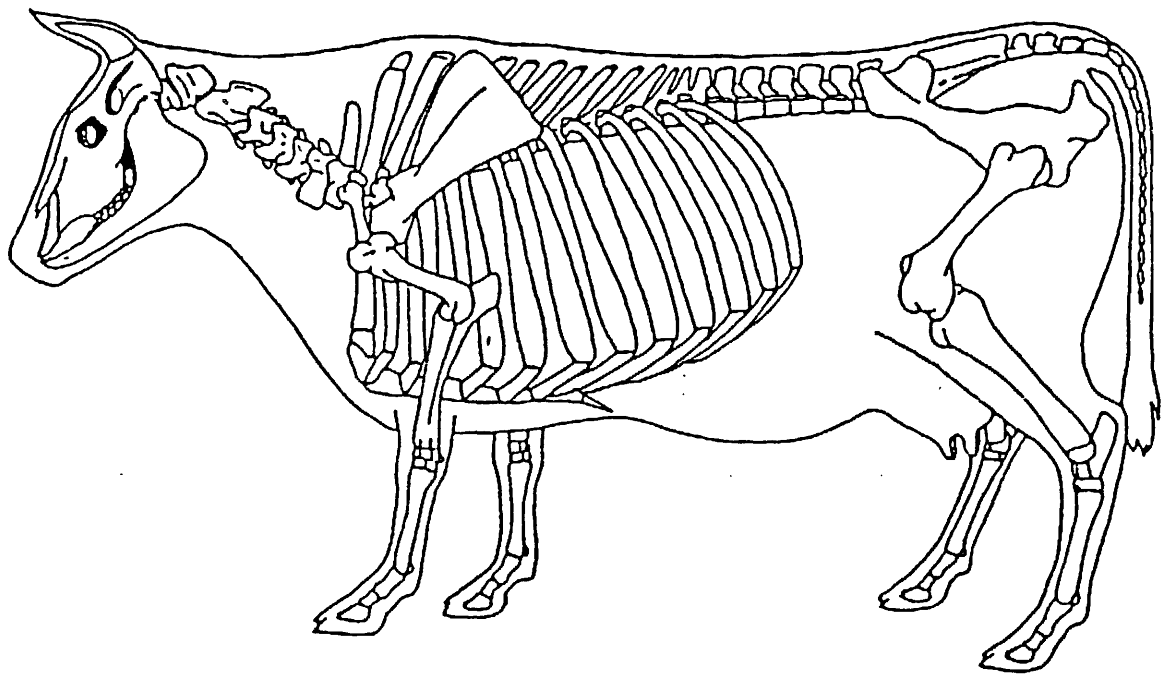

FIGURE I.
TOO MUCH ANGULATION

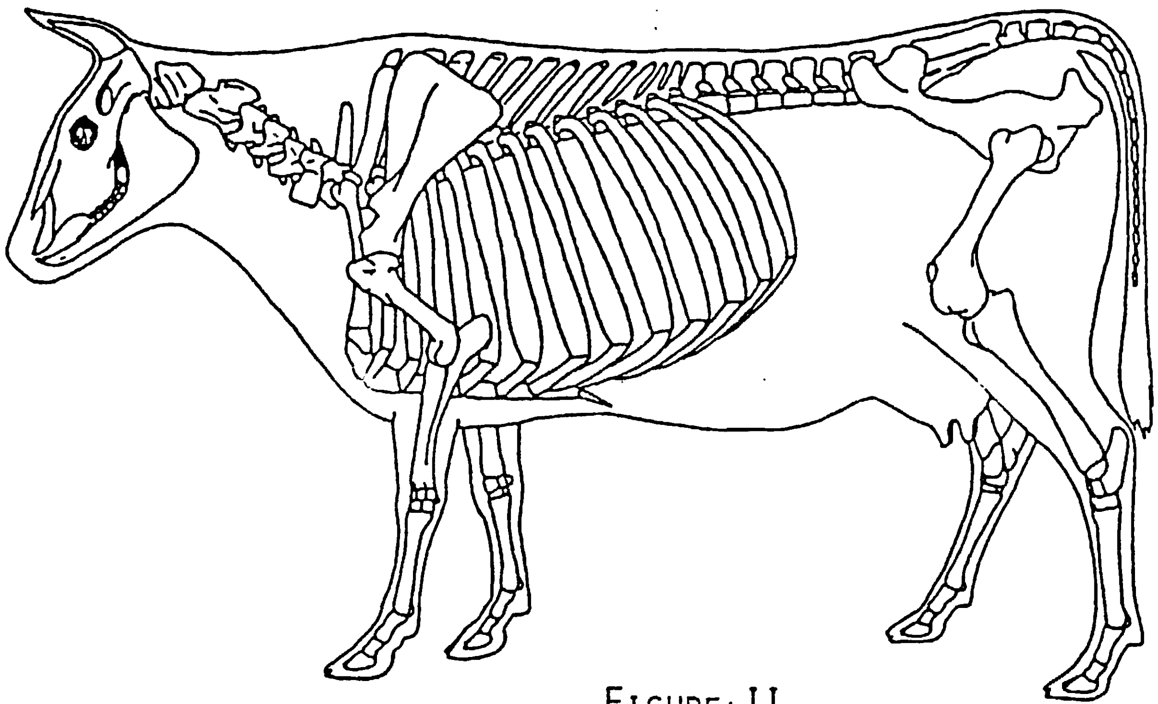

FIGURE II.
CORRECT ANGULATION

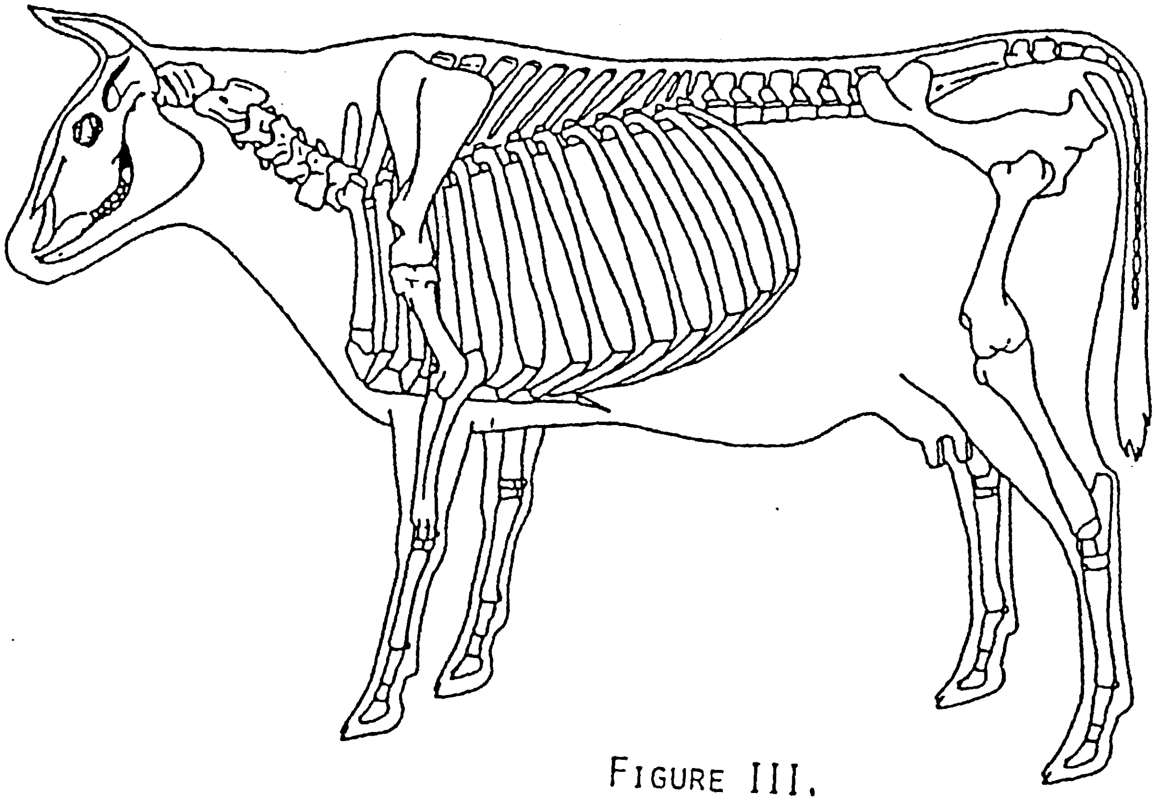

FIGURE III.

NOT ENOUGH ANGULATION → STILTED

TABLE 1. FEEDLOT PERFORMANCE OF IDENTICAL TWIN CALVES CONSUMING DIFFERENT ENERGY DENSITY DIETS

Item	High Energy	Low Energy	P>F	S.E.
Days on feed	208	277	.001	4.88
Dry matter intake, kg/d	8.62	8.23	.31	.18
Weight gain, kg	232.23	236.43	.52	3.08
Average daily gain, kg	1.14	.87	.001	.056
Feed:gain	7.67	9.58	.05	.23
Average daily ME* intake, Mcal	26.05	20.01	.001	.41

* Metabolizable energy

TABLE 2. INITIAL SKELETAL MEASUREMENTS OF IDENTICAL TWIN CALVES

Initial meas.	High Energy	Low Energy	P>F	S.E.
Hip height, cm	111.2	111.9	.18	.24
Wither height, cm	105.9	105.9	.91	.31
Body length, cm	118.7	118.9	.83	.4
Cannon circumference, cm	16.6	16.7	.77	.036
Cannon length, cm	14.8	14.8	.99	.024

TABLE 3. FINAL SKELETAL MEASUREMENTS OF IDENTICAL TWIN CALVES CONSUMING DIFFERENT ENERGY DENSITY DIETS.

Final meas.	High Energy	Low Energy	P>F	S.E.
Hip height, cm	128.1	129.2	.05	.23
Wither height, cm	123.7	123.6	.91	.32
Body length, cm	141.9	142.3	.52	.34
Cannon circumference, cm	19.5	20.0	.02	.099
Cannon length, cm	16.6	16.9	.0006	.035

TABLE 4. CARCASS CHARACTERISTICS OF IDENTICAL TWIN CALVES CONSUMING DIFFERENT ENERGY DENSITY DIETS

Item	High Energy	Low Energy	P>F	S.E.
Hot carcass weight, kg	298.3	297.0	.86	1.87
Fat thickness (12th rib), cm	1.04	.84	.12	.057
Kidney, heart and pelvic fat, %	2.4	2.5	.72	.15
Ribeye area, cm^2	79.4	78.1	.55	1.27
Quality grade	10.2	10.2	.99	.12
Yield grade	2.60	2.54	.64	.09
Femur, kg	1.97	2.09	.003	.014
Biceps Femoris, kg	5.41	5.62	.20	.08
Muscle:bone*	2.76	2.70	.35	.033

* Biceps femoris:femur

TABLE 5: MUSCLE:BONE RELATIONSHIPS AMONG SLAUGHTER STEERS

LIVE MEASUREMENTS

Steer #	1	2	3
Live wt. (lbs.)	1450	1300	1005
Length of Body (in.)	60.23	60.23	59.84
Rump Length (in.)	20.07	20.07	20.47
Ht. Withers (in.)	51.96	51.57	52.36
Ht. Hips (in.)	53.54	53.14	53.93

TABLE 6: MUSCLE:BONE RELATIONSHIPS AMONG SLAUGHTER STEERS

DISSECTION DATA

Steer #	1	2	3
Lbs. of Bone	64	68	67
% Bone	13.1%	16%	23%
Lbs. of Muscle	320	262	168
% Muscle	66%	63%	59%
Lbs. of Fat	104	81	53
% Fat	21%	19%	18%
Muscle:Bone	5.01	3.88	2.52
Muscle:Bone 1M Fat Included	5.16	3.94	2.61

TABLE 7: MUSCLE:BONE RELATIONSHIPS AMONG SLAUGHTER STEERS

CARCASS MEASUREMENTS

Steer #	1	2	3
Carcass Wt.	976	820	570
Dress %	67%	64%	57%
Maturity	A^{75}	A^{50}	A^{75}
Marbling	$Small^{30}$	$Slight^{80}$	$Slight^{60}$
Quality Grade	Ch^{-}	Gd^{+}	Gd^{o}
Fat thickness (in.)	.3	.3	.12
Rib Eye Area (Sq. in.)	18.1	14.3	9.9
% KHP	3.0%	2.5%	2.5%
Yield Grade	1.8	2.3	2.3

Application of Ultrasound In Commercial Feedlots and Beef Breeding Programs

by

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Kansas State University

As the beef cattle industry moves closer to the "specification era" cattlemen are asking themselves, "Where will my cattle fit?" Seedstock producers, commercial cattlemen, stockers and feeders will all be affected by specifications that cause the "windows of acceptability" to narrow for carcass weight, cutability and quality grade. With this in mind, cattlemen are becoming increasingly interested in carcass trait evaluation of feedlot and breeding cattle.

Of primary interest to feedlot managers is the ability to identify and market groups of cattle that will consistently produce carcasses of similar weight with acceptable yield and quality grades. This could be accomplished using one, or a combination of the following methods:

1) Improve the uniformity of pens by sorting cattle into the feedlot based on body composition and frame (biological type)

2) determine a compositional endpoint at which a set of cattle should be slaughtered and identify and market individuals or groups of cattle as they reach that point, or

3) Identify breeding cattle with the genetics to consistently produce progeny with acceptable yield and quality grades at a specified weight and/or age.

Theoretically, an effective sire line evaluation system for carcass traits could eliminate the need to sort cattle on any basis other than genetic background. This would streamline the processing and penning of incoming feedlot cattle and simplify marketing decisions for feedlot managers. Sorting by genetic background will remain unrealistic, however, unless an effective sire line evaluation system for carcass traits is developed. Up until now, sire line evaluation for carcass traits has been relatively unsuccessful and criticized, because of 1) the length of time necessary to collect progeny data, 2) labor and expense and 3) the lack of a consistent management system.

How Important Are Carcass Traits Compared to Live Performance?

Along with carcass traits, it's also well documented that live performance largely affects feedlot cattle profitability. Table 1 reinforces this fact by illustrating the importance of average daily gain and feed efficiency on feedlot economics.

Table 1. **Live Performance of Commercial Feedlot Steers***

Item	Pen Average	Top 25%	Bottom 25%	Top 75%
Initial Wt. (lb.)	770	719	825	722
Final Wt. (lb.)	1109	1197	1027	1136
Daily Gain (lb)	3.38	4.47	2.02	3.84
Feed/Gain (lb.)	8.29	7.33	9.23	7.86
Cost of Gain ($)	45.00	39.25	52.70	42.42
Return/Head ($)	-2.43	61.30	-42.63	35.26

*Data collected in Southwest Kansas by Dr. Scott Laudert, KSU Extension Livestock Specialist.

Notice the tremendous difference that existed in this set of cattle between the top and bottom 25% of the pen in terms of their live performance and subsequent profitability. These data clearly demonstrate that the industry cannot tolerate low performing feedlot cattle and that we must not sacrifice live performance in the effort to improve predictability of carcass traits. Instead, every effort should be made to determine an optimal combination of live performance and carcass traits. To point this out even further, Tables 2 and 3 show the differences in value that can exist in a set of cattle that vary in feed conversion and quality grade.

Table 2. **Feed Cost/LB of Gain at Varying Feed Conversions and Varying Ration Costs**

Feed Conversion DM/lb Gain (lb)	6.0	7.0	8.0	Range Due to Conversion
Cost of DM (/lb)				
4.0	.24	.28	.32	.08
5.0	.30	.35	.40	.10
6.0	.36	.42	.48	.12
7.0	.42	.49	.56	.14
8.0	.48	.56	.64	.16
Range Due to Cost	.24	.28	.32	

Table 3 **Influence of Quality Grade on Carcass Value ***

Select under Choice ($/cwt)	$5.00	$10.00	$15.00
Discount/Carcass ($)	$36.25	$72.50	$108.75
Discount/100 hd ($) % Select in Lot			
10	362.50	725.00	1087.50
20	725.00	1450.00	2175.00
30	1087.50	2175.00	3262.50
40	1450.00	2900.00	4350.00
50	1812.50	3625.00	5437.50

*Choice quality grade is considered ideal;
1150 lbs. x 63% dress = 725 lb carcass

It is evident from these tables that feedlot profitability hinges on cost of production as well as carcass traits such as quality grade. Of course, yield grade and carcass weight are other important carcass traits to consider and can affect carcass value in a similar manner depending on the discounts that are applied.

Can Ultrasound Help Monitor Carcass Traits?

Realizing the importance of carcass traits, cattlemen have become interested in ultrasound as a method of determining body composition in the live animal. The procedure is harmless to the animal and allows selection for carcass traits without slaughtering the animal.

The basic principal of ultrasound is of an echo rebounding from soft tissues. Once the transducer is placed in contact with the animal's back, the ultrasound equipment transfers electrical pulses to high frequency sound waves, hence the name ultrasound. These waves travel into the body and are reflected from boundries between different densities of tissues. The image which the ultrasound waves transmit back through the transducer is projected on the screen of the ultrasound unit and the appropriate measurements are made.

Backfat thickness is measured between the 12th and 13th ribs in cattle and may be measured directly from the screen of the ultrasound unit via internal calipers. Cursors are set at the top and bottom of the backfat layers and the distance between the two cursors is determined automatically.

Loin eye area is also measured between the 12th and 13th ribs. The image is recorded on video tape and traced from the monitor. A planimeter is used to determine the area of the loin muscle. Due to the size of the loin eye area in mature beef cattle, the entire image of loin muscle cannot be projected onto a single screen. Therefore, an ultrasound unit with split-screen capabilities is necessary to measure loin eye area in cattle over 600-700 lbs. The split-screen capability found in some ultra-sound units allows the technician to record images of the medial and lateral halves of the loin muscle and match the halves together into one complete image.

Several researchers have successfully correlated ultrasonic measurements taken from live animals with carcass measurements. (Table 4)

Table 4. **Correlation (r) of Live and Carcass Ultrasonic Measurements to "Actual" Carcass Measurements in Beef Cattle**

Instrument	Researcher/ Location	Measurement	Live (r)	Carcass (r)
Technicare 210 DX	Stouffer/ 1984-85	Marbling	.21	---
		BF	.92	.85
		LEA	.86	.82
	USMARC 1985	BF	.81-.85	.81-.84
		LEA	.47-.50	.70
	Iowa State, 1985	BF*	.42-.82	.43-.84
		LEA	.49-.68	.56-.59
	Turlington, 1987	BF	.82-.86	---

*The author's explanation for the lower correlation coefficients reported in this study was due to lack of variation in backfat of the sample population.

These data would suggest that backfat measurements taken from live beef cattle are relatively accurate in predicting carcass backfat thickness using the Technicare 210 DX Ultrasound equiment. Loin eye area correlations are lower but show potential for accuracy (particularly with the development of split-screen technology).

What Factors Influence the Accuracy of Ultrasound?

Kansas State University and USMARC researchers have theorized that ultrasound measurements are actually more accurate than carcass data collections would indicate. These researchers hypothesized that different configerations might exist in backfat and loin eye area in a standing animal versus a hanging carcass, therefore reducing the correlation between live ultrasonic measurements and carcass measurements. To test this theory, 50 market pigs were measured ultrasonically for backfat and loin eye area, slaughtered, and chilled with one half of each carcass kept is a standing position and one half placed in a hanging position. Table 5 shows the differences that existed in backfat and loin eye measurements for the ultrasonically measured live animal, the hanging carcass and the standing carcass.

Table 5. **LEA and BF-10 Position Comparisons**

	Position[1]			
	Live	Hanging	Standing	P<
LEA (In.2)	5.38[a]	5.52[b]	5.28[c]	.02
BF-10 (In.)	1.19[a]	1.24[b]	1.11[a]	.001

[1]1LSD comparisons made

[abc]Values with different superscripts within row differ significantly by given P value. (Turlington et al., 1988)

Although these data show that differences do exist in fat and muscle configeration when the carcass is placed in a hanging position, it is still important to realize that this is the position carcasses are in when they are evaluated in packing plants. Therefore, since hanging carcasses represent the "real world," a frequency distribution was prepared to compare ultrasonically measured backfat and loin eye area to backfat and loin eye area in hanging carcasses. (Table 6)

Table 6 **Frequency Comparison of Live LEA and BF to Hanging LEA and BF:**

	Cumulative Frequency, %	
In.^{2}or In.	Hanging LEA	Hanging BF
±.05	79	98
±.10	83	100
±.15	86	---
±.20	93	---
±.25	95	---

Turlington et al., 1988)

Even with the differences that existed in configeration between the standing animals and hanging carcasses, the technician in this study was still able to determine loin eye area within 0.25 square inch 95% of the time and backfat within 0.10 inch 100% of the time.

This would indicate that ultrasonic measurements of backfat and loin eye area can be accurate. However, it's important to realize that the accuracy of ultrasound measurements is largely dependent upon operator technique!

How Can Ultrasound Be Used in Commercial Feedlots?

In an effort to improve feedlot efficiency many feedlot managers have expressed an interest in ultrasound technology to 1) sort cattle into the feedlot based on body composition and 2) more efficiently market cattle at a specified body compositional endpoint. To test the effectiveness of this concept a project was initiated by Kansas State University in August of 1987 in cooperation with Decatur County Feed Yard in Oberlin, KS and Hoyt and Sons Ranches in Burns, OR. Although this study also included a sire line component that involved 144 head of steers, the data presented herein will deal with the 706 steers that were sorted into six pens based on incoming measurements of backfat and hip height.

In this study, cattle were received into the feedlot as long-yearlings weighing an average of just over 700 lbs. The cattle were shipped to Kansas in mid-August from Burns, OR., where they had been managed as a group on native range. Once the cattle were received into the feedlot, all steers were subjected to the same management and feeding program for the duration of the trial. Forty-eight hours after reaching the feedlot, the cattle were processed, ultrasonically measured for backfat and loin eye area, measured for hip height, weighed and sorted into pens. This entire process required approximately 30-35 seconds per head and was managed by scanning and taking hip heights in the "on-deck" position located just behind the working chute. This allowed the processing crew to work on the preceeding animal in the working chute without interference. In addition, individual weights were recorded from a digital read out scale which was located on the working chute.

As soon as a backfat measurement and hip height were recorded for each steer a decision was made as to what pen that animal would be placed in. Pen designations were determined by pre-set levels of backfat and hip height which were based on the variation exhibited by a 50 head sample of the group.

The cattle were sorted six ways into the following groups:

1. Light Conditioned - Small Framed
2. Light Conditioned - Large Framed
3. Average Conditioned - Small Framed
4. Average Conditioned - Large Framed
5. Heavy Conditioned - Small Framed
6. Heavy Conditioned - Large Framed

Light conditioned cattle had an initial backfat of .08 inch or less, average conditioned cattle had .12 inch, and heavy conditioned cattle had .16 inch or greater. Small framed cattle had initial hip heights of 46.5 inches or less and large framed cattle were greater than 46.5 inches at the hip.

Performance information that was recorded included gain, feed conversion and days on feed. In addition, bi-monthly backfat measurements and weights were recorded on a 15% sample of each pen once the cattle had been on feed for 70 days.

Once the 15% sample from each pen averaged either .40 inch of backfat or 1300 lbs. of live weight, the entire pen of cattle was slaughtered and complete quality and yield grade data were collected from each individual carcass.

Table 7 relates live performance and carcass traits that were observed by pen. Statistical analysis also revealed that as initial hip height increased, average daily gain increased ($P<.006$) and backfat increased ($P<.006$). In addition, as initial hip height increased by 1.0 inch, days on feed increased by 1.1 days ($P<.001$).In contrast, as initial backfat increased by 0.1 cm (.04 inch), days on feed decreased by 8.5 days ($P<.001$).

In summary, cattle in this study were sorted into pens based on incoming measurements of backfat and hip height. They were slaughtered by pen once a random 15% sample from that pen averaged either .40 inch of backfat or 1300 lbs. live weight. When managed in this manner, days on feed between pens ranged from 83 to 104 days for a 21 day difference. Average backfat at slaughter by pen ranged from .37 to .44 $\pm$ .09 to .13 inches.This indicates that ultrasonic measurements were useful in marketing the cattle at a constant compositional endpoint of .40 inch of backfat. Furthermore, the standard deviations reported here would suggest that the cattle were sorted into relatively uniform pens. In addition, yield grades and marbling scores by pen were very consistent ranging from 2.7 to 3.1 and Sm^{07} to SM^{32}, respectively.

Table 7 **Means of Live and Carcass Traits by Pen**

Item	Light Condition[a] Sm[b]	Light Condition[a] Lg[c]	Average Condition[a] Sm[b]	Average Condition[a] Lg[c]	Heavy Condition[a] Sm[b]	Heavy Condition[a] Lg[c]
No. of Head	128	83	172	165	84	74
Initial Hip Height (in)	45.06	47.74	45.35	47.78	45.36	47.99
Initial Backfat (in)	.08	.08	.12	.12	.16	.16
Initial Weight (lb)	703	777	750	812	790	836
Average Daily Gain (lb)	3.77	4.11	3.80	3.99	3.79	3.84
Days on Feed	104	104	91	97	83	91
Hot Carcass Weight (lb)	683	760	682	754	689	747
Fat Thickness (in)	.40	.39	.41	.37	.43	.44
Loin Eye Area (in^2)	11.3	12.5	11.8	12.4	11.7	12.0
Kidney Knob (%)	2.3	2.2	2.4	1.7	1.4	2.4
Yield Grade	2.9	2.8	2.8	2.7	2.8	3.1
Marbling	Sm 32	Sm 32	Sm 07	Sm 22	Sm 20	Sm 12
Maturity	A 51	A 53	A 47	A 56	A 57	A 48
Quality Grade	Ch-	Ch-	Ch-	Ch-	Ch-	Ch-

[a]Light Condition < .08", Average Condition = .12", Heavy Condition > .16" of backfat on day one of the test.
[b]Sm denotes smaller framed cattle with hip heights < 46.5 on day one of the test.
[c]Lg denotes larger framed cattle with hip heights > 46.5 on day one of the test.
(Perry, Houghton, Allen; Kansas State University)

These results indicate that sorting feeder cattle by backfat and hip height can result in uniform pens of cattle that could be marketed as a group once a predetermined body composition is achieved. In addition, sorting feeder cattle could allow managers to feed cattle of different body types for the appropriate number of days necessary to reach acceptable and consistent yield and quality grades. The net result of marketing more uniform pens of cattle at minimal days on feed should be increased profitability of commercial feedlots.

What is The Future of Ultrasound In the Beef Cattle Industry?

Possibly no other technology has created as much excitement in the beef cattle industry as the recent advancement in ultrasound equipment. There is no doubt that ultrasound can be very useful to cattlemen as the emphasis on carcass traits increases.

Feedlot managers could utilize ultrasound to sort large groups of feeder cattle into uniform pens for feeding and marketing purposes. In addition, they could use ultrasound on fed cattle to help them market groups or individuals in narrow "windows of acceptability." The practicality and economic value of ultrasound, however, will depend on individual management systems and marketing programs. For example, a vertically integrated operation that has large groups of cattle (over 600 head) under one ownership may be able to effectively use ultrasound to sort cattle based on incoming body composition. Likewise, a feedlot that markets a brand name beef item may be interested in incorporating ultrasound into their program.

In breeding cattle programs, ultrasound could help improve selection for carcass traits without requiring animal slaughter. In addition, progeny testing could be made more practical and less expensive if measurements could be taken on progeny at an earlier age and carcass data collection in packing plants were minimized.

These benefits could be of key importance to cattlemen and breed associations who wish to develop EPDs for carcass traits.

As we look at the future use of ultrasound, however, it is important to realize that this technology must be used carefully and correctly. If it is not, breeding and feedlot programs could suffer due to inaccurate measurements and data collection. With this in mind, here are several key considerations:

1. The continued validation of ultrasonic measurements for backfat and loin eye area in beef cattle is necessary.

2. The accuracy of ultrasound measurements is highly related to operator technique. Cattlemen should be sure trained, "certified" technicians are used if they decide to incorporate ultrasound into their programs.

3. Cost, durability and practicality of the equipment needs to be considered.

4. A reliable data base needs to be developed that monitors muscle growth and fat deposition in various biological types of cattle under different management systems.

5. Adjustment factors need to be developed for loin eye area and backfat so that animals can be compared at a constant age and /or weight.

Beef Evaluation with Real Time Ultrasound

J.R. Stouffer

Cornell University

Although ultrasound has been used for evaluating beef cattle for over 25 years, it has only been for the last couple of years that its use has expanded significantly. This is due primarily to the technological development of real time linear array ultrasonic transducers and scanners in the medical field.

Previously a single transducer was used to measure fat depth readings at one point (A-mode) or by time exposure on film of a continuous series of A-modes coordinated with the movement of the transducer over the cattles back (B-scan, Scanogram) to produce a cross section of rib eye and fat thickness. Although the images were reasonably accurate, the technique was too slow and labor intensive to be practical.

Real time ultrasonic transducers represent a major break through because there are 64 linear crystal elements that generate and receive signals 15 times per second, i.e., "real time ultrasound." Therefore a total cross sectional image is produced with a display of the underlying soft tissue with very good clarity and detail.

How can we use this "new tool" to benefit the BEEF INDUSTRY? Simply stated it can benefit all segments; the breeder, producer, feed lot operator, packer, retailer and consumer because of its ability to identify "whats under the hide".

Since fat thickness, rib eye area and marbling are all highly heritable, ultrasound is a very important tool in improving these characteristics in a herd or population as an aid in selection. We have been able to determine these characteristics on live cattle, on the farm or at bull test station, at 25-30 head/hour. Others have demonstrated that it is practical to group uniform feed cattle in pens that have similar fat thickness and frame size and predict the number of days on feed required to market them as Choice 3's.

Preliminary studies have indicated that ultrasound can be used to identify cattle that would have a minimum of seam fat in ribs and chucks. This will be more important as we increase our efforts in supplying beef that meets the consumer's demand.

It has also been demonstrated that we can measure fat thickness and rib eye area of hide-on carcasses at commercial chain speeds of 200-400 per hour. This suggests that instrument grading may be just around the corner. If yield and quality grades are uncoupled ultrasonics could then facilitate hot fat trimming and provide many more processing tools for more efficient handling and processing of beef by management at meat packing plants.

These steps would improve the efficiency and effectiveness of the marketing system and ensure that the producers are getting paid the true value for the beef cattle that they produce.

This ultrasonic technique will be shown through slides and video tapes at the meetings. The actual equipment will also be demonstrated as part of the program.

REFLECTIONS ON 20 YEARS OF THE BEEF IMPROVEMENT FEDERATION

by Frank H. Baker

My family and I traveled through the mountains of Colorado and Wyoming in the early 1960s. We saw many small lakes but none more beautiful than one called Mirror Lake in the Snowy Range -- so named for the beautiful reflections. Last year we saw similar beauty in the reflections in the fjords in Norway. The reflecting pool between the Lincoln and Washington monuments in our national capital provides special opportunities for reflections in the passing of the generations in our national history, just as we are attempting to reflect between eras of beef improvement today.

But reflections can also be deadly. As we learned in military training, the reflections from the lens of binoculars or other glittering objects can provide targets for deadly rifle fire. Reflections can be boring to the disinterested but exciting to the interested -- my children are bored with my stories of the past, but my grandchildren say, "Tell us another story!"

The next few minutes will be a quick review of where we came from, where we are, and maybe where we are going!

Conception, gestation, and birth of BIF occurred during the ferment in the industry in 1966, '67, and '68. Some features of the ferment were the new associations of breeders of newly imported breeds of cattle, new research on germplasm evaluation in the new Meat Animal Research Center, new commercial production concepts based on crossbreeding, artificial insemination as a tool in purebred and commercial herds, relocation of the cattle-feeding and meat-packing facilities from the Midwest to Southwest, and challenges to the usefulness of the showing in cattle improvement. Traditionalists tried to stay in the middle of the road until probable outcomes became more clear, but innovators were saying, "Get the hell out of the middle of the road -- you're blocking progress."

An important facet of BIF in the early years was the creation of a communication network among the many energy sources or power bases for cattle breeding, production, and marketing. BIF became neutral territory where technologies and issues could be examined without any individual or group being compromised. Individuals and organizations could use or disregard information from discussions according to their wishes and policies. Progressive people from the purebred and commercial segments of the industry came together with association leaders, the livestock press, and research and extension leaders to exchange and share ideas. It was the beginning of a communication network that was more important as the concepts and ideas became more complex and sophisticated.

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*Presented at the Beef Improvement Federation meeting, Albuquerque, New Mexico, U.S.A., May 13, 1988.

The success of BIF as a communication network through its annual symposia was evident in the fact that it released and channeled a tremendous amount of enthusiasm and energy for cattle improvement back into the member organizations. In fact, the organization took the form of a beef-industry improvement and development group involved in technology transfer for optimizing cattle improvement. Researchers or the developers of concepts were given the opportunity to become involved in applying their results to the problems of individual breeders and associations, rather than publishing the results in obscure pages of scientific journals and saying, "Go find the answer to your problem; it is in the literature." And many of them liked the experience -- those who didn't stop participating in BIF. Extension specialists and industry professionals -- the transferers of ideas -- found themselves in a rapid-moving transfer process previously unequalled in the beef-cattle educational field. Breeders and commercial producers -- the receivers of new ideas and concepts -- became the review panels for research results. And they liked it because they found usable data and procedures that the researchers offered from experiences in managing the research herds. Soon mutual respect evolved from the interactions among the participants in this improvement, development, and technology-transfer network. The synergism was soon evident in the cooperation among breeders, breed associations, extension specialists, AI personnel, and researchers in committee work in BIF.

We began developing guidelines for improvement programs. We were dealing with measurement of traits and responses to selection. We published the rationale for the measurements and programs as well as the specific procedures and criteria. Today BIF guidelines are still current, dynamic, and relevant because the farsighted group of planners established procedures for continuous review and update of the guidelines. From the committee meetings this year some new recommendations for changes or additions in the guidelines will probably come.

To give you a quick overview of my reflections, I have divided the 20-year BIF history into four periods of 5 years each and looked for the highlights of each.

1968 to 1973:
- Presidents - Clarence Burch, Doug Bennett, Dave Nichols
- Executive director - Frank Baker
- National sire evaluation program and the first National Sire Summaries in three breeds
- BIF Guidelines, first and second editions
- Breeding values for growth

1974 to 1978:
- Presidents - Ray Meyer, Martin Jorgensen, James Bennett
- Executive directors - Frank Baker, Robert DeBaca
- National Sire Summaries in six breeds
- Maternal breeding values
- BIF Guidelines, third edition

1979 to 1983:

- Presidents - Mark Keffler, Jack Farmer, Roger Winn, Steve Radakovich
- Executive directors - Art Linton, A. L. Eller
- Field data analysis in sire summaries
- BIF Guidelines, fourth edition
- Genetic prediction workshop focusing on the animal model

1984 to 1988:

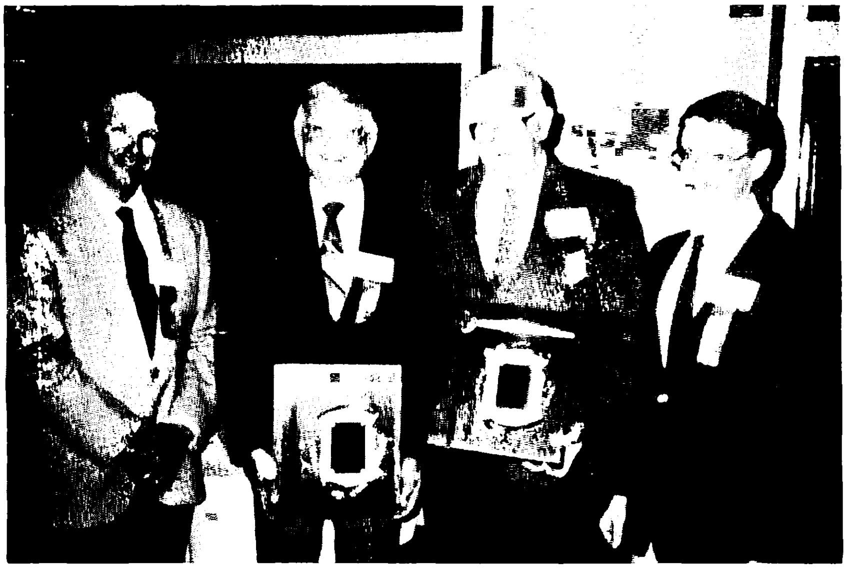
- Presidents - Bill Borror, Gene Schroeder, Henry Gardner, Harvey Lemmon, Bob Dickenson
- Executive directors - A. L. Eller, Roger McCraw
- Animal-model and reduced-animal-model analyses in National Sire Summaries
- BIF Guidelines, fifth edition
- Systems analysis workshop
- Multiple-trait-reduced animal model in National Sire Summaries
- Genetic prediction workshop II

The challenge to BIF is to remain dynamic and move into the twenty-first century with a program attuned to the technology of that era. Embryo transfer, cloning, sexed-semen, gene splicing, super computers, satellite conferences, EPDs for carcass traits are the 1988 issues and buzzwords that were dreams of innovative, forward thinkers of 1968. Beef improvement of the decades ahead can be made by keeping the BIF model relevant, fine-tuning it, and applying it effectively to the accelerated pace of development in the future. How will BIF relate to 1) monclonal-antibody products, 2) vaccines produced by biotechnology, 3) recombinant-DNA-derived protein drugs, 4) fetal diagnostic testing, 5) gene therapy, 6) altered bacteria, and 7) the public attitude about scientific modification of animals? Frankly, I hardly know the definitions of the words, but those of you who aspire to breed cattle in the twenty-first century must learn them and know them well! You can't afford to live in the past. Let us old folks do the reflecting; you must reload, recharge, and respond to your challenges, which are far beyond our wildest dreams when BIF was chartered in 1968 and which are probably beyond our ability to dream and conceptualize today. In other words, you must ignite the next set of booster rockets and get the hell on up the road or up into the sky or wherever the action is. I plan to be at your meeting in 2018 to see where you have gone and how fast you have traveled.

BIF 20th Anniversary Recognition

Presidents of BIF. Pictured (seated, left to right) are Dave Nichols, Martin Jorgensen, Bob Dickinson and Bill Borror. Standing (left to right) are Henry Gardiner, Ray Meyer, Harvey Lemmon and Steve Radakovich.

Executive Directors of BIF. Left to right, Frank Baker, Art Linton, A. L. "Ike" Eller, Jr. and Roger McCraw.



Dixon Hubbard (second from left) and Frank Baker (second from right) received special recognition for their instrumental roles in founding BIF and for their dedicated service during the past twenty years. Bob Dickinson (left), BIF President, and Roger McCraw (right), BIF Executive Director.

MINUTES

Genetic Prediction Committee
May 13, 1988
Albuquerque, New Mexico

Chairman (acting) Larry Benyshek called the meeting to order at 2:30 p.m. in the Salon G-H rooms of the Marriot Hotel in Albuquerque, New Mexico.

BIF Guidelines - Chapter 9 Rewrite

The first order of business was to review a draft rewrite of BIF Guidelines Chapter 9: National Animal Evaluation Program prepared by Richard Willham. Chairman Benyshek appointed R. Willham to serve as Chairman of a subcommittee to finalize the rewrite of Chapter 9 and to have this accomplished by the November 1988 BIF Board Meeting. Those appointed to assist on this subcommittee include: Larry Benyshek, Keith Bertrand, Rick Bourdon, Jim Brinks, John Pollak, Dick Quaas, and Doyle Wilson. Major discussion of the rewrite centered around whether to have this chapter contain detailed procedures (matrix algebra, etc.) or to be more cursory in its presentation. The discussion favored a comprehensive description of currently used procedures. It was also suggested that Section 9.2.2 be more definitive in the description of traits and to include a discussion on gestation length, direct and maternal calving ease, scrotal circumference, and mature size in addition to the growth and carcass traits being evaluated. It was also suggested that procedures for computing interim EPD be included in the rewrite.

Keith Bertrand moved that BIF Guidelines Chapter 9 be comprehensive in its description of currently used animal genetic evaluation methodology and to include a description on back-solving procedures. Motion was seconded. Motion passed unanimously. R. Willham is to make writing assignments to the appointed rewrite subcommittee.

Collection of Carcass Data for Genetic Evaluation

As the second order of business, Larry Corah presented an overview of a relatively new Kansas State centralized testing program for evaluation of feedlot performance and carcass desirability of progeny from known beef sires. The program is designed to help purebred producers and commercial cattlemen identify sire lines superior for carcass merit. This program was initiated as a result of needs expressed at the 1987 BIF Meeting. The presentation by L. Corah covered options for carcass data collection, progress to date, problems and possible opportunities for expansion of the testing to 6 or 8 other locations in the United States. L. Corah asked the committee for their thoughts on this program and whether BIF should become involved in facilitating the expansion of the testing program and develop uniform guidelines for centralized feedlot and carcass testing programs.

Representatives from the Simmental, Polled Hereford, Barzona, and Angus Associations generally stated that they support and promote the concept but that they are not in a position to commit themselves nor their breeders to providing cattle to the testing program. The American Hereford Association supports Kansas State in their effort but will not promote the program to their breeders because they already have in place a live animal evaluation testing program. Most discussion supported the idea of BIF establishing guidelines for both live and carcass data collection programs similar to the Kansas State program.

Bob Schalles moved that Larry Cundiff appoint a subcommittee to expand the BIF guidelines with respect to uniform procedures for collection of live animal and progeny carcass data for use in genetic prediction programs for carcass merit. Motion seconded by J. Brinks. Motion passed unanimously.

Sire Summary Reporting Procedures

The idea of recommending that breed associations publish EPD averages by birth year as an aid to commercial bull buyers was brought before the committee. This idea did not receive any support from the committee. It is felt that EPD distributions of the total population are more informative than would be birth year averages.

Other reporting procedure discussion centered on percentile ranking of bulls, possible change values, and accuracy.

J. Pollak moved that breed associations be uniform in providing (at a minimum) EPD distributions in their sire summaries, but that each association decide for themselves whether to publish percentile rankings of sires. R. Whitman seconded the motion. Motion passed unanimously.

Chairman Benyshek reminded all associations that a recommendation from the Second Beef Genetic Prediction Conference Workshop held in Kansas City, Mo. March 10-11, 1987 called for having EPD distributions, possible change to accuracy conversion tables, and a heritabilities and genetic correlations table included as a part of each sire summary.

Dollar EPDs

The last major topic of discussion centered around the possibility of developing dollar EPD values for bulls listed in sire summaries. There was little support for this idea because of the innumerable combinations of environments and breeding objectives. Chairman Benyshek summarized the discussion by stating this subject area should be allowed to evolve and that BIF not become involved at this time.

Meeting was adjourned by Chairman Benyshek.

Respectfully submitted,

Doyle E. Wilson
Acting Secretary

John Crouch Committee
Live Animal Evaluation

Dr. Robert Long comments

Everyone is in agreement that the beef industry should be concerned about the composition of its product. Excess fat is not acceptable to a health and fitness conscious consumer public. However, the elimination of excess fat without reducing the quality grade resulting in a less desirable product is a real danger. This requires a change in the genetic background of cattle which can only be brought about by accurate selection for improved compositon in our breeding stock.

Ultrasound is one of the methods that is useful in identifying desirable composition. However we must keep in mind the following fact.

No measure of composition, regardless of accuracy, is a useful or legitimate measure unless the cattle in question are of the same sex and age and have been treated alike. Even then, we have to concern ourselves with whether or not the cattle are of the same physiological maturity.

John Crouch comments

A final order of business: Chairman Crouch appointed a special committee consisting of Dr. J. R. Stouffer, Dr. Patsy Houghton and Dr. Lorna Pelton to study and make recommendations to the committee regarding guidelines for the use of ultrasound in measuring carcass traits. Such report is to be available at the BIF mid-year meeting in November 1988.

Central Test Committee Minutes

The Central Test Committee was called to order by chairman Charles McPeake on Friday, May 13, 1988. David Kirkpatrich, University of Tennessee, reported on the use of EPD's in central test reports. A survey was sent to 62 central test stations. Of the 28 respondents, 16 used EPD's in their sale catalog. Sire EPD's are reported by 3 stations; individual EPD's are reported by 7 stations; and 6 stations use both. The most commonly reported EPD's are birth, weaning, yearling and milk.

John Hough, Auburn University, reported on the use of central test data in sire evaluations. There is a problem with the use of data from central test stations since bulls come from different weaning contemporary groups. A subcommittee was named to work on formation of a bull test data bank to be used for research on methods of using central test data. The data bank will also be available for research on future problems. Members of the subcommittee are: Ike Eller, John Hough and Dave Buchanan.

Keith Vandervelde, American Breeder's Service, discussed bulls for use on heifers. Since central tests place an emphasis on gain, it is often difficult to find low birth weight and high maternal bulls. Using maximum birth weight standards for bulls was discussed.

A subcommittee was appointed to revise the central test section of the Guidelines and to develop recommendations for the use of EPD's in central test stations. Members are: John Hough, Ron Bolze, Dave Buchanan and Ronnie Silcox.

A motion was made to set up a core committee of 10-12 members that would be present at future meetings. A list of volunteers was made.

Respectfully Submitted,
Ronnie Silcox, Secretary

On May 13, 1988 at the meeting of the Central Test Committee of BIF, the following people signed up to serve on the core committee in 1988-89:

Ron Bolze (Chairman)
Ohio State University
Room 222
Animal Science Building
Columbus, Ohio 43210

Ronnie Silcox (Secretary)
University of Georgia
Cooperative Extension Service
Landrum Box 8112
Statesboro, Georiga 30460

Carla Gale Nichols
University of Kentucky
804 Ag. Sci-S
Lexington, Kentucky 40546

Keith Zoellner
Kansas State University
Call Hall
Manhattan, Kansas 66506

Larry Olson
Clemson University
Edisto Research & Education Center
Blackville, South Carolina 29817

Scott Hansen
Iowa Cattlemen's Association
123 Airport Road
Ames, Iowa 50010

Jean Hansen
Anjou Hiwa Hawaii Ranch
P O Box 2596
Kailua-Kona, Hawaii 96745

Bill Glanz
Wyoming BCIA
Route 2
Worland, Wyoming 82401

Larry A. Nelson
Purdue University
Animal Science Department
W. Lafayette, Indiana

Bob McGuire
Auburn University
212 ADS Building
Auburn University, Alabama 36849

David Kirkpatrich
University of Tennessee
P O Box 1071
Knoxville, Tennessee 37901

Brian Pogue
Onterio Ministry of Agriculture
P O Box 1030
Guelph, Canada N1H 6N1

David Buchanan
Oklahoma State University
206 Animal Science
Stillwater Oklahoma 78078

Minutes of Beef Improvement Federation
Board of Directors Meeting
May 11 through May 14, 1988
Albuquerque Marriott
Albuquerque, New Mexico

The BIF Board of Directors held two meetings in conjunction with the 1988 Annual Convention at the Albuquerque Marriott in Albuquerque, New Mexico. The first was a dinner meeting held on Wednesday, May 11, from 6:00 p.m to 11:30 p.m. The second was held on Saturday, May 14, from 6:30 a.m. to 7:30 a.m.

Attending the board meeting were Bob Dickinson, president; Jack Chase, vice-president; Roger L. McCraw, executive director; Daryl Strohbehn, Ron Bolze and Doug Hixon, regional secretaries; Frank Baker, John Crouch, Henry Gardiner, Jim Gibb, Bruce Howard, Dixon Hubbard, James H. Leachman, Harvey Lemmon, Craig Ludwig, Marvin Nichols, Keith Vander Velde, Wayne Vanderwert, Roy A. Wallace, Bill Warren, Gary Weber, Richard Whitman, Darrell Wilkes and Leonard Wulf. New directors in attendance were Jim Spawn and Mark Cowan.

Also in attendance were Ron Parker and Bobby Rankin, New Mexico State University; David Kirkpatrick, University of Tennessee; and Charlie McPeake, Oklahoma State University.

Not attending the meeting was Larry Cundiff.

President Dickinson called the meeting to order following dinner, cleared the agenda, and the following items of business were transacted.

Minutes of the mid-year board meeting. Minutes of the mid-year board meeting held November 5, 1987, at the Hilton Airport Plaza Inn in Kansas City, Missouri, were distributed to each director by McCraw. Vander Velde moved that the minutes be approved as written. Wilkes seconded and the minutes were approved.

Treasurer's Report. McCraw provided copies of the treasurer's report for the calendar year 1987 and for 1988 from January 1 to April 30. Copies of these reports are attached. Total assets as of January 1, 1987, amounted to $42,160.52.

Assets on December 31, 1987, totalled $47,259.68. Income for 1987 was $17,226.84. Disbursements were $12,127.68. As of April 30, 1988, balances in accounts were: checking acount, $2,545.18; cash investment account, $5,418.46; certificate of deposit with maturity date of August 24, 1988, and interest rate of 6.85%, $36,359.04; and certificate of deposit maturing January 14, 1989, bearing 6.7% interest, $10,000.00. For the year 1988 through April 30, total income is $10,681.24. Total expenses for the same period are $3,618.24.

Crouch moved acceptance of the treasurer's report. His motion was seconded and carried.

Membership Report. McCraw distributed copies of the membership report, a copy of which is attached. The report showed that 32 state organizations, 22 breed associations and 17 other firms or organizations have paid dues as of May 9, 1987. This total of 72 paid members represents an increase of 20 compared to last year at the same time.

McCraw indicated that he had received a letter from the Montana Beef Performance Association indicating that their organization had disbanded and would no longer be a member of BIF. Baker suggested that McCraw contact the state livestock association or Art Linton about another group in Montana joining.

McCraw stated that he had mentioned in an issue of the *BIF Update* that sustaining memberships were available at $50 per year. As a result of this, eight firms or individuals have paid memberships.

At the mid-year meeting, Bruce Howard suggested that McCraw write a letter soliciting memberships from Canadian organizations and that he would co-sign it and send it. From these efforts, BIF currently has ten Canadian groups as members compared to five last year.

Convention Plans. Ron Parker welcomed the board to New Mexico and gave a review of the plans for the Convention. He noted that several momentos had been prepared to commemorate the 20th Anniversary of BIF. These included designing a special commerative emblem to be used on printed material such as the program, tour guide, luncheon program and proceedings. Key chains featuring this emblem were included in registration packets. Also, inscribed folios, note folders and roller point pens were included.

He indicated that there were about 225 pre-registered for the convention. If there are 265 paid attendees, BIF should break even on the Convention.

He stated that the tour planned for Saturday would make a long day. He estimated that busses should return by 6:00 p.m.; however, one bus and a van are scheduled to return earlier.

Cash contributions to support the tour totalled $1,300. In addition, beef for a barbecue lunch on the tour has been donated.

In his welcoming remarks, Rankin said that it was appropriate for the 20th Anniversary Convention to be held in New Mexico since some of the very early work on performance testing records was done here.

Whitman indicated that 15 groups were planning to have display booths. Nine groups will be making presentations. Weber indicated that 14 states submitted summaries of their activities. Six states will be presenting reports.

Plans for 1989 Convention. David Kirkpatrick indicated that plans are to have the 1989 Convention in Nashville, Tennessee. He discussed possible dates and hotels. He indicated that tours were being planned with some possibilities being the Grand Ole Opry and the Jack Daniels Brewery.

There will not be a trade show in conjunction with the Convention.

Following discussion, Gibb moved that the Convention be held at the Hyatt Regency in Nashville on May 11-14, 1989. Wallace seconded and the motion passed.

Whitman moved that registration fees be set at $65 for the 1989 Convention. Crouch seconded and the motion carried.

Committee activity planned. McCraw reported that since Cundiff was unable to attend, Larry Benyshek will be chairing the meeting of the Genetic Prediction Committee. Revision of the *Guidelines* will be discussed. In addition, Larry Corah will discuss genetic prediction for carcass traits.

John Crouch, chairman of the Live Animal and Carcass Trait Evaluation Committee, has arranged for Jim Stouffer and Patsy Houghton to discuss the use of real-time ultra sound. Bob Long will discuss how carcass evaluation fits in the beef industry.

Charlie McPeake, chairman of the Central Test Committee, indicated that David Kirkpatrick will report on a survey of the use of EPDs in central test reports and catalogs. Larry Benyshek will discuss how central test data may be incorporated into national genetic evaluation programs. Finally, Keith Vander Velde will discuss methods for assuring availability of bulls that can be used on heifers.

Appointment of 1989 Convention program committee. Dickinson appointed the vice-president-elect of BIF as chairman of the program committee. Other members are Ron Bolze, David Kirkpatrick and Ron Parker.

Committee activity for 1989 Convention. McCraw indicated that it has been some time since all the standing committees have met. There has been some criticism also regarding the amount of time allocated for committee activity. He suggested that the program committee take these matters into consideration in planning for next year's meeting.

Meeting site for 1990 Convention. McCraw read a letter of invitation from Brian Pogue and Don Burgomaster of the Ontario Beef Cattle Performance Association. This group was offering to host the 1990 Convention in Ontario. The letter stated that the Ontario Ministry of Agriculture and Food supports their invitation.

Howard said the meeting would probably be held in Toronto or Guelph. Guelph is about a 45-minute drive from the airport in Toronto.

Wallace moved that the board accept the invitation. Crouch seconded. The motion passed.

There was a recommendation from the board that the meeting dates be no later than mid-May, if at all possible.

Revision of *Guidelines*. McCraw reported that some sections of the *Guidelines* have been revised but not reprinted. He also said there were other sections currently being revised and asked for suggestions on how the revised sections should be distributed since we do not have a list of all those who have received copies of the 5th edition.

Ludwig moved that we revise the sections of the *Guidelines* that need to be revised and reprint and distribute the complete booklet. His motion further stipulated that the revisions be made as soon as possible and approved at the next mid-year board meeting. This motion was seconded and approved.

Revision of *Fact Sheets*. Strohbehn reported that most of the *Fact Sheets* need revisions and that some authors have agreed to revise theirs. McCraw indicated that there are numerous requests for these and that they should be revised as soon as possible.

Executive Director position. McCraw stated that he had discussed with Weber and Hubbard his desire for the board to begin considering a replacement. He indicated that he had enjoyed very much his period of service and greatly appreciated the opportunity to serve; however, he informed the board that, due to changes at his university, it would be necessary to relinquish these duties.

President Dickinson asked the nominating committee to make a recommendation on a possible successor. Later in the meeting, this committee reported that they had discussed this position with Charlie McPeake of Oklahoma State University and he had agreed to serve, if elected. He would work with McCraw for the remainder of this year and assume the duties following the 1989 Convention.

Review of BIF letterhead. Dickinson passed a notepad around so board members could list their names the way they want them to appear on the letterhead. Following discussion, the consensus was that only names should be listed and that it would be inappropriate to list affiliations.

Seedstock and Commercial Producer of the Year Nomination. Forms were reviewed. Some judges of the applications had indicated to McCraw that perhaps the forms needed some revisions. Following discussion, the nomination forms in their current versions were approved without revisions.

Canadian and American Divisions for Producer of the Year Awards. McCraw stated that some of the judges suggested that judging the nominees might be done more fairly and easier if the Canadian and American nominees were judged in separate divisions. Discussion indicated no sentiment in favor of two divisions; however, there was a consensus that an effort should be made to involve qualified Canadians as judges of the nominees. McCraw indicated that they would be included in the future.

US-USSR Business Roundtable. McCraw reported that he had received a letter from the US-USSR Business Roundtable requesting that he share information about the organization with BIF members. The Roundtable is involved in promoting trade between the US and USSR. They will provide seminars to groups interested in exporting to the USSR. The letter was available for those who were interested.

Plaques for performance judging contests. McCraw thanked Gibb for again obtaining plaques for the performance classes of the National 4-H and collegiate judging contests. McCraw indicated that organizers of these contests had requested that BIF sponsor the plaques again. The board approved continued sponsorship and Gibb suggested that the local organizers obtain the plaques in the future.

Audit of financial records. McCraw reported that he thought it would be a good idea to have the financial records audited when the directorship changes. He was authorized to have an audit done prior to the next meeting.

Mid-Year Board Meeting. Dickinson requested suggestions on a place and time for the mid-year board meeting. After discussion on meeting places in Kansas City, Strohbehn moved that the meeting be scheduled for November 2-4, 1988, at the Holiday Inn at the Kansas City Airport. The program committees will meet on the afternoon of November 2 and the board meeting will be held on November 3 and half-day on November 4. The motion was seconded and approved.

Other business. Leachman commended the BIF leadership for the meaningful program which accounted for the good attendance of the conference and recommended that another strong program be planned for next year.

He raised a concern about the NAAB proposal of an active A.I. sire list. He felt it was not in the best interests of the industry and that it would have a negative effect on sampling of young sires. Concerns were also expressed by others that it would require bulls to have CSS certification in order to be listed. These concerns were discussed but no action was taken.

Another concern raised by Leachman pertained to ABS announcing their GTS program in the genetic prediction workshop. He stated that it was inappropriate to announce it and BIF should not be viewed as endorsing it. A motion that ABS be informed that the board viewed their announcement as inappropriate and requested that press releases not imply a connection with BIF was made. No action was taken.

Election of officers. Henry Gardiner, chairman of the nominating committee, moved that the following slate of officers be nominated: president, Bob Dickinson; vice-president, Jack Chase. Crouch seconded. Dickinson opened the floor for other nominations. Lemmon moved that nominations cease and the above slate be elected. Motion was seconded and carried.

Roy Wallace moved that Charlie McPeake be elected executive director to begin serving following the 1989 Convention. Crouch seconded and the motion passed.

Awards at 1988 Convention. The following awards were presented:

Seedstock Producer of the Year - W. T. "Bill" Bennett, Washington

Commercial Producer of the Year - Gary V. Johnson, Kansas

Continuing Service Award - Bruce Howard, Agriculture Canada

Ambassador Award - Fred Knop, *Drover's Journal*

Pioneer Awards - George F. and Mattie Ellis, New Mexico; A. F. "Frankie" Flint, New Mexico; Christian A. Dinkel, South Dakota

Two special awards were presented. They were presented to Frank Baker, Winrock International (Arkansas) and Dixon Hubbard, USDA-ES (Washington, D.C.) for their roles in founding BIF and for 20 years of service on the board of directors.

Respectfully submitted,

Roger L. McCraw

Roger L. McCraw
BIF Executive Director

Beef Improvement Federation
Financial Status - Calendar Year 1987
by

Roger L. McCraw

Assets	*1-1-87*	*12-31-87*
Checking Account	$ 1,471.36	$ 7,354.43
Money Market Account	689.16	3,745.95
Certificates of Deposit	40,000.00	36,159.30
	$42,160.52	$47,259.68

1987 BIF Income

Dues	$ 7,500.00
Proceedings	448.90
Guidelines	177.00
Interest	2,219.92
Annual Convention	6,881.02
	$17,226.84

1987 BIF Expenses

Salary and Taxes (office secretary)	$ 2,213.02
Office Supplies	97.62
Postage	1,863.21
Printing	
Programs/Certificates	507.70
Proceedings	1,861.65
Updates, other	381.15
Awards Plaques, engraving, photos	440.15
Convention Speakers' Travel:	
Darrell Wilkes	300.00
J. W. Turner	436.00
Dave Buchanan	103.40
Lamar Reynolds	484.96
Del Allen	149.10
Gary Bennett	127.35
Larry Cundiff	178.50
Fees for transferring funds	25.00
Directors' Travel	1,835.87
Mid-Year Board Meeting (Hilton Inn)	931.56
Checking a/c, service charge	5.00
Plaques-Nat'l Livestock Judging Contest-Louisville	157.85
Discount on Canadian checks	28.59
	$12,127.68

Beef Improvement Federation

Financial Status - January 1, 1988 - April 30, 1988

Assets

Checking Account	$ 2,545.18
Money Market	5,418.46
Certificates of Deposit	
(1) 6.85% - 8/24/88	36,359.04
(2) 6.70% - 1/14/89	10,000.00
	$ 54,322.68

Income

Dues	$ 9,878.50
Proceedings	101.00
Guidelines	159.00
Coffee Break Sponsors	200.00
Refund (Crestline)	25.49
Interest* (Cash Inv. Act. - 5.5% var.)	317.25
	$ 10,681.24

Expenses

Salary and Taxes (Office Secretary)	$ 1,263.00
Office Supplies	76.61
Postage	568.23
BIF Convention Programs	435.75
Folios, pens, ribbons - BIF Convention	1,084.90
Discount on Canadian Checks	49.89
Dept. of State - Colorado	10.00
Carpenter and Klatskin	45.00
Printing - Updates	73.50
Telephone	11.36
	$ 3,618.24

PAID
BIF MEMBER ORGANIZATIONS AND AMOUNT FOR DUES - 1988 AS OF MAY 9, 1988

State BCIA's	*Dues*
Alabama	$100.00
Buckeye Beef (Ohio)	$100.00
California	$100.00
Florida	$100.00
Georgia	$100.00
Hawaii	$100.00
Idaho	$100.00
Illinois	$100.00
Indiana	$100.00
Iowa	$100.00
Kansas	$100.00
Kentucky	$100.00
Minnesota	$100.00
Mississippi	$100.00
Missouri	$100.00
New Mexico	$100.00
New York	$100.00
North Carolina	$100.00
North Dakota	$100.00
Northeast Kentucky	$100.00
Oklahoma	$100.00
Oregon	$100.00
Pennsylvania	$100.00
South Carolina	$100.00
Tennessee	$100.00
Texas	$100.00
Utah	$100.00
Virginia	$100.00
Washington	$100.00
West Virginia	$100.00
Wisconsin	$100.00
Wyoming	$100.00
Breed Associations	
American Angus	$600.00
American Brahman	$300.00
American Chianina	$200.00
American Gelbvieh	$200.00
American Hereford	$500.00
American Int'l Charolais	$300.00
American Polled Hereford	$500.00
American Red Poll	$100.00
American Salers	$200.00
American Shorthorn	$200.00
American Simmental	$300.00
American Tarentaise	$100.00
Beefmaster Breeders	$300.00
Canadian Aberdeen-Angus	$ 50.00
Canadian Charolais	$200.00
Canadian Hereford	$100.00
Canadian Simmental	$100.00
Int'l Brangus Breeders	$300.00
North American Limousin	$300.00
Red Angus	$200.00
Salers Assoc. of Canada	$100.00
Santa Gertrudis Breeders	$300.00
Others	
Agricultural Business Research Institute	$ 50.00
Agricultural Canada	$100.00
American Breeders Service	$100.00
Beefbooster Cattle Lt'd	$100.00
Great Western Beef Expo	$ 50.00
King Ranch	$ 50.00
Manitoba Agriculture	$100.00
Nat'l Assoc. of Animal Breeders	$100.00
National Cattlemen's Assoc.	$100.00
NOBA, Inc.	$100.00
Rancho Arboleda	$ 50.00
Saskatchewan Livestock Assoc.	$ 50.00
Ronald Schlegel	$ 50.00
Select Sires, Inc.	$100.00
Taylors Black Simmentals	$ 50.00
Turner Bros. Farms, Inc.	$ 50.00
21st Century Genetics	$100.00

BIF MEMBERS WHO HAVE NOT PAID MEMBERSHIP DUES FOR 1988, as of MAY 9, 1988

State BCIA's	*Dues*
South Dakota	$100.00
Breed Associations	
Simmentalers	$100.00
Others	
Alberta Agriculture	$ 50.00

The Seedstock Breeder Honor Roll of Excellence

John Crowe	CA	1972
Dale H. Davis	MT	1972
Elliot Humphrey	AZ	1972
Jerry Moore	OH	1972
James D. Bennett	VA	1972
Harold A. Demorest	OH	1972
Marshall A.Mohler	IN	1972
Billy L. Easley	KY	1972
Messersmith Herefords	NE	1973
Robert Miller	MN	1973
James D.Hemmingsen	IA	1973
Clyde Barks	ND	1973
C. Scott Holden	MT	1973
William F. Borror	CA	1973
Raymond Meyer	SD	1973
Heathman Herefords	WA	1973
Albert West III	TX	1973
Mrs. R. W. Jones, Jr.	GA	1973
Carlton Corbin	OK	1973
Wilfred Dugan	MO	1974
Bert Sackman	ND	1974
Dover Sindelar	MT	1974
Jorgensen Brothers	SD	1974
J. David Nichols	IA	1974
Bobby Lawrence	GA	1974
Marvin Bohmont	NE	1974
Charles Descheemaeker	MT	1974
Bert Crame	CA	1974
Burwell M. Bates	OK	1974
Maurice Mitchell	MN	1974
Robert Arbuthnot	KS	1975
Glenn Burrows	NM	1975
Louis Chesnut	WA	1975
George Chiga	OK	1975
Howard Collins	MO	1975
Jack Cooper	MT	1975
Joseph P. Dittmer	IA	1975
Dale Engler	KS	1975
Leslie J. Holden	MT	1975
Robert D. Keefer	MT	1975
Frank Kubik, Jr.	ND	1975
Licking Angus Ranch	NE	1975
Walter S. Markham	CA	1975
Gerhard Mittnes	KS	1976
Ancel Armstrong	VA	1976
Jackie Davis	CA	1976
Sam Friend	MO	1976
Healy Brothers	OK	1976
Stan Lund	MT	1976
Jay Pearson	ID	1976
L. Dale Porter	IA	1976
Robert Sallstrom	MN	1976
M. D. Shepherd	ND	1976
Lowellyn Tewksbury	ND	1976
Harold Anderson	SD	1977
William Borror	CA	1977
Rob Brown, Simmental	TX	1977
Glenn Burrows, PRI	NM	1977
Henry, Jeanette Chitty	FL	1977
Tom Dashiell, Hereford	WA	1977
Lloyd DeBruycker	MT	1977
Wayne Eshelman	WA	1977
Hubert R. Freise	ND	1977
Floyd Hawkins	MO	1977
Marshall A. Mohler	IN	1977
Clair Percel	KS	1977
Frank Ramackers, JR.	NE	1977
Loren Schlipf	IL	1977
Tom & Mary Shaw	ID	1977
Bob Sitz	MT	1977
Bill Wolfe	OR	1977
James Volz	MN	1977
A. L. Frau		1978
George Becker	ND	1978
Jack Delaney	MN	1978
L. C. Chestnut	WA	1978
James D. Benett	VA	1978
Healey Brothers	OK	1978
Frank Harpster	MO	1978
Bill Womack, Jr.	AL	1978
Larry Berg	IA	1978
Buddy Cobb	MT	1978
Bill Wolfe	OR	1978
Roy Hunt	PA	1978
Del Krumwied	ND	1979
Jim Wolf	NE	1979
Rex & Joann James	IA	1979
Leo Schuster Family	MN	1979
Bill Wolfe	OR	1979
Jack Ragsdale	KY	1979
Floyd Mette	MO	1979
Glenn & David Gibb	IL	1979
Peg Allen	MT	1979
Frank & Jim Willson	SD	1979
Donald Barton	UT	1980
Frank Felton	MO	1980
Frank Hay	CAN	1980
Mark Keffeler	SD	1980
Bob Laflin	KS	1980
Paul Mydland	MT	1980
Richard Tokach	ND	1980
Roy & Don Udelhoven	WI	1980
Bill Wolfe	OR	1980
John Masters	KY	1980
Floyd Dominy	VA	1980
James Bryan	MN	1980
Charlie Richards	IA	1980
Blythe Gardner	UT	1980

Richard McLaughlin	IL	1980
Bob Dickinson	KS	1981
Clarence Burch	OK	1981
Lynn Frey	ND	1981
Harold Thompson	WA	1981
James Leachman	MT	1981
J. Morgan Donelson	MO	1981
Clayton Canning	CAN	1981
Russ Denown	MT	1981
Dwight Houff	VA	1981
G. W. Cornwell	IA	1981
Bob & Gloria Thoma	OR	1981
Roy Beeby	OK	1981
Herman Schaefer	IL	1981
Myron Aultfathr	MN	1981
Jack Ragsdale	KY	1981
W. B. Williams	IL	1982
Garold Parks	IA	1982
David A. Breiner	KS	1982
Joseph S. Bray	KY	1982
Clare Geddes	CAN	1982
Howard Krog	MN	1982
Harlin Hecht	MN	1982
Willard Kottwitz	MO	1982
Larry Leonhardt	MT	1982
Frankie Flint	NM	1982
Gary & Gerald Carlson	ND	1982
Bob Thomas	OR	1982
Orville Stangl	SD	1982
C. Ancel Armstrong	KS	1983
Bill Borror	CA	1983
Charles E. Boyd	KY	1983
John Bruner	SD	1983
Leness Hall	WA	1983
Ric Hoyt	OR	1983
E. A. Keithley	MO	1983
J. Earl Kindig	MO	1983
Jake Larson	ND	1983
Harvey Lemmon	GA	1983
Frank Myatt	IA	1983
Stanley Nesemeier	IL	1983
Russ Pepper	MT	1983
Robert H. Schafer	MN	1983
Alex Stauffer	WI	1983
D. John & Lebert Shultz	MO	1983
Phillip A. Abrahamson	MN	1984
Rob Bieber	SD	1984
Jerry Chappell	VA	1984
Charles W. Druin	KY	1984
Jack Farmer	CA	1984
John B. Green	LA	1984
Ric Hoyt	OR	1984
Fred H. Johnson	OH	1984
Earl Kindig	VA	1984
Glen Klippenstein	MO	1984
A. Harvey Lemmon	GA	1984

Lawrence Meyer	IL	1984
Donn & Sylvia Mitchell	CAN	1984
Lee Nichols	IA	1984
Clair K. Parcel	KS	1984
Joe C. Powell	NC	1984
Floyd Richard	ND	1984
Robert L. Sitz	MT	1984
Ric Hoyt	OR	1985
J. Newbill Miller	VA	1985
George B. Halterman	WV	1985
Davis McGehee	KY	1985
Glenn L. Brinkman	TX	1985
Gordon Booth	WY	1985
Earl Schafer	MN	1985
Marvin Knowles	CA	1985
Fred Killam	IL	1985
Tom Perrier	KS	1985
Don W. Schoene	MO	1985
Everett & Ron Batho & Families	CAN	1985
Bernard F. Pedretti	WI	1985
Arnold Wienk	SD	1985
R. C. Price	AL	1985
Clifford & Bruce Betzold	IL	1986
Gerald E. Hoffman	SD	1986
Delton W. Hubert	KS	1986
Dick & Ellie Larson	WI	1986
Leonard Lodden	ND	1986
Ralph McDanolds	VA	1986
Roy D. McPhee	CA	1986
W. D. Morris & James Pipkin	MO	1986
Clarence Van Dyke	MT	1986
John H. Wood	SC	1986
Evin & Verne Dunn	CAN	1986
Gknn L. Brinkman	KS	1986
Jack & Gini Chase	WY	1986
Henry & Jeannette Chitty	FL	1986
Lawrence H. Graham	KY	1986
A. Lloyd Grau	NM	1986
Mathew Warren Hall	AL	1986
Richard J. Putnam	NC	1986
Robert J. Steward & Patrick C. Morrissey	OR	1986
Leonard Wulf	MN	1986
Charles & Wynder Smith	GA	1987
Lyall Edgerton	CAN	1987
Tommy Branderberger	TX	1987
Henry Gardiner	KS	1987
Gary Klein	ND	1987
Ivan & Frank Rincker	IL	1987
Larry D. Leonhardt	WY	1987
Harold E. Pate	AL	1987
Forrest Byergo	MO	1987
Clayton Canning	CAN	1987

James Bush	SD	1987	Leonard Lorenzen	OR	1988
Robert J. Steward &			George Schlickau	KS	1988
Patrick C. Morrissey	OR	1987	Hans Ulrich	CAN	1988
Eldon & Richard Wiese	MN	1987	Donn & Sylvia Mitchell	CAN	1988
Douglas D. Bennett	TX	1988	Darold Bauman	WY	1988
Don & Diane Guilford &			Glynn Debter	AL	1988
David & Carol Guilford	CAN	1988	William Glanz	WY	1988
Kenneth Gillig	MO	1988	Jay P. Book	IL	1988
Bill Bennett	WA	1988	David Luhman	MN	1988
Hansell Pile	KY	1988	Scot Burtner	VA	1988
Gino Pedretti	CA	1988	Robert E. Walton	WS	1988

Seedstock Breeder of the Year

John Crowe	CA	1972
Mrs. R. W. Jones	GA	1973
Carlton Corbin	OK	1974
Leslie J. Holden	MT	1975
Jack Cooper	MT	1975
Jorgensen Brothers	SD	1976
Glenn Burrows	NM	1977
James D. Bennett	VA	1978
Jim Wolf	NE	1979
Bill Wolfe	OR	1980
Bob Dickinson	KS	1981
A. F. "Frankie" Flint	NM	1982
Bill Borror	CA	1983
Lee Nichols	IA	1984
Ric Hoyt	OR	1985
Leonard Lodoen	ND	1986
Henry Gardiner	KS	1987
W. T. "Bill" Bennett	**WA**	**1988**

The Commercial Producer Honor Roll of Excellence

Chan Cooper	MT	1972	Victor Arnaud	MO	1978
Alfred B. Cobb, Jr.	MT	1972	Ron & Malcolm McGregor	IA	1978
Lyle Eivens	IA	1972	Otto Uhrig	NE	1978
Broadbent Brothers	KY	1972	Arnold Wyffels	MN	1978
Jess Kilgore	MT	1972	Bert Hawkins	OR	1978
Clifford Ouse	MN	1973	Mose Tucker	AL	1978
Pat Wilson	FL	1973	Dean Haddock	KS	1978
John Glaus	SD	1973	Myron Hoeckle	ND	1979
Sig Peterson	ND	1973	Harold & Wesley Arnold	SD	1979
Max Kiner	WA	1973	Ralph Neill	IA	1979
Donald Schott	MT	1973	Morris Kuschel	MN	1979
Stephen Garst	IA	1973	Bert Hawkins	OR	1979
J. K. Sexton	CA	1973	Dick Coon	WA	1979
Elmer Maddox	OK	1973	Jerry Northcutt	MO	1979
Marshall McGregor	MO	1974	Steve McDonnell	MT	1979
Lloyd Mygard	ND	1974	Doug Vandermyde	IL	1979
Dave Matti	MT	1974	Norman, Denton &		
Eldon Wiese	MN	1974	Calvin Thompson	SD	1979
Lloyd DeBruycker	MT	1974	Jess Kilgore	MT	1980
Gene Rambo	CA	1974	Robert & Lloyd Simon	IL	1980
Jim Wolf	NE	1974	Lee Eaton	MT	1980
Henry Gardiner	KS	1974	Leo & Eddie Grubl	SD	1980
Johnson Brothers	SD	1974	Roger Winn, Jr.	VA	1980
John Blankers	MN	1975	Gordon McLean	ND	1980
Paul Burdett	MT	1975	Ed Disterhaupt	MN	1980
Oscar Burroughs	CA	1975	Thad Snow	CAN	1980
John R. Dahl	ND	1975	Oren & Jerry Raburn	OR	1980
Eugene Duckworth	MO	1975	Bill Lee	KS	1980
Gene Gates	KS	1975	Paul Moyer	MO	1980
V. A. Hills	KS	1975	G. W. Campbell	IL	1981
Robert D. Keefer	MT	1975	J. J. Feldmann	IA	1981
Kenneth E. Leistritz	NE	1975	Henry Gardiner	KS	1981
Ron Baker	OR	1976	Dan L. Weppler	MT	1981
Dick Boyle	ID	1976	Harvey P. Wehri	ND	1981
James D. Hackworth	MO	1976	Dannie O'Connell	SD	1981
John Hilgendorf	MN	1976	Wesley & Harold Arnold	SD	1981
Kahua Ranch	HI	1976	Jim Russell & Rick Turner	MO	1981
Milton Mallery	CA	1976	Oren & Jerry Raburn	OR	1981
Robert Rawson	IA	1976	Orin Lamport	SD	1981
William A. Stegner	ND	1976	Leonard Wulf	MN	1981
U.S. Range Exp. Sta.	MT	1976	Wm. H. Romersberger	IL	1982
John Blankers	MN	1977	Milton Krueger	MO	1982
Maynard Crees	KS	1977	Carl Odegard	MT	1982
Ray Franz	MT	1977	Marvin & Donald Stoker	IA	1982
Forrest H. Ireland	SD	1977	Sam Hands	KS	1982
John A. Jameson	IL	1977	Larry Campbell	KY	1982
Leo Knoblauch	MN	1977	Lloyd Atchison	CAN	1982
Jack Pierce	ID	1977	Earl Schmidt	MN	1982
Mary & Stephen Garst	IA	1977	Raymond Josephson	ND	1982
Odd Osteross	ND	1978	Clarence Reutter	SD	1982
Charles M. Jarecki	MT	1978	Leonard Bergen	CAN	1983
Jimmy G. McDonnal	NC	1978	Kent Brunner	KS	1983

Tom Chrystal	IA	1983	Kenneth Bentz	OR	1986
John Freitag	WI	1983	Gary Johnson	KS	1986
Eddie Hamilton	KY	1983	Ralph G. Lovelady	AL	1986
Bill Jones	MT	1983	Ramon H. Oliver	KY	1986
Harry & Rick Kline	IL	1983	Kay Richardson	FL	1986
Charlie Kopp	OR	1983	Mr. & Mrs. Clyde Watts	NC	1986
Duwayne Olson	SD	1983	David & Bev Lischka	CAN	1986
Ralph Pederson	SD	1983	Dennis &Nancy Daly	WY	1986
Ernest & Helen Schaller	MO	1983	Carl & Fran Dobitz	SD	1986
Al Smith	VA	1983	Charles Fariss	VA	1986
John Spencer	CA	1983	David J. Forster	CA	1986
Bud Wishard	MN	1983	Danny Geersen	SD	1986
Bob & Sharon Beck	OR	1984	Oscar Bradford	AL	1987
Leonard Fawcett	SD	1984	R. J. Mawer	CAN	1987
Fred & Lee Kummerfeld	WY	1984	Rodney G. Oliphant	KS	1987
Norman Coyner & Sons	VA	1984	David A. Reed	OR	1987
Franklyn Esser	MO	1984	Jerry Adamson	NE	1987
Edgar Lewis	MT	1984	Gene Adams	GA	1987
Boyd Mahrt	CA	1984	Hugh & Pauline Maize	SD	1987
Don Moch	ND	1984	P.T. McIntire & Sons	VA	1987
Neil Moffat	CAN	1984	Frank Disterhaupt	MN	1987
William H. Moss, Jr.	GA	1984	Mac, Don & Joe Griffith	GA	1988
Dennis P. Solvie	MN	1984	Jerry Adamson	NE	1988
Robert P. Stewart	KS	1984	Ken, Wayne & Bruce Gardiner	CAN	1988
Charlie Stokes	NC	1984	C. L. Cook	MO	1988
Milton Wendland	AL	1985	C.M. & D.A. McGee	IL	1988
Bob & Sheri Schmidt	MN	1985	William E. White	KY	1988
Delmer & Joyce Nelson	IL	1985	Frederick M. Mallory	CA	1988
Harley Brockel	SD	1985	Stevenson Farmily	OR	1988
Kent Brunner	KS	1985	Gary Johnson	KS	1988
Glenn Harvey	OR	1985	John McDaniel	AL	1988
John Maino	CA	1985	William A. Stegner	ND	1988
Ernie Reeves	VA	1985	Lee Eaton	MT	1988
John E. Rouse	WY	1985	Larry D. Cundall	WY	1988
George and Thelma Boucher	CAN	1985	Dick & Phyllis Henze	MN	1988

Commercial Producer of the Year

Chan Cooper	MT	1972
Pat Wilson	FL	1973
Lloyd Nygard	ND	1974
Gene Gates	KS	1975
Ron Bake	OR	1976
Steve & Mary Garst	IA	1977
Mose Tucker	AL	1978
Bert Hawkins	OR	1979
Jeff Kilgore	MT	1980
Henry Gardiner	KS	1981
Sam Hands	KS	1982
Al Smith	VA	1983
Bob & Sharon Beck	OR	1984
Glenn Harvey	OR	1985
Charles Fariss	VA	1986
Rodney G. Oliphant	KS	1987
Gary Johnson	**KS**	**1988**

Ambassador Award

Warren Kester	*Beef Magazine*	MN	1986
Chester Peterson	*Simmental Shield*	KS	1987
Fred Knop	***Drover's Journal***	**KS**	**1988**

Pioneer Awards

Jay L. Lush	Iowa State University	Research	1973
John H. Knox	New Mexico State University	Research	1973
Ray Woodward	American Breeders Service	Research	1974
Fred Willson	Montana State University	Research	1974
Charles E. Bell, Jr.	USDA-FES	Education	1974
Reuben Albaugh	University of California	Education	1974
Paul Pattengale	Colorado State University	Education	1974
Glenn Butts	Performance Registry Int'l	Service	1975
Keith Gregory	RHLUSMARC	Research	1975
Bradford Knapp, Jr.	USDA	Research	1975
Forrest Bassford	Western Livestock Journal	Journalism	1976
Doyle Chambers	Louisiana State University	Research	1976
Mrs. Waldo Emerson Forbes	Wyoming Breeder	Breeder	1976
C. Curtis Mast	Virginia BCIA	Education	1976
Dr. H. H. Stonaker	Colorado State University	Research	1977
Ralph Bogart	Oregon State University	Research	1977
Henry Holszman	South Dakota State University	Education	1977
Marvin Koger	University of Florida	Research	1977
John Lasley	University of Missouri	Research	1977
W. L. McCormick	Tifto, Georgia Test Station	Research	1977
Paul Orcutt	Montana Beef Performance Assn	Education	1977
J. P. Smith	Performance Registry Int'l	Education	1977
James B. Lingle	Wye Plantation	Breeder	1978
R. Henry Mathiessen	Virginia Breeder	Breeder	1978
Bob Priode	VPI & SU	Research	1978
Robert Koch	RLHUSMARC	Research	1979
Mr.and Mrs. Carl Roubicek	University of Arizona	Research	1979
Joseph J. Urick	U. S. Range Livestock Experiment Station	Research	1979
Byron L. Southwell	Georgia	Research	1980
Richard T. "Scotty" Clark	USDA	Research	1980
F. R. "Ferry" Carpenter	Colorado	Breeder	1980
Clyde Reed	Oklahoma State University		1981
Milton England	Panhandle A&M College		1981
L. A. Moddox	Texas A&M University		1981
Charles Pratt	Oklahoma		1981
Otha Grimes	Oklahoma		1981
Mr. and Mrs. Percy Powers	Texas		1982
Gordon Dickerson	Nebraska		1982
Jim Elings	California		1983
Jim Sanders	Nevada		1983
Ben Kettle	Colorado		1983
Carroll O. Schoonover	University of Wyoming		1983
W. Dean Frischknecht	Oregon State Unviersity		1983
Bill Graham	Georgia		1984
Max Hammond	Florida		1984
Thomas J. Marlowe	VPI&SU		1984
Mick Crandell	South Dakota State University		1985

Mel Kirkiede	North Dakota State University	1985
Charles R. Hendeson	Cornell University (retired)	1986
Everett J. Warwick	USDA-ARS (retired)	1986
Glenn Burrows	New Mexico	1987
Carlton Corbin	Oklahoma	1987
Murray Corbin	Oklahoma	1987
Max Deets	Kansas	1987
George F. & Mattie Ellis	**New Mexico**	**1988**
A. F. "Frankie" Flint	**New Mexico**	**1988**
Christian A. Dinkel	**South Dakota State University (retired)**	**1988**

Continuing Service Awards

Clarence Burch	OK	1972
F. R. Carpenter	CO	1973
E. J. Warwick	DC	1973
Robert De Baca	IA	1973
Frank H. Baker	OK	1974
D. D. Bennett	OR	1974
Richard Willham	IA	1974
Lkarry V. Cundiff	NE	1975
Dixon D. Hubbard	DC	1975
J. David Nichols	IA	1975
A. L. Eller, Jr.	VA	1976
Ray Meyer	SD	1976
Don Vaniman	MT	1977
Lloyd Schmitt	MT	1977
Martin Jorgensen	SD	1978
James S. Brinks	CO	1978
Paul D. Miller	WI	1978
C. K. Allen	MO	1979
William Durfey	NAAB	1979
Glenn Butts	PRI	1980
Jim Gosey	NE	1980
Mark Keffeler	SD	1981
J. D. Mankin	ID	1982
Art Linton	MT	1983
James Bennett	VA	1984
M. K. Cook	GA	1984
Craig Ludwig	MO	1984
Jim Glenn	IBIA	1985
Dick Spader	MO	1985
Roy Wallace	OH	1985
Larry Benyshek	GA	1986
Ken W. Ellis	CA	1986
Earl Peterson	MT	1986
Bill Borror	CA	1987
Daryl Strohbehn	IA	1987
Jim Gibb	MO	1987
Bruce Howard	**CAN**	**1988**

Organizations of the Year

Beef Improvement Committee, Oregon Cattlemen's Association	1972
South Dakota Livestock Production Records Association	1973
American Simmental Association, Inc.	1974
American Simmental Association, Inc. (Breed)	1975
Iowa Beef Improvement Association (BCIA)	1975
The American Angus Association (Breed)	1976
The North Dakota Beef Cattle Improvement Association (BCIA)	1976
The American Angus Association (Breed)	1977
The Iowa Beef Improvement Association (BCIA)	1977
The American Hereford Association (Breed)	1978
Beef Performance Committee of Cattlemen's Association	1978
The Iowa Beef Improvement Association (BCIA)	1979

1988 BIF SEEDSTOCK PRODUCER OF THE YEAR NOMINEES

1. **DAROLD BAUMAN**, Bauman Ranch, Carpenter, Wyoming. Nominated by the American International Charolais Association. Twenty-eight years in the seedstock business with 350-cow Charolais herd. Uses AI and embryo transfer to increase genetic progress. Uses central tests to evaluate and market bulls. Nineteen years of Charolais Association performance records document the progress made at Bauman Ranch. 1988 American International Charolais Association Outstanding Commercial Producer Award. Member Rocky Mountain Charolais Association and American International Charolais Association.

2. **BILL BENNETT**, BB Cattle Company, Connell, Washington. Nominated by Washington Cattlemen's Association and Oregon, Washington, and Northern Idaho Hereford Association. Twenty-five years in the Hereford and Braford seedstock business; 25 years of performance records on his herd of 1,200 Herefords and 1,200 Brafords have increased both weaning and yearly weights by over 100 pounds. Uses National Breed Summaries to select AI sires. Uses on-the-farm test to evauate his bull calves. Was an early proponent of evaluating carcass merit and continues to place much emphasis on carcass merit in his breeding program. Serves on board of directors of American Hereford Association chairman of Total Performance Records Committee for Hereford Association. First chairman of Beef Improvement Committee of Washington Cattlemen's Association. Served on board of directors of Washington Cattlemen's Association; vice-president of Washington Cattlemen's Association. Premier Breeders Award 1985, 1986, 1987 (Northwest) American Hereford Association.

3. **DOUGLAS D. BENNETT**, Lone Star Hereford Ranch, Henrietta, Texas. Nominated by Texas Agricultural Extension Service. Ten years in the seedstock business with herd of 450 Hereford cows. Uses the Hereford Association's performance programs to monitor herd's progress. Sire summary information is used to select herd sires. Embryo transfer is used on a limited basis to multiply genetics of top individuals. Is a frequent consignor of bulls to central test stations. Has served on the board of directors and as president of the National Beef Improvement Federation. Served on the executive board of the American Hereford Association; the executive board of the Texas Hereford Association, and as district chairman for Beef Checkoff in Texas.

4. **JAY P. BOOK**, Northland Farms, Sterling, Illinois. Nominated by the Cooperative Extension Service of Illinois. Eight years in the seedstock business with herd of 65 Simmental cows. Runs an on-the-farm bull test in addition to consigning bulls to several central test stations. Information from sire summary is used to select AI sires. Estrus synchronization is used to expedite AI breeding. Embryo transfer is used to accelerate breeding program. Uses American Simmental Association and Illinois Beef Improvement Association performance records to monitor herd's performance. 1987 Illinois Seedstock Producer of the Year; member American Simmental Association, the Illinois Simmental Association, the Illinois Beef Association, the National Cattlemen's Association, and the Whiteside County Livestock Feeders Association.

5. **SCOT BURTNER**, Bunker Hill Farm, Mt. Solon, Virginia. Nominated by the Virginia Beef Cattle Improvement Association. The family has been in cattle business for 65 years with their 225-cow Simmental herd developed since 1970. Breeding program is designed specifically for the commercial producer. Performance records have allowed for selection of medium frame, high maternal, black factor polled Simmentals. About 60 bulls are marketed annually through Virginia's BCIA All Breed Performance Tested Bull Sales and at private treaty. Served as vice-president and president of the Virginia Beef Cattle Improvement Association and has served three terms as president of Virginia Simmental Association. 1984 Northern Virginia Outstanding Young Farm Family Award; 1988 Virginia Seedstock Producer of the Year.

6. **GLYNN DEBTER**, Debter Hereford Farm, Horton, Alabama. Nominated by Alabama Beef Cattle Improvement Association. Forty years in the seedstock business with a herd of 225 Hereford cows. Twenty-five years of performance records are used to evaluate each animal's performance. Top-producing cows are used in an embryo transfer program to multiply progeny of proven cows. An on-farm bull testing program is used to evaluate all but a few bulls that go to central test stations for evaluation under different conditions. Alabama Seedstock Producer of the Year 1988; Alabama State Farmer Award 1948; American Farmer Award 1952; Alabama Agri-Business Man of the Year 1980; director of Alabama Beef Cattle Improvement Association; director of Alabama Purebred Beef Council; director of Alabama Hereford Association; president of Alabama Hereford Association; lifetime director of Alabama Cattlemen's Association; president of American Hereford Association.

7. **KENNETH GILLIG**, Aurora, Missouri. Nominated by Missouri Beef Cattle Improvement Association. Forty-seven years in seedstock business with 85-cow Angus herd. Uses AI, sire summaries and young bulls from AI studs to improve herd. Tests his top bulls on his farm. Has used Missouri and the Angus Association's performance records to measure progress of his herd for the past 19 years. Serves as treasurer and sale manager for the Southwest Missouri Beef Cattle Improvement Association. Served as board member for the Missouri Angus Association. Serves as a board member for Lawrence County Cattlemen's Association; member of Southwest Missouri Steer Feedout Committee. Southwest Missouri Beef Cattle Improvement Association Seedstock Producer of the Year in 1981; Missouri Beef Cattle Improvement Association Seedstock Producer 1987; University of Missouri Extension Service Leaders' Honor Roll in 1975.

8. **WILLIAM (BILL) GLANZ**, Fausset and Glanz, Inc., Worland, Wyoming. Nominated by Wyoming Beef Cattle Improvement Associaton. Simmental seedstock producer for 18 years with a herd of 100 cows. Uses AI, sire summaries and performance records to improve herd. Conducts a central test on his farm to test his bulls and others consigned through the Wyoming Beef Cattle Improvement Association. Emphasizes calving ease in his breeding program. Several of his bulls are in AI studs and show up as trait leaders in the Simmental Sire Summary. Served on Bull Test Committee and board of directors for Wyoming Beef Cattle Improvement Association. Served the Wyoming Simmental Association as president and second vice-president. Member Bull Test and Sale Committee for National Simmental Association. Worland Jaycees Outstanding Young Farmer Award 1972; Outstanding Simmental Breeder by Wyoming Simmental Association 1976.

9. **DON AND DIANE GUILFORD**, Guilford Hereford Ranch, and **DAVID AND CAROL GUILFORD**, Guilford Farms, Clearwater, Manitoba. Joint nomination from Manitoba Beef Cattle Performance Association. The two families operated a single enterprise until a year ago. The records of both cow herds date back 21 years. Most significant herd improvements have been in increased weaning weights, reduced calving season, and improved calving ease. Both Canadian and Ameristations. **David** was Total Herd Enrollment fieldman for 2 years, member of the board of directors of Manitoba Beef Cattle Performance Association and Manitoba Hereford Association; president of Manitoba Hereford Association. **Don** currently serves as president of Manitoba Beef Cattle Performance Association, past president Louise Forage Improvement Association, member Manitoba Record of Performance Advisory Board. The Guilfords are joint winners of the 1987 Manitoba Premier Purebred Beef Producers of the Year.

10. **LEONARD A. LORENZEN**, Lorenzen Ranches, Inc., Pendleton, Oregon. Nominated by Oregon Cattlemen's Association, Beef Cattle Improvement Committee. Seedstock producer for 29 years. One-half of the herd is Red Angus with the remainder being a composite animal comprized of Red Angus, Simmental and Salers. Central test stations were used until numbers made it practical to have an on-farm testing program. Weaning and yearling weights have increased substantially through the judicious use of sire summary information, AI and embryo transfer. Carcass evaluation is an important selection tool at Lorenzen Ranches. Director and president of Red Angus Breeders of the Northwest; national director Red Angus Association of America; member board of directors Pacific International Livestock Expostion; 1987 Red Angus Association of America Outstanding Breeder of the Year.

11. **DAVID LUHMAN**, Luhmanway Simmentals, Goodhue, Minnesota. Nominated by Minnesota Beef Cattle Improvement Association. Sixty-cow Simmental herd has been producing seedstock for 13 years. American Simmental Association's performance records have been instrumental in the herd's increased productivity. The use of AI and sire summary information has allowed Luhmanway Simmental bulls to set several yearling weight records at central test stations. Served as president of the Minnesota Simmental Association; state director of Minnesota Simmental Association for 6 years; director of Minnesota Beef Improvement Federation for 10 years; president Minnesota Beef Improvement Federation for 2 years; vice-president and chairman of Central Bull Test Committee of Minnesota Beef Improvement Federation; director of the Minnesota Beef Council. Helped organize Dairyland Beef Association. 1987 Minnesota Purebred Seedstock Producer of the Year.

12. **DONN AND SYLVIA MITCHELL**, Klondike Farms, Douglas, Manitoba. Nominated by Canadian Advisory Board for Beef Cattle Improvement. Farm has been in the seedstock business for 50 years with a breeding herd of 270 Polled Hereford cows. Thirty-two years of performance testing have documented an increase of over 100 pounds in both weaning and yearling weights. Extensive use of sire summary data, AI, embryo transfer and test station bulls have produced these results. Markets bulls through private treaty and bull test station sales. First president Manitoba Beef Cattle Performance Association and Douglas Test Station; director, Brandon Fair Board; past chairman Western Grain Stabilization Board; board member Canadian Wheat Board Advisory Committee; director Canadian Western Agribition. 1983 Purebred Producer of the Year in Manitoba.; 1987 co-winner of Canadian Beef Cattle Performance Award.

13. **GINO PEDRETTI**, Pedretti Ranches, El Nido, California. Nominated by University of California Cooperative Extension Service and Merced County and Merced-Mariposa Cattlemen's Associations. Producer of Hereford seedstock for 42 years Has used California Beef Cattle Improvement Association's performance records for 33 years. Uses performance records as a marketing tool to sell bulls upon completion of on-the-farm feed test. Females are rigorously selected for high fertility and structural soundess. Six year director of American Hereford Association; 12 year director of California-Nevada Hereford Association. Hosted numerous field days and judging contests. 1956 Outstanding Young Farmer of Merced County; 1975 Outstanding Livestock and Dairy Producer Merced City/County Chamber of Commerce; 1979 California Hereford Man of the Year.

14. **HANSELL PILE**, Pile Stock Farm, Cecilia, Kentucky. Nominated by Hardin County Beef Cattle Association. Has been in seedstock business for 40 years with 60 Polled Hereford cows. Twenty-three years of Kentucky Beef Herd Improvement and American Polled Hereford performance records have increased weaning weights by one-third and yearling weights by one-fourth. Uses AI, sire summaries, and test station bulls to improve herd. Is a frequent consignor to central test station. Serves as president of the Performance Division of the Kentucky Beef Herd Improvement Program. Served as director for Kentucky Beef Herd Improvement Program; president of Hardin County Livestock Improvement Association; board of directors, Kentucky Polled Hereford Association; superintendent of Beef Show Hardin County Fair. 1985 Hardin County Outstanding Grassland Farmer, Kentucky Forage and Grassland Council. Certificate of Recognition, Beef Industry Award, Hardin County Beef Cattle Association.

15. **GEORGE H. SCHLICKAU**, Schlickau Herefords, Haven, Kansas. Nominated by Kansas Livestock Association. Farm has been in the seedstock business for 75 years with herd of 300 Hereford cows. Markets 100 bulls annually through production sale, private treaty and central test sales. Thirty-two years of performance testing have led to increases in weaning weights, frame scores, and herd productivity. Genetic progress is enhanced by the use of sire summary information, AI and bulls from central test stations. Served on the committee to organize and implement the central bull test station at Beloit, Kansas. Served as president, vice-president and director of Kansas Hereford Association. Served as president, vice-president and board member of the American Hereford Association. Served as president, vice-president, director, and on the executive board of Kansas Junior Livestock Show. Served as advisor of the American Junior Hereford Association. Served as secretary, treasurer and on the board of Reno County Cattlemen's Association. Reno County's first Outstanding Young Farmer, Kansas Hereford Breeder of the Year.

16. **HANS ULRICH**, Ulrich Hereford Ranch, Claresholm, Alberta. Nominated by the Canadian Hereford Association. Thirty years in the seedstock business with a 180-cow Hereford herd. Has used beef cattle performance concepts for 30 years. The Canadian Hereford Association's Total Herd Evaluation program has helped increase weaning weights by 140 pounds. AI, embryo transfer, and test station bulls are used to speed genetic progress. Ulrich Hereford bulls have been consigned to both U.S. and Canadian test stations for over 20 years. Member Alberta Beef Cattle Performance Test Advisory Committee, Alberta producer representative to Canadian Advisory Board; director for 4 years of Canadian Hereford Association, director of Alberta Cattle Breeders. Launched Canadian Hereford Progeny Test program; initiated European performance Testing for Simmental Breeders Limited. 1987 co-winner of Canadian Beef Cattle Performance Award; 1987 winner of Alberta Beef Cattle Performance Award.

17. **DR. ROBERT E. WALTON**, Simmental Valley, Inc., DeForest, Wisconsin. Nominated by Wisconsin Beef Improvement Association. Twenty years in seedstock business with 60-cow herd of Simmental. has used performance records for 20 years to improve herd. Breeds entire herd AI. Uses sire summaries to select sires. Samples a limited number of young bulls annually. Embryo transfer is used on a limited basis. Has consigned consistently top-performing bulls to the Wisconsin Bull Test Station. Several Simmental Valley bulls are in AI service at American Breeders Service. Served as board member and past president of Wisconsin Beef Improvement Association; member Performance Committee, American Simmental Association. Distinguished Animal Science Alumnus Oklahoma State University 1975; Oklahoma 4-H Alumni Award 1979; Distingished Service Award Wisconsin State FFA 1979; Award of Distinction University of Wisconsin 1980; World Dairy Expo Industry Person of the Year 1982; International Stockmen's School All-Time Great Dairyman 1983; National Award for Agricultural Excellence National NAMA 1985; Distinguished Service Award; National Association of Animal Breeders 1986; Dairy Shrine Guest of Honor 1987.

1988 BIF COMMERCIAL PRODUCER OF THE YEAR NOMINEES

1. **JERRY ADAMSON,** Rocking J Ranch, Cody, Nebraska. Nominated by American Chianina Association. Runs 1,650 Angus-based crossbred cows and 50 purbred Chianina cows on his 103 year old ranch. His ranch has utilized a computer inventory program performance testing and AI to increase weaning weights 145 pounds in twenty years. Has successfully used bulls purchased from central test stations. Finishes 500 head annually. Markets about 80 bulls per year from their own breeding program. Jerry follows up on the sale of these bulls by helping the buyers market their cattle. Jerry has been a leader in research and marketing lean or "lite" beef. 1955 Nebraska Stock Growers Association Youth of the Year; 1974 Valentine Jaycees top rancher in Cherry County; 1976 4-H leader award in beef; 1984 Knights of Ak-Sar-Ben Agriculture Achievement Award.

2. **C. L. "BUSTER" COOK,** Taneyville, Missouri. Nominated by the Missouri Beef Cattle Improvement Association. Buster has been in commercial cattle business for 35 years with 150 head of primarily Angus-based crossbred cows. Cows are bred naturally to performance tested Santa Gertrudis and Simmental bulls. Eighteen years of performance tested bulls have increased weaning weights, frame size, and eye appeal. Buster's farm is a frequent stop on local and state-wide cattle tours. He is an ardent supporter and promoter of performance tested bull sales.

3 **LARRY D. CUNDALL,** Glendo, Wyoming. Nominated by Wyoming Beef Cattle Improvement Association. Commercial cattleman for 9 years with 200 cow herd of Angus and Angus-Hereford cows. His on-the-farm computer has allowed him to store data and process his own herd records. Breed association sire summaries are used to choose AI sires. Natural service sires come from central test stations or on-the-farm tests. Weaning weights have increased 160 pounds in 9 years. Larry is a charter member of Wyoming Beef Cattle Improvement Association and has helped teach AI course. Was awarded State Farmer Award in 1967. Bronze Star for Cattle and Swine Vaccination Program and Public Service, Viet Nam 1971; Army Commendation Medal for model swine project in Viet Nam, 1972; Honorary Chapter Farmer Award Assistance to local FFA Chapter, 1978; Wyoming Commercial Producer of the Year 1987.

4. **LEE EATON,** Eaton Charolais, Lindsay, Montana. Nominated by the American International Charolais Association. Runs 1,025 black and black-Charolais cross cows on ranch that has been in cattle business for 79 years. Feeds all his calves plus calves purchased from his bull buyers in a custom lot. Has used performance records for 24 years to cull cows and select bulls from his purebred herd. Lee has served as president of Montana Charolais Association, director of Montana Charolais Association, and director of Montana Beef Performance Association.

5. **KEN, WAYNE, AND BRUCE GARDINER**, Gardiner Farms, Lakeland Manitoba. Nominated by Manitoba Beef Performance Awards Committee. The Gardiners have been in the cattle business for 20 years, keeping performance records since 1979. Their Charolais-Hereford-Limousin crossbred herd consists of 175 cows. Weaning weights have increased 180 pounds since 1980. Herd sires have come exclusively from test stations. The Gardiners are the winners of the 1987 Manitoba Commercial Beef Cattle Performance Award.

6. **MAC, DON, JOE GRIFFITH**, G-Whiz Farms, Buchan, Georgia. Nominated by University of Georgia Extension Service. G-Whiz Farms has been in the commercial cattle business for 18 years specializing in producing high-quality crossbred show steers and heifers for 4-H and FFA youth. The 150-cow herd is predominantly Angus-based. The sire breeds are Chianina, Simmental, Maine-Anjou, Limousin, Gelbvieh and Salers. They hold an animal club calf production sale. The use of performance records, AI, bulls from central test stations and breed association sire summaries allow G-Whiz Farms to produce a more uniform, saleable product. **Don** has been president, vice-president, and regional vice-president of the Georgia Cattlemen's Association, president of Haralson County Cattlemen's Asociation, member National Beef Promotion/Research Board, Haralson County Farm Family of the Year. **Mac** has served as executive director of Haralson Polk ASCS and chairman of Haralson-Polk Food and Agricultural Council. **Joe** is a director of Haralson County Cattlemen's Association, has served as president of Georgia Junior Angus Association and was 1987 Haralson County Farm Family of the Year.

7. **DICK AND PHYLLIS HENZE,** 3 R Ranch, Fort Ripley, Minnesota. Nominated by Minnesota Beef Cattle Improvement Association. Have been in cattle business for 30 years with 350-head of Angus-Simmental cross cows. Have used performance records for 15 years to increase weaning weights 250 pounds. All cows are bred naturally to bulls from central test stations or from producers with on-the-farm tests. **Dick** has served as president of the Mid-Minnesota Cattlemen, director of the Minnesota Beef Council, 1987 Minnesota Beef Cattle Improvement Association's Cattleman of the Year, 1985 Cattlemen of the Year. **Phyllis** has served as president of the Minnesota CattleWomen's Association, Beef Promotion Chairman, and Legislative Committee Chairman. She was the first woman to serve on the Minnesota Beef Council.

8. **GARY JOHNSON**, Johnson Farms, Dwight, Kansas. Nominated by Kansas Livestock Association Purebred Council. Twenty-two years in commercial cattle business, 600 head of Angus-Hereford cows bred AI with the help of estrous synchronizaton. AI sires are selected through use of breed association sire summaries. Performance records, performance pedigrees, performance tested bulls have led to weaning weight increases of 170 pounds and yearling weights have increased 200 pounds. Calves are marketed as yearling feeders. Presented programs at the 8th Annual Agricultural Symposium in Monterrey, Mexico, 1985 American Hereford Association type conference, Oklahoma Angus Association performance seminar. Has hosted educational tours for Kansas State University. Member of Kansas bull test committee, commercial advisor to the Kansas Hereford Association and the 1986 Kansas nominee for BIF Commercial Producer of the Year.

9. **FREDERICK M. MALLERY**, Cross My Heart Ranch, Janesville, California. Nominated by University of California Cooperative Extension Service. Has been in cattle business for 45 years with 600 head Angus-cross cows. Uses on-the-farm computer to process performance records. Use of AI, central test station bulls, and breed association sire summaries has increased weaning weights 150 pounds. The Mallery selection procedures have resulted in numerous winnings in both performance and showring situations.

10. **JOHN McDANIEL**, McDaniel Farms, Ashford, Alabama. Nominated by Alabama Beef Cattle Improvement Association. Commercial cattle business for 47 years with 76 Angus-Hereford cross cows being bred to Gelbvieh bull. Has used other breeds through AI to determine usefulness in the herd. Finishes all calves except replacement heifers on farm-grown grain. Twenty-five years of performance records have reduced calving season, increased weaning weights, and increased efficiency. John served as a director for Alabama BCIA, Commercial Producer of the Year. President of the Houston County Cattlemen's Association and director of the Houston County Cattlemen's Association.

11. **MIKE AND DAVE McGEE**, Catlin, Illinois. Nominated by Illinois Cooperative Extension Service. The McGees have been in the commercial cattle business for 14 years with their herd of 70 crossbred cows. Their on-the-farm computer is used to store and process performance data. All cows are bred naturally to performance tested bulls. Performance records and performance tested bulls have permitted the McGees to shorten their calving season and increase weaning weights by 100 pounds. Mike and Dave received the 1987 Commercial Producer of the Year Award in Illinois.

12. **WILLIAM A. STEGNER**, Stegner's Faster Gaining Beef, Rhame, North Dakota. Nominated by North Dakota Beef Cattle Improvement Association. Stegner has been in the commercial cattle business for 38 years with 450 cows. Began with Angus cows and now has gone entireley to Simmental AI breeding. Except for heifer replacements, all calves go to a custom feedlot to capitalize on superior performing animals. Twenty six years of performance records have led to large increases in weaning weights. Named by the North Dakota Beef Cattle Improvement Association to receive the Top Commercial Cattle Producers Award in 1976, 1987 Outstanding Producer Award by the North Dakota Beef Cattle Improvement Association and the 1983 North Dokata State University Agriculturist Award.

13. **STEVENSON FAMILY,** Knee Deep Cattle Co., Eugene, Oregon. Nominated by Oregon Beef Improvement Federation Committee. The Stevenson family have been commercial cattlemen for 33 years with approximately 500 crossbred cows. Hereford cows are bred to Angus bulls to produce crossbred cows that are bred to Simmental, Limousin, and Simbrah bulls. Calves are marketed as weaned calves, yearling feeders, or finished cattle depending on market conditions. Weaning weights have increased about 200 pounds through the use of performance tested bulls and performance records. The family has been involved in many community activities over the years. Other awards and positions held include: Steer Classic Carcass winners and, in 1974, named Lane County Livestock Association Producers of the Year. Bill has served on the Oregon Beef Council as both chairman and treasurer. The family has produced four presidents of the county livestock association. Bill has served as president of Western Oregon Livestock Association and as vice-president of the Oregon Cattlemen's Association.

14. **WILLIAM E. WHITE**, Somerset, Kentucky. Nominated by Kentucky Beef Cattle Association. Has been in commercial cattle business for 13 years. Angus and Simmental are basic breeds of the 16 cow herd. Has used performance records, AI and performance tested bulls to increase weaning weights by over 50 percent. Has served as president of local Feeder Calf Association, secretary of Kentucky Beef Cattle Association.

BIF Seedstock Producer of the Year

W. T. "Bill" Bennett

The Beef Improvement Federation named Bill Bennett of BB Cattle Company, Connell, Washington, as its Seedstock Producer of the Year for 1988.

Bennett grew up on his parents' registered Shorthorn ranch in the state of Washington. He, his father (J. W. "Bill" Bennett), his mother, and his three brothers had the largest registered Polled Shorthorn herd in the world during the 1940's and '50's.

He attended Washington State University at Pullman and, for six years, was in charge of the University's beef cattle herd and performance testing program. While there, he and his wife got their two sons and two daughters involved in the cattle business through 4-H programs.

(left to right) Bob Dickinson, BIF President, W. T. "Bill" Bennett and Mrs. Bennett

In 1967 he became manager-partner with Harold Thompson at TT Herefords, Connell, Washington. In 1969 TT Herefords sold its entire herd of 321 cows to Stone Hereford Ranch in Oregon. Bennett and his wife Norma purchased the 480 acre TT Herefords headquarters. With 12 Hereford cows owned by the four Bennett children, they founded BB Cattle Company.

They now farm 2,500 acres of irrigated land and run cattle on 20,000 acres of dry pasture land. They have registered more Hereford cattle each year than any other breeder during the past six years. in 1987 they registered 1,281 Herefords and 800 Brafords. They own and manage a total of 4,000 breeding cows and heifers.

All four Bennett children are married, have children of their own, and all work as part of BB Cattle Company. All agree that producing the right kind of cattle based on total performance is the key to their success.

Bennett said, "Back in 1970, our bull calves averaged 600 pounds at 205 days; in 1987 they averaged 710 pounds. in 1970 our bulls averaged 1,005 pounds at 365 days. in 1987 they averaged 1,125 pounds and that is on 1,000 bulls. Of course, our top bulls are heavier."

BB Cattle Company enjoys a world-wide market for their breeding stock. Bennett has served in many positions of leadership in beef cattle improvement and annually sponsors well-attended cattle breeding seminars at BB Cattle Company.

Bennett was nominated for this award by the Washington Cattlemen's Association, Washington Extension Service and the Oregon, Washington, Northern Idaho Hereford Association.

BIF Commercial Producer of the Year

Gary V. Johnson

The Beef Improvement Federation selected Gary V. Johnson, Johnson Farms, of Dwight, Kansas, as its Commercial Producer of the Year for 1988.

His boyhood enthusiasm for cattle and farming is still evident in his operation today. He began with 22 cows in 1966 and has expanded to more than 600 cows, 700 yearlings, 6,000 acres of range and 1,500 acres of cultivated land. Johnson, his wife Joan, who is a veterinary pathologist, their four children, and one hired hand operate the farm.

Productivity and cost-effectiveness are important in Johnson's operation. To achieve these goals, he has implemented standards for sire selection with the aid of sire summary data, a planned Hereford-Angus crossbreeding program, identification of cows, calves and their sires, culling of cows and bulls based on records, and an effective herd health program. The combined effect has led to an increase in yearling weights of more than 200 pounds in the past 10 years.

(left to right) Bob Dickinson, BIF President, Gary Johnson, Mrs. Johnson, Roger McCraw, BIF Executive Director

Improvement in all areas of the cattle business has been very important to Johnson; however, genetic progress through the use of performance data and sire summary data is high on his list of priorities. Informing other producers of the advantages of using performance data is also very important to him. "I'm just trying to help other commercial producers understand the sire summaries and select better stock," Johnson said.

As a proponent of cowherd management and sire selection, Johnson was invited to speak and consult at the 8th Annual Agricultural Symposium in Monterrey, Mexico, in October of 1987. He also has spoken before the General Assembly of the American Hereford Association's type conference, the Kansas Livestock Association's Cow-Calf/Stocker seminar and the Oklahoma Angus Association's performance seminar. The Johnson family has hosted students from Mexico and Taiwan through the International Meat and Livestock Program of Kansas State University and hosted educational tours for KSU's Department of Animal Science. He is the commercial advisor for the Kansas Hereford Association and serves on the Kansas bull test committee. He is involved in promoting livestock projects for Morris County 4-H clubs and is the local 4-H club beef leader. Johnson is active in many other businesses, community and church activities.

Johnson was nominated for this honor by the Purebred Council fo the Kansas Livestock Association.

1988 Pioneer Award

Christian A. Dinkel

Dr. Dinkel was born June 18, 1922, in Sprigfield, South Dakota. Following high school, he served 33 months in the United States Air Force and then enrolled at Iowa State University. He received his B.S. degree in Animal Science in 1948. He was awarded an M.S. degree in Animal Breeding from South Dakota State University in 1949 and obtained a Ph.D. degree in Animal Breeding and Genetics from Iowa State University in 1953. Dr. Dinkel joined the animal science faculty at South Dakota State University in 1951 and remained there until retirement as a full profesor in 1986. He served as project leader for beef cattle breeding research and taught a graduate-level course in animal breeding, population genetics and experimental design. He directed graduate programs of more than 25 students and published numerous journal articles, abstracts, and papers.

Dr. Dinkel demonstrated a unique ability to design comprehensive and meaningful animal breeding research projects, to analyze and interpret the results, and to suggest appropriate and effective application of the results in the industry. His research concerned primarily new concepts and beef breeding techniques to aid in achieving permanent improvement in all economically important traits. Major contributions of his work were to: (1) identify genetic parameters in beef cattle; (2) quantify the influence of heredity on fertility, growth, conformation, and carcass characteristics; (3) improve techniques by which breeding stock are selected; (4) develop operations models and incorporate basic research results from several fields of animal science into usable prediction equations for livestock improvement, and (5) evaluate efficiency in beef cattle production.


(left to right) Bob Dickinson, BIF President, Dr. C. A. Dinkel, Mrs. Dinkel

He developed a comprehensive computer simulation program that allowed producers to evaluate breeds and breeding systems for particular nutrition and management situations. A recent extension of this simulation concept permits complete systems modeling for livestock producers. This work represents a unique and valuable contribution to the beef cattle industry. It is designed to assemble and use research results and known facts from all appropriate disciplines and combine these into systems models that identify the most efficient and profitable production options.

Dr. Dinkel is a member of the American Society of Animal Science, the American Genetic Association, Sigma Xi, Phi Kappa Phi, and Gamma Sigma Delta. He has been named in *Who's Who in the Midwest, Who's Whoin American Education-Leaders of Science*, and *Who's Who in Frontiers of Science and Technology.*

He and his wife Claudia have two daughters.

1988 Pioneer Award

A. F. "Frankie" Flint

A. F. Flint and Sons is a family operation which involves Flint's three sons and one son-in-law. Flint has been a producer of Angus cattle for more than 55 years. They have measured weaning weight, yearling weight and carcass traits for more than 30 years. Flint was a founding cooperator in the Tucumcari Bull Testing Program. His wisdom and support have contributed much to the development and success of this program. The performance of Flint's bulls in this test every year since its inception in 1961 and at a number of test station in other states including Arizona, Texas and Oklahoma, demonstrate his success as a breeder. Numerous Flint bulls have been involved in the National Sire Evaluation Prog-arm of the American Angus Asso ciation.

(left to right) Bob Dickinson, BIF President, A. F. Flint, Mrs. Flint, Roger McCraw, BIF Executive Director

His life has been one of service to his fellow cattlemen and to the industry he loves. Flint has contributed greatly to the teaching and research programs at the New Mexico State University. He has served on the New Mexico Livestock Board, the state convention for revising the New Mexico Constitution, the American Angus Association board of directors and has held leadership roles in many other community and state activities. He has been a member of the New Mexico Beef Cattle Performance Association for many years and has served as chairman of that group. He has served BIF as a delegate from the Western Region, as a board member, and as a member of the sire evaluation committee which developed the reference sire system.

Flint ws there when BIF was born. He followed the principles of cattle improvement which PRI, the New Mexico Beef Cattle Improvement Association and the Beef Improvement Federation have helps to put in widespread use. The New Mexico Cattlegrowers Association has named him Cattleman of the Year, he was the 1982 BIF Seedstock Producer of the Year and it is very fitting that his contributions to beef improvement are now recognized by presenting him the 1988 BIF Pioneer Award.

1988 Pioneer Award

George F. and Mattie Ellis

George Ellis was first employed at the historic Bell Ranch in 1944 as assistant manager. He was a graduate of Kansas Agricultural College (now Kansas State University). When the Bell Ranch holdings were broken up in 1974, Ellis was hired as manager of the headquarters unit, a position he held until his retirement in 1970.

Beginning in 1948, he pioneered the use of performance testing to improve range beef cattle by developing a within herd selection program to improve growth and conformation in a very large herd of Hereford cattle. With advice and assistance from professors J. A. Knox and Marvin Koger, he became the first large herd manager to apply knowledge about the inheritance of economic traits.

Mr. George F. Ellis, Jr., Mrs. Mattie Ellis, Mrs. Jeane Davidson

The selection progam at the Bell Ranch applied principles of adjusting for known environmental efects such as age of dam and age of calf on weaning weights, comparing only among contemporaries, and using mass selection and progeny testing. Mrs. Mattie Ellis played a key role by maintaining all herd production records by hand. Their methods were described in a bulletin, *Cattle Improvement on the Bell Ranch*, co-authored by professor Knox and George Ellis and published by the New Mexico Agricultural Experiment Station in 1969 as memoir series No. 3.

After retirement from his position as manager of the Bell Ranch, Mr. and Mrs. Ellis moved to nearby Conchas, New Mexico. Ellis wrote about the history of the Bell Ranch and the breeding program in a book entitled *Bell Ranch as I Knew It* which was published in 1973. Ellis died in 1972, shortly after finishing his work on the book. Mrs. Mattie Ellis has published several books of stories and poems about the Bell Ranch.

Dr. Bobby Rankin, Head of the Department of Animal and Range Sciences, New Mexico State University, who, as a young extension specialist was involved in the selection program at the Bell Ranch from 1961 to 1970, said "What I learned from Mr. George Ellis and professor John Knox, one of the first BIF Pioneer Award recipients, was invaluable in helping me conduct an extension program in beef cattle improvement for New Mexico." The Ellises were truly pioneers in every sense of the word. Together they developed new breeding methods on one of the oldest and, historically, largest privately owned ranches in the southwest.

1988 BIF Ambassador Award

Fred Knop

Fred Knop, editor of the *Drovers Journal*, Shawnee Mission, Kansas, was presented the Ambassador Award by the Beef Improvement Federation.

Knop was raised on a crop and livestock farm near Ida Grove, Iowa. In 1949, after serving four years with the U. S. Marine Corps in the USA, Guam and Japan, Knop began his journalism career doing broadcast and public relations work in the San Francisco area. From 1956 to 1982 he gained a background rare to the beef cattle journalism profession by working in the veterinary/drug industry as a marketing and promotion director. For the past six years he had prodded and applauded the industry by serving as editor of the *Drovers Journal*.

Bob Dickinson, BIF President, Fred Knop, Roger McCraw, BIF Executive Director

He has combined his experiences as a cattle breeders, broadcaster, writer and veterinary/drug industry marketer and promotor with keen analytical skills to help move the beef industry forward.

Knop is known throughout all beef industry sectors for his analytical skills. These served him well as a purebred breeder in northwest Iowa and have been a benefit to loyal readers of his cattle industry news and business reporting and editorial writings.

Knop recalls attending his first BIF meeting in 1983. "I had followed BIF's activities for years, but remember 1983 as a time when BIF was widely recognized for its leadership in moving the specification beef concept to the production sector."

Among a list of accomplishments, Knop cites *Drovers Journal* receiving the Livestock Publications Council's weekly livestock newspaper excellence award each of the five years he had served as editor.

Reflecting on his writings, Knop said "It's appropriate that the *Drovers Journal* take a position encouraging the adoption of production methods designed to meet targeted specifications. Our leadership role calls us to analyze for individual producers the developments in all of the industry sectors. Simply reporting what happened is no longer adequate."

Knop is a member of the following professional organizations: member and former board member of the Livestock Publications Council; Kansas Farm Writers and Broadcasters member and KFWB representative to the advisory council of the Kansas State University Agriculture Council; member of the Livestock Marketing Committee of the Kansas City, Missouri, Chamber of Commerce.

1988 BIF Continuing Service Award

Bruce Howard

Bruce Howard gained his experience and keen interest in beef cattle improvement on the family beef farm near Knowlton, Quebec, and through his education at the University of Guelph in Ontario. His career with the government of Canada has also provided numerous opportunities to dedicate himself to the genetic improvement of beef cattle in Canada.

Howard was appointed Manager, Beef Cattle Improvement in 1982. His responsibilities at that time were to manage and administer the federal-provincial Record of Performance program for beef cattle improvement (ROP Beef). Widely respected across Canada for his management of this large program, he has also been successful in coordinating the activities of the industry-based National Advisory Board for Beef Cattle Improvement and its committees.

He has recently led the drive to convert the ROP Beef program from a centralized data processing system on a mainframe computer to regionally located micro-computers which are capable of producing Expected Progeny Differences from a national database, as well as a number of reports which enhance the producer's selection decisions. These systems provide faster and better service to enrolled producers. Other subjects of his interest are the national test station program and the Canadian Beef Sire Evaluation Program which monitors progeny performance of widely used beef bulls.

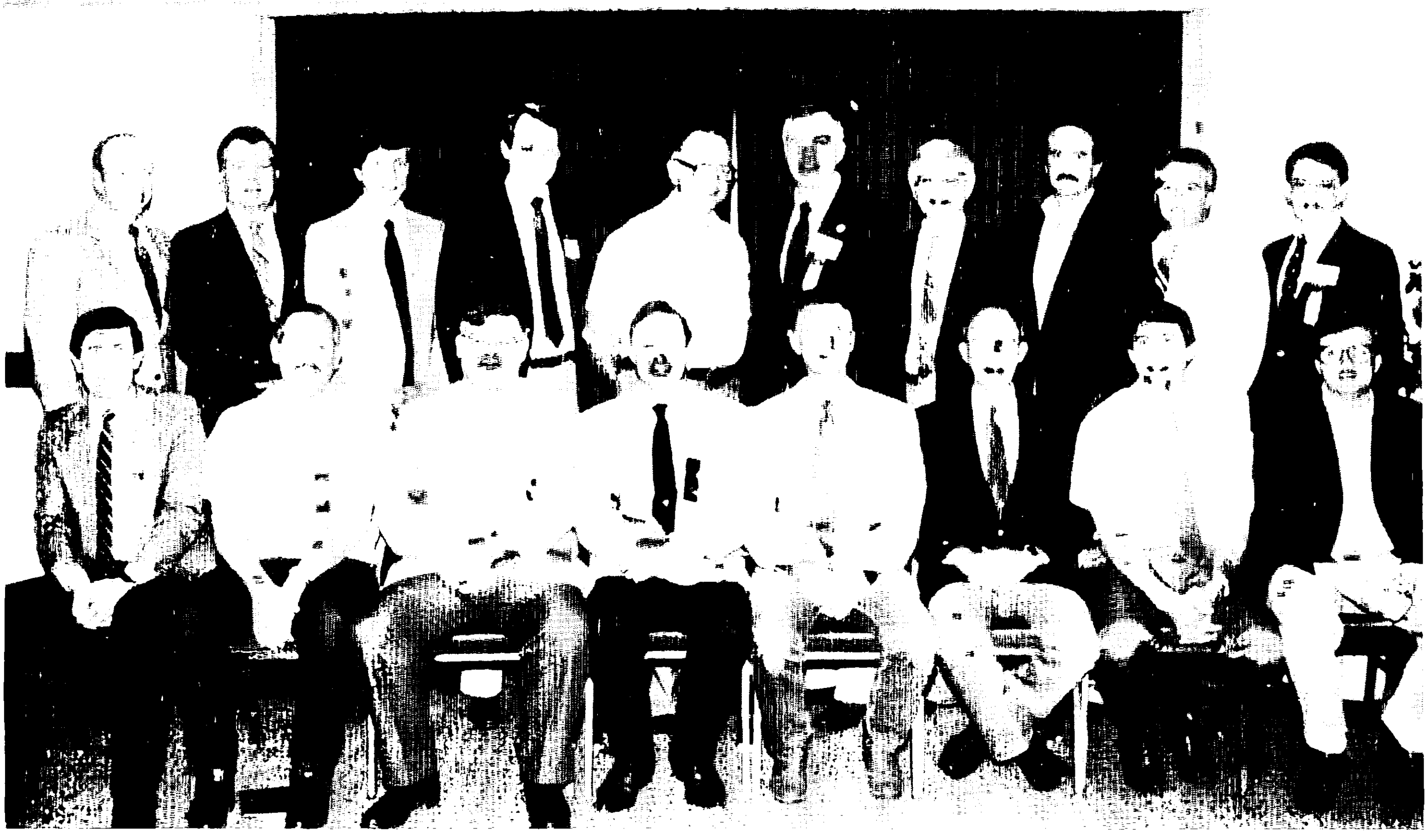
Bob Dickinson, BIF President, Bruce Howard, Roger McCraw, BIF Executive Director

Since 1982, he has served as a director on the executive board of Beef Improvement Federation, always imparting a Canadian view on the discussions there. BIF will be holding its annual convention in Canada for the first time in 1990, in part due to his efforts to secure the Board's approval and to find a Canadian host organization.

Howard was recently asked to manage the Red Meat Section which includes the performance programs for beef, sheep and swine in addition to the marketing and market development for all three species. In the interests of market development, he has visited China and South America and has gained a perspective on how to market Canadian beef cattle genetics in other parts of the world.

Fluently bilinqual in English and French, Howard is married and has a three-year old daughter. He lives in Ottawa when not on the road, and is still saving to buy his own farm and beef herd.

BIF Board of Directors



(Seated, left to right) Doug Hixon, Daryl Strohbehn, Roy Wallace, Bob Dickinson, President; Jack Chase, Vice-President; John Crouch, Gary Weber, Wayne Vanderwert. (Standing, left to right) Harvey Lemmon, Marvin Nichols, Ron Bolze, Bruce Howard, Henry Gardiner, Rich Whitman, Dixon Hubbard, Mark Cowan, Jim Spawn, Roger McCraw, Executive Director.

Not pictured: Jim Leachman, Larry Cundiff, Frank Baker, Craig Ludwig, Keith Vander Velde, Darell Wilkes, Leonard Wulf, Jim Gibb and Bill Warren.

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