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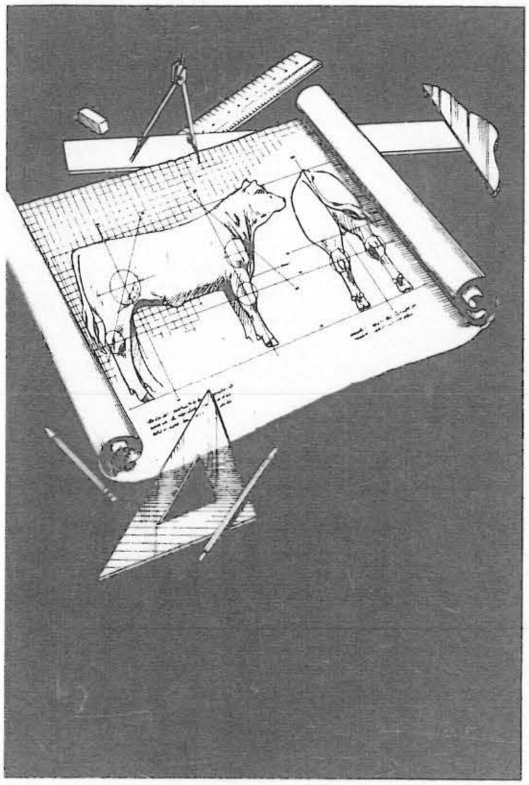
1988 NATIONAL BEEF CATTLE CONFERENCE



Blue Print for the Right Kind

May 24-25, 1988
Oklahoma State University

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ACKNOWLEDGEMENTS

The Animal Science Department of Oklahoma State University wishes to express our thanks and gratitude for the support of the National Beef Cattle Conference by all co-sponsors. Without their physical, moral and financial support the conference would not have been possible.

In addition, the Animal Science Department wishes to express our appreciation to all conference speakers, as well as breeders who furnished cattle, for their time, effort and generosity.

A very special thanks and appreciation is extended to Frank Evans and Jandra Pricer of the Agricultural Conference Center, Amy Bruce, Jeana DeMuth, Wendy Clouse, Valerie Hafner, Katy Shell, Debbie Hart, and Leslie Stidham for secretarial and organizational assistance; Tom Sturgeon and Mark Johnson for Arena coordination: Mark Fink, Roy Duer and Beef Center crew, Tim Stidham and Mark Scroggs of OBI, Carl Farrow and farm crew and especially, the Arena crew - Randy Nation, Ron Ramming and Robert Spencer for their assistance; Joe Hughes, John Castree, Mike Woltmann, Greg Dietz, Jim Hyer, Marty Anderson, Eugene Tinker, Ron Scott and Stan McPeake for transportation; David Buchanan and Neil McCarter for the opinion survey; Glen Dolezal and Fred Ray for the meat display.

Last, but not least, the Animal Science Department wishes you, the conference participant, for your support and attendance.

PREFACE

In 1982, as an outgrowth of the concerns among numerous people regarding the type of steers winning most national shows, our National Steer Symposium addressed show ring steer types, production and management procedures as well as end product quality and acceptability. At the conclusion of the symposium, industry specifications were developed to identify the ideal market steer. Anyone involved in the livestock industry realizes the major impact that the 1982 National Steer Symposium held at OSU has had on recent trends in show steer type. The specifications developed at the Steer Symposium match the carcass specifications recently developed by the packing industry.

Today, we feel a National Conference is in order to address the role of the purebred industry in the total beef chain as well as the kind of purebred cattle necessary to provide seedstock bulls to the commercial cow-calf producers in order for them to produce calves that will satisfy the needs and desires of the consuming public.

Signals are being sent to the commercial cattle producer that the consumer of our product wants beef that has the tenderness, flavor and acceptability of U.S.D.A. Choice quality, but in a leaner, more healthful form. The commercial cow-calf producers are looking to the purebred industry for bulls to meet their needs, but many commercial producers feel the purebred industry has gone too far in selection for frame and disregarded traits more economically important to the industry. As a result of almost single trait selection in recent years for frame, purebred cattle breeders have decreased their selection emphasis on fertility, structural soundness, natural muscling and body composition, as well as volume, capacity and doing ability, traits essential for survival in the commercial industry.

The questions are:

- What are the needs and desires of the consuming public in terms of beef?
- How does the packing industry plan to purchase slaughter cattle that will ultimately meet consumer demands?
- What carcass specifications will satisfy consumer demands?
- What kind of slaughter cattle will meet the desired carcass specifications?
- What kind of purebred bulls are necessary to breed the national cow herd to produce desirable slaughter cattle?
- What kind of purebred seedstock are necessary to produce these purebred bulls?

Hopefully this conference will provide everyone involved in the beef industry a unique opportunity to evaluate the total picture of the beef cattle industry and determine what changes need to occur in order to achieve a common goal..."Demand for our product and ultimately profit for the producer".

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Why Are We Here?

Bob Totusek
Head, Animal Science Department
Oklahoma State University

We are here because "the truth is more important than the trend."

There has been an obvious trend for some years. It started when we realize cattle were to small. At that time it was very appropriate to select bigger cattle. The trend has continued unabated, often involving single trait selection-for frame size. Many other functional traits have received minimal attention or have been ignored.

Frame size has been a trait of great economic importance, since there has been a big demand for extremely large frame size, particularly for showring purposes. But how about the industry? How about the other traits? How much muscling and "condition" will be appropriate for "specification beef" <u>and</u> its production? How about milk production? How about structural soundness?

It is not unusual for beef cattle selection trends to go too far. In fact, they usually do. Why? Perhaps it is because we don't indulge in enough dialogue. Judges, producers, industry people and exhibitors are intelligent, reasonable folks. But after a trend starts rolling, it seems difficult for individuals acting alone to slow its momentum.

In this day of much information and rapid communication, it should be much easier to arrive at valid rationale as a basis for consensus about "the right kind" for the industry than in the past. We have never had so many tools, and we "ain't seen nuthin' yet." The next decade or two will provide a vast array of new tools, as a result of the biotechnology revolution. We'll be able to "tailor make" cattle, but we must know the "right kind" to engineer. We no longer need to guess and speculate, and we cannot afford to.

If we look at the factors and study industry needs, and dialogue about these things, today and in the future, we should be able to develop a meaningful blueprint for the right kind.

That's why we are here!

The Retail Product - Meeting Consumer Demands
"The Known and the Unknown"

John Francis, National Livestock and Meat Board and Darrell Wilkes, National Cattlemen's Association

We have been asked to address the topic of consumer demands for beef. Our approach is to cover the things we know and point out the things we don't know about satisfying consumer demands.

Failing to act on what we know is a mistake, just as it is a mistake to pretend that we have all the answers to this question firmly in hand.

The following outline is the basis of our presentation:

What We Know	**What We Don't Know**
A. People enjoy beef for taste	A. Does beef taste as good as it used to?
B. There are at least two different kinds of taste for beef	B1. Are there more than two? B2. Precise, marketable descriptions of consumer segments
C. People want little, if any trimmable fat	C. Impact of trimming before cooking, on palatability... and nutrient profile
D. Seam fat is primary contributor to plate waste: the more bone in a retail cut, the greater the seam fat	D. How to efficiently, cleanly remove seam fat; genetic/management means to less seam fat
E. Consumers want, and are willing to pay for convenience	E. Point(s) of price resistance
F. Different appetites are best satisfied with different portion sizes	F. Fabrication specs for full range of portion sizes from 750 lb. carcass.
G. Uniformity/consistency is one indicator of quality in the eyes of consumers	G. Genetics/management opportunities for enhancing consistency; mechanical/meat
H. While consumers are seeing less fat on beef cuts, that does not necessarily imply that less fat is being produced than 10 years ago	H. A quality/yield profile of beef supply, i.e. consist study

I. Consumers want minimum-plus quality beef with no plate waste	I. Marketplace signal for quality gets through; signal for less fat is lost in retailers' backroom.
J. Consumers use color as an indicator of freshness . . . the brighter, the fresher	J. How to positively merchandise purple-red (not a "fresh" color) of vacuum packaged beef
K. How to centrally cut, vacuum package and then distribute retail cuts of beef	K. How to communicate the new math cuts; how to vaccuum package fresh, and retain bright red color
L. "Natural" and "lite" have been used as positive marketing terms for a number of food products	L. Influence of the terms their credibility and sales potential for beef products

Trends in the Beef Industry

Dr. Dell M. Allen, Excel Inc.

During the first half of the century, centralized slaughter plants were the state of the industry. These plants were typically located near large terminal livestock markets in several Midwestern cities on the Missouri and Mississippi Rivers. They were primarily what were known as kill and chill plants, in that cattle were purchased, slaughtered and the resulting carcasses sold as the primary production product. In the 1960's and 70's, the packing industry underwent species specialization and decentralization. New companies were formed and they built single-species plants located in smaller cities near the source of livestock. In the beef industry many of these plants not only slaughtered the cattle but also fabricated carcasses and shipped them in cut form. Vacuum bagging of these cuts and shipping them in boxes became the norm resulting in what we know as boxed beef today. This practice resulted in increased efficiencies of transportation due to a reduction in shipping of waste fat and bone, improved product freshness and considerable savings in product shrinkage.

During the past twenty years there has also been a marked change in consumer perceptions of what is desirable in beef, the product. The emphasis of this shift has largely been one of demanding a leaner product. This shift is a result of changes in consumer lifestyles and an awakening of diet-health concerns on the part of a large proportion of the U.S. consuming public. In 1985, results of a National Consumer Survey sponsored by the National Livestock and Meat Board and other industry groups, clearly showed that consumers preferred beef cuts that were closely trimmed of external fat. Retailers nation- wide have quickly accepted the results of this study and today most fresh beef sold at retail is trimmed to 1/4 inch or less of external fat.

Excel has responded to these trends in the industry and is attempting to aid the retailer who has the problem of not being able to sell beef with extra fat. To aid with this problem Excel decided if they "can't sell the fat, we won't ship the fat". Out of this attitude came our "Perfect Trim" program. This is a product which provides the retailer with boxed beef trimmed to an average of 3/8 of an inch external fat trim. In other words, extra fat is taken off at plant level, delivering to the retailer a more salable product that requires minimal additional trim.

About the same time, Excel initiated the "Branded Beef" program. This is simply boxed beef converted to pre-packed retail cuts available for the retailer to simply place in his meat counter. These retail cuts are trimmed to 1/4 inch or less external fat and individually packaged in a vacuum bag. Our company research has shown that most fresh beef purchased today is either cooked or frozen within two days of purchase. Due to the branded product being vacuum packaged, the customer can be sure the product will stay fresh in the refrigerator for at least seven days. If the consumer decides not to cook the product within the seven day period they can place the product in their freezer and then pull it out at their own convenience for cooking at a later time. This program addresses the convenience and product freshness concerns of the consumer. It also results in transportation efficiencies since all waste fat and bone is removed before shipping. There are also other potential savings in the program relating to labor savings, increased product shelf-life and shrink reduction.

Due to the "Perfect Trim" and "Branded Beef" programs, Excel became concerned with the raw product from which these are produced - cattle. Due to this, Excel set out to identify a system of scoring and classifying animals that relates to their retail product yields. Through company research and the help of University experts, we developed a muscle scoring system for cattle and carcasses. This system is relatively simple and is based on the amount of outside fat present on the animal plus the size of the ribeye muscle. Obviously, the less outside fat an animal carries, the less will have to be trimmed on the resulting retail cuts. Also, the larger the muscle system present in the animal, the greater will be the resulting muscle mass in retail product form. Table 1 shows the Excel muscle scoring system as it relates to the two factors that determining the muscle score of the animal or its carcass. A-1's and A-2's are the more desirable types, B-3's are average type cattle in the industry today and C-4's and C-5's are inferior from the standpoint of retail product yield. It is Excel's intent to pay more for A-1 and A-2 type cattle, pay the average price for B-3's and to discount C-4's and C-5's. This type of pricing system should encourage the breeding and feeding of the more desirable cattle by the industry and discourage the continued production of waste fat and inferior muscled animals. It is intended to give a price signal to producers according to the true value of animals with true value being determined by salable product yields.

This does not mean that we want to de-emphasize product eating quality (palatability) since it is still important that the product maintain the desirable attributes of tenderness, juiciness and flavor. Research has indicated that these product attributes are highly related to the genetic background of the animal and that progress can be made in producing leaner animals that will still retain the desirable attributes of palatability. It is Excel's hope to aid cattle producers in identifying animals of this type and to encourage them in increasing their production of these higher value animals.

Table 1

EXCEL Muscle Scoring System

Muscle Score	External Fat Thickness	Area of Ribeye Muscle/Cwt. Carcass
A-1	.35 inch or less	2.0 inches/cwt. or more
A-2	.36 to .45 inches	1.8 to 1.99 inches/cwt
B-3	.46 to .60 inches	1.70 to 1.79 inches/cwt
C-4	.61 to .80 inches	1.40 to 1.69 inches/cwt
C-5	.80 inches or more	Less than 1.4 inches/cwt

IBP - Supplying Consumer Demand

Charles Mostek, Iowa Beef Packers

IBP wishes to thank Dr. Bob Kropp and Oklahoma State University for the opportunity to discuss this matter with you.

In attempting to relate to this group the carcass specifications that we at IBP need in our operations I think it would be wise to examine what we are looking for today as well as what we believe we'll need in the future. At IBP we sell, either directly or indirectly, approximately 70% of our finished products to retailers and 30% to the hotel, restaurant and institutional trade. Consequently, we currently can accommodate a wide range of beef carcasses.

Weights

First, let's address the criteria of carcass weight. The majority of our sales to retailers is in our Cattle-Pak product line. Cattle-Pak is basically carcasses processed into the various cuts, with a great deal of the fat and bone removed but still sold to the customer in whole cattle increments. When a customer buys, say 50 head of Cattle-Pak he will receive all the loins, ribs, chucks etc. from 50 cattle, processed to a particular criteria, vacuum packaged and boxed. Cattle-Pak product is derived from carcasses that fall generally between 550 and 700 lbs, while our HRI product line, which is basically the product sold as separate cuts includes carcass weights to 950 lbs. This range of 550 to 950 lbs then accommodates our current clientele - the lighter weights going into boneless and semi-boneless fabrications and sold primarily in cattle units, while the heavier weights are usually fully boned and sold as individual cuts. While we can safely say that the current spread of weights in our carcass mix (with the exception of those over 900 lbs or under 550 lbs) accommodates our customer base, I can certainly tell you that from a sales perspective we'd rather have more 650 to 700 pounders than 750 to 950's.

If we look at the carcass weight issue more closely, we can see that within the Cattle-Pak range of 550/700 lbs, the ideal weight would be 700 lbs or at least 650/700. This is for the two basic reasons that the 650/700 pound carcass will out yield (in terms of closely trimmed retail cuts) the lighter weights for the retailer, and since it costs us the same amount to process a 700 pounder as a 550 pounder, our production costs per pound would be lower. Our studies have indicated that optimum saleable yields would be achieved from carcasses weighing around 750 lbs. We may see retailers moving more toward that weight as they gain comfort in retailing portions from the slightly larger cuts and as they accept more fully boneless cuts for chain store use. However, heavier weights don't appear to be the trend at retail.

Once the carcass weight exceeds 750 lbs, we progressively lose the enhanced retail cut out values that we gained as we approached 750 lbs from the other side. Additionally, the heavier the carcass gets, the more limited the customer base becomes due to difficulties in merchandising the larger cuts.

So our conclusion on carcass weights is that while today's 550/950 weight range adequately serves our present purpose, we recognize a trend toward weights that may ultimately reach a 600 to 800 lb. range.

Cutability

Today, IBP processes yield grade 1's, 2's, and 3's exclusively, selling the yield grade 4's and 5's in carcass form. This standard has always been in place with us and will continue in the future.

On a long term basis we envision a tightening of our cutability specifications to eliminate the fatter end of the yield grade 3 carcasses, perhaps at 3.3 or 3.5. The industry can cut the excess fat off, but developing ways to keep it from getting there to start with is obviously more desirable. We believe more emphasis should and will be placed on back fat with some de-emphasis of the other yield grade criteria.

Quality

Today IBP processes carcasses that meet the minimum general requirements for U.S. Select. Since, like most other processors, we don't apply grade marks to the Selects, our product line consists of Prime (in very limited quantities), Choice and "No-Roll". Our marketing program accommodates the natural fall of carcasses into these 3 grades. As you all are acutely aware, though the percentage of Selects in the mix can drastically effect the value difference between Choice and Select. The discounts as high as $17.00/CWT last summer illustrate this sensitivity. Retail marketing of the Select grade or even "No-Roll" hasn't progressed the way some of us thought it would. We are still (at least in the marketing chain) driven by marbling. We must eventually recognize that in young beef what happens for an hour in the kitchen has much more impact on eating quality of beef than what happened in the last 100 days of the animal's life. We hope that future trends will permit us to remove emphasis on marbling as the key quality indicator and develop a marketing program based on young, lean beef.

Maturity

At IBP we currently accept carcasses that fall into the "A" or "B" maturity group recognizing that through our live procurement program nearly 100% of the cattle we slaughter are "A" maturity. What this means is that nearly all the cattle we process are under 28 months of age, some substantially younger. As we evolve away from dependence on marbling we believe it will be highly important to emphasize youth in our beef. This is not to suggest that cattle in "A" maturity will be unacceptable, but we do suggest that even low "B" maturity will be undesirable.

Miscellaneous

Other areas for consideration are:

- **Conformation** - At IBP we have always sought full muscled animals. We don't process carcasses with dairy type conformation. We don't see that changing in the future.

- **Meat Texture** - Like everyone else in the trade we desire a firm textured muscle. As you continue your efforts at genetic improvement we recommend that you avoid creating course textured muscling.

- **Meat Color** - Again, like the rest, we desire a light red color in the lean. Darker meat is and will continue to be undesirable.

Once again, we appreciate this opportunity to share these views with you and I hope that this information is beneficial to your purpose.

U.S. Standards for Grades of Feeder Cattle

Fred Williams, U.S.D.A.

Changes in our nation's beef cattle breeding herds have resulted in the production of feeder cattle that differ widely in frame size, muscling, body type, and relative ability to gain weight and fatten. Where once our herds were basically descended from three British breeds, we are now dealing with more than 70 different breeds of cattle. This and other changes prompted the U.S. Department of Agriculture to revise the Official United States Standards for Grades of Feeder Cattle.

The standards were designed to describe the various types of feeder cattle now being produced. They are used as a basis for Federal-State livestock market reporting and can be used to provide a common trading language between buyers and sellers. They are a tool for penning cattle at sales where feeder cattle are officially graded and ownership comingled. They provide guidelines for better planning of breeding, management, and marketing programs. The grades are based on evaluating differences in frame size and thickness--two of the most important genetic factors affecting merit (value) in feeder cattle.

Frame size is related to the weight at which, under normal feeding and management practices, an animal will produce a carcass of a given grade. Large frame animals require a longer time in the feedlot to reach a given grade and will weigh more than a small-framed animal would weigh at the same grade. Thickness is related to muscle-to-bone ratio and at a given degree of fatness to carcass yield grade. Thicker muscled animals will have more lean meat. The grades recognize three frame size grades and three thickness grades.

In addition to nine possible combinations (3 frame size, 3 muscle thickness) of feeder grades for thrifty animals, there is an Inferior grade for unthrifty animals. The Inferior grade includes feeder cattle which are unthrifty because of mismanagement, disease, parasitism, or lack of feed. An animal grading Inferior could qualify for a thickness and frame size grade at a later date provided the unthrifty condition is corrected.

"Double-muscled" animals are included in the Inferior grade. Although such animals have a superior amount of muscle, they are graded U.S. Inferior because of their inability to produce carcasses with an acceptable degree of meat quality.

What are the Specifications for Each Frame Size?

Large Frame (L): Feeder cattle which have typical minimum qualifications for this grade are thrifty, have large frames, and are tall and long bodied for their age. Steers would not be expected to produce the amount of external (subcutaneous) fat opposite the twelfth rib--usually about .5 inch (1.3 cm)--normally associated with the U.S. Choice grade until their live weight exceeds 1,200 pounds (544 kg). Heifers would not be expected to provide Choice carcasses until their live weight exceeds 1000 lbs. (454 kg).

Medium Frame (M): Feeder cattle which possess typical minimum qualifications for this grade are thrifty, have slightly large frames, and are slightly tall and long bodied for their age. Steers would be expected to produce U.S. Choice carcasses (about .5 inch (1.3 cm) fat at twelfth rib) at live weights of 1,000 to 1,200 pounds (454 to 544 kg). Heifers would be expected to produce Choice carcasses at 850 to 1,000 pounds (386 to 454 kg).

Small Frame (S): Feeder cattle included in this grade are thrifty, have small frames, and are shorter bodied and not as tall as specified as the minimum for the Medium Frame grade. Steers would be expected to produce U.S. Choice carcass (about .5 inch (1.3 cm) fat) at live weights of less than 1,000 pounds (454 kg). Heifers would be expected to produce Choice carcasses at live weights of less than 850 pounds (386 kg).

What are the Specifications for Thickness?

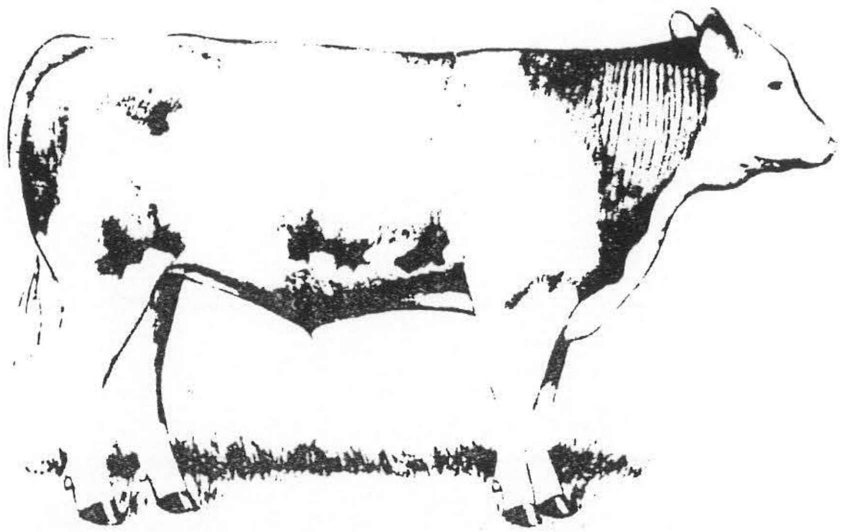
Number 1: Feeder cattle which possess minimum qualifications for this grade usually show a high proportion of beef breeding. They must be thrifty and slightly thick throughout. They are slightly thick and full in the forearm and gaskin, showing a rounded appearance through the back and loin with moderate width between the legs, both front and rear. Cattle show this thickness with a slightly thin covering of fat; however, cattle eligible for this grade may carry varying degrees of fat.

Number 2: Feeder cattle which possess minimum qualifications for this grade are thrifty and are narrow through the forequarter and the middle part of the rounds. The forearm and gaskin are thin and the back and loin have a sunken appearance. The legs are set close together, both front and rear. Cattle show this narrowness with a slightly thin covering of fat; however, cattle eligible for this grade may carry varying degrees of fat.

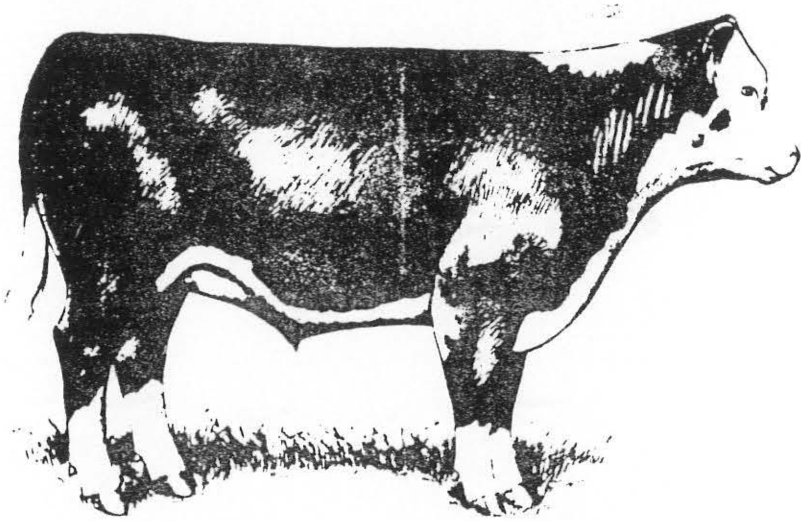
Number 3: Feeder cattle include in this grade are thrifty animals which have less thickness than the minimum requirements specified for the No. 2 grade.

Frame Size

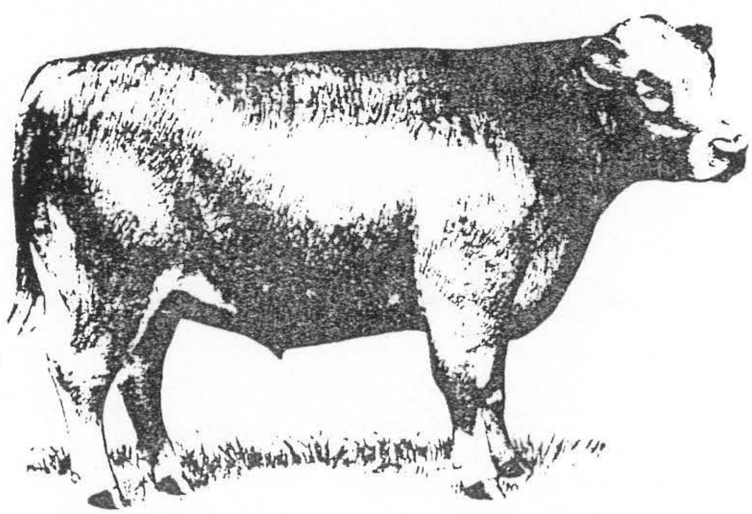
Large



Medium



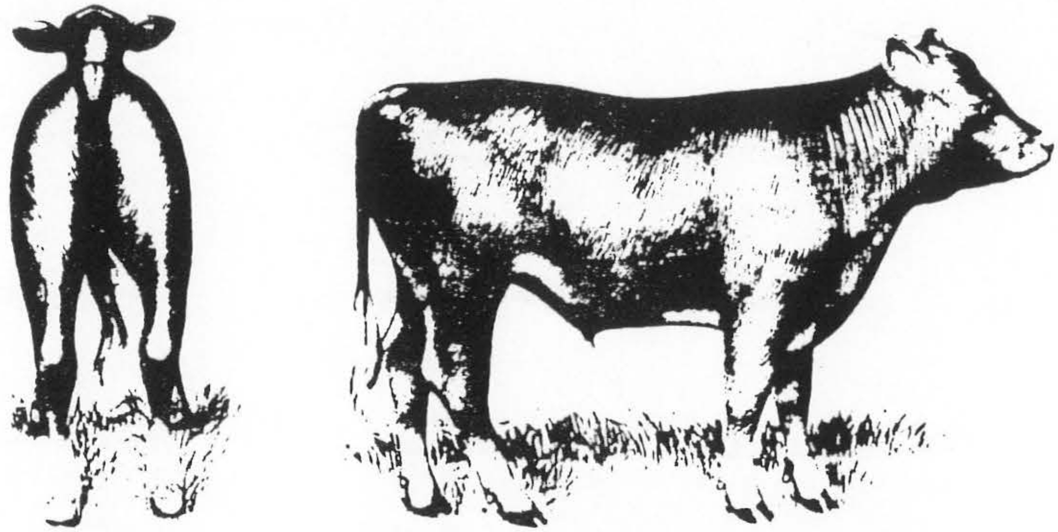
Small



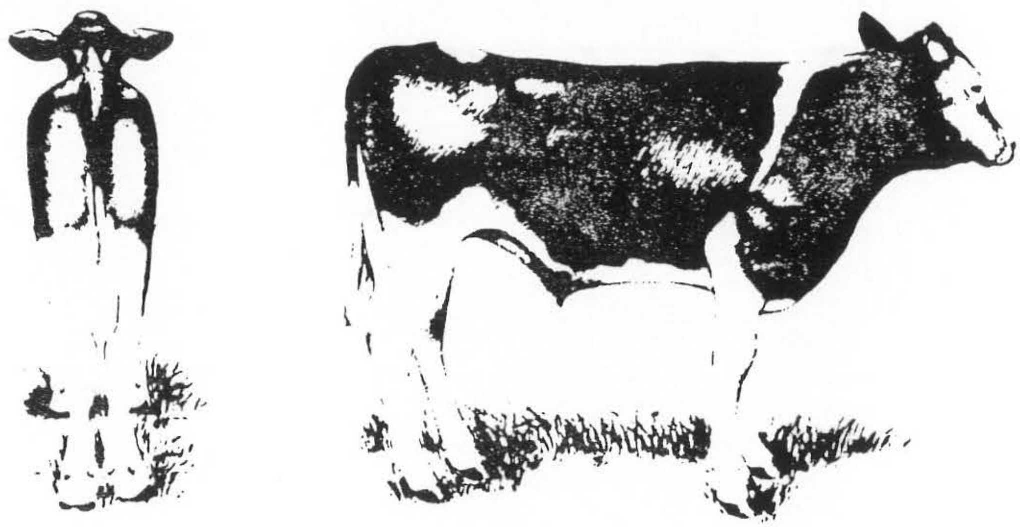
Large and medium frame pictures depict minimum grade requirements. The small frame picture represents an animal typical of the grade.

Thickness

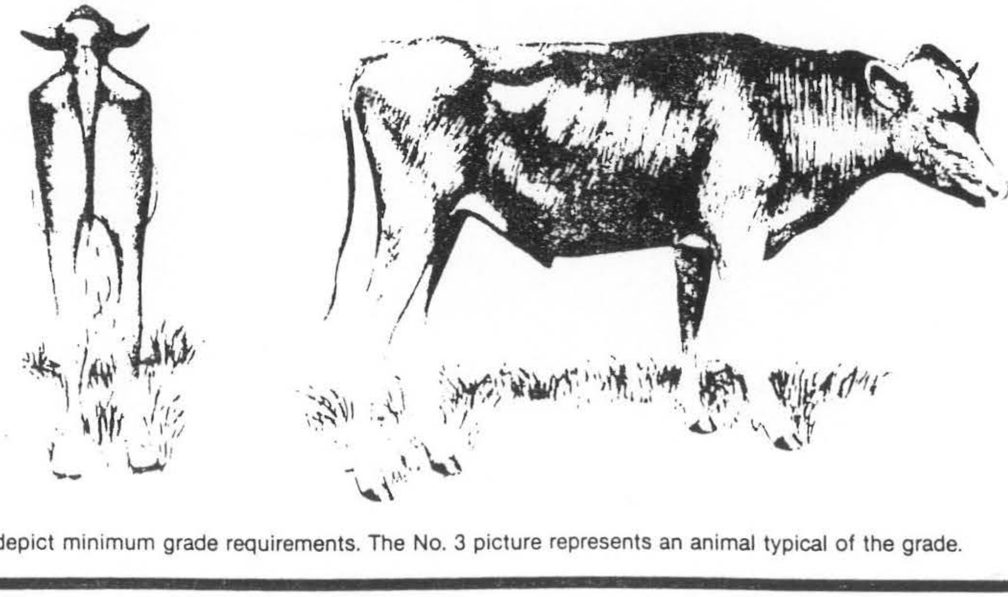
No. 1



No. 2



No. 3



No. 1 and No. 2 thickness pictures depict minimum grade requirements. The No. 3 picture represents an animal typical of the grade.

Application of Standards for Grades of Slaughter Cattle

General: Grades of slaughter cattle are intended to be directly related to the grades of the carcasses they produce. To accomplish this, these slaughter cattle grade standards are based on factors which are related to the grades of beef carcasses. Eight quality designations-Prime, Choice, Select, Standard, Commercial, Utility, Cutter, and Canner are applicable to steers and heifers. There are five yield grades, which are applicable to all classes of slaughter cattle and are designated by numbers 1 through 5, with Yield Grade 1 representing the highest degree of cutability. The grades of slaughter cattle shall be a combination of both their quality and yield grades, except that slaughter bulls are yield graded only.

Quality Grades: Slaughter cattle quality grades are based on an evaluation of factors related to the palatability of the lean, herein referred to as "quality." Quality in slaughter cattle is evaluated primarily by the amount and distribution of finish, the firmness of muscling, and the physical characteristics of the animal associated with maturity. Progressive changes in maturity past 30 months of age and in the amount and distribution of finish and firmness of muscling have opposite effects on quality. Therefore, for cattle over thirty months of age in each grade, the standards require progressive greater development of the other quality-indicating factors. In cattle under 30 months of age, a progressively greater development of the other quality indicating characteristics is not required.

Since carcass indices of quality are not directly evident in slaughter cattle, some other factors in which differences can be noted must be used to evaluate their quality. Therefore, the amount of external finish is included as a major grade factor herein, even though cattle with a specific degree of fatness may have widely varying degrees of quality. Identification of differences in quality among cattle with the same degree of fatness is based on distribution of finish and firmness of muscling. Descriptions of these factors are included in the specifications. For example, cattle which have more fullness of the brisket, flank, twist, and cod or udder and which have firmer muscling than that indicated by any particular degree of fatness are considered to have higher quality than indicated by that degree of fatness.

Yield Grades: The yield grades for slaughter cattle are based on the same factors as used in the official yield grade standards for beef carcasses. Those factors and the change in each which is required to make a full yield grade change are as follows:

Factor	Effect of increase on yield grade[1]	Approximate change in each factor required to make a full yield grade change[2]
Thickness of fat over ribeye	Decreases	4/10 in.
Percent of kidney, pelvic, and heart . . .	do	5%
Carcass weight	do	260 lb.
Area of ribeye	Increases	3 $in.^2$

[1]The yield grades are denoted by numbers 1 through 5 with Yield Grade 1 representing the highest cutability or yield of closely trimmed retail cuts. Thus, an "increase" in cutability means a smaller yield grade number while a "decrease" in cutability means a larger yield grade number.

[2]This assumes no change in the other factors.

When evaluating slaughter cattle for yield grade, each of these factors can be estimated and the yield grade determined by using the equation contained in the official standards for grades or carcass beef. However, a more practical method of appraising slaughter cattle for yield grade is to use only two factors normally considered in evaluating live cattle - muscling and fatness.

In the latter approach to determining yield grade, evaluation of the thickness and fullness of muscling in relation to skeletal size largely accounts for the effects of two of the factors - area of ribeye and carcass weight. By the same token, an appraisal of the degree of external fatness largely accounts for the effects of thickness of fat over the ribeye and the percent of kidney, pelvic, and heart fat.

These fatness and muscling evaluations can best be made simultaneously. This is accomplished by considering the development of the various parts based on an understanding of how each part is affected by variations in muscling and fatness. While muscling of most cattle develops uniformly, fat is normally deposited at a considerably faster rate on some parts than on others. Therefore, muscling can be appraised best by giving primary consideration to the parts least affected by fatness, such as the round and the forearm. Differences in thickness and fullness of these parts - with appropriate adjustments for the effects of variations in fatness - are the best indicators of the overall degree of muscling in live cattle.

On the other hand, the overall fatness of an animal can be determined best by observing those parts on which fat is deposited at a faster-than-average rate. These include the back, loin, rump, flank, cod or udder, twist, and brisket. As cattle increase in fatness, these parts appear progressively fuller, thicker, and more distended in relation to the thickness and fullness of the other parts, particularly the round. In thinly muscled cattle with a low degree of finish, the width of the back usually will be greater than the width through the center of the round. The back on either side of the backbone also will be flat or slightly sunken. Conversely, in thickly muscled cattle with a similar degree of finish, the thickness through the rounds will be greater than through the back and the back will appear full and rounded. At an intermediate degree of fatness, cattle which are thickly muscled will be about the same width through the round and the back will appear only slightly rounded. Thinly muscled cattle with an intermediate degree of finish will be considerably wider through the back than through the round and will be nearly flat across the back. Very fat cattle will be wider through the back than through the round, but this difference will be greater in thinly muscled cattle than in those that are thickly muscled. Such cattle with thin muscling also will have a distinct break from the back into the sides, while those with thick muscling will be nearly flat on top, but will have a less distinct break into the sides. As cattle increase in fatness, they also become deeper bodied because of larger deposits of fat in the flanks and brisket an along the underline. Fullness of the twist and cod or udder and the bulge of the flanks, best observed when an animal walks, are other indications of fatness.

In determining yield grade, variations in fatness are much more important than variations in muscling.

Other Considerations: Other factors such as heredity and management also may affect the development of the grade-determining characteristics in slaughter cattle. Although these factors do not lend themselves to description in the standards, the use of factual information of this nature is justifiable in determining the grade of slaughter cattle.

Muscle-How Much Do We Need To Optimize Carcass And Meat Characteristics

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Introduction

Historically, when steers were finished on pasture, ability to finish at a young age was desirable. Particularly when market requirements for fatness were great. However, ability to fatten became a handicap as we shifted to increased use of concentrate feeds in diets of growing-finishing cattle. Consequently, yield grades were added to the USDA grading system to reflect variation in carcass value associated with differences in yield of retail product. Recently, consumer pressure to reduce caloric and fat content of beef and other red meats has intensified because coronary heart disease is believed to be associated with elevated blood-cholesterol levels. Cholesterol levels are, in turn, associated with dietary intake of saturated fat. Dietary control of the type and amount of fat consumed is strongly recommended by members of the medical profession in an attempt to regulate blood-cholesterol levels. The purpose of this paper is to examine genetic variation among and within breeds in amount and distribution of muscle (lean) in beef carcasses, to evaluate opportunities to geneticly change leanness in beef carcasses, and to assess changes in other characteristics likely to result from selection among and within breeds for leanness and muscling in beef cattle.

Germ Plasm Evaluation Program

Most of my comments will be based on results from the Germ Plasm Evaluation (GEP) Program at the Roman L. Hruska U.S. Meat Animal Research Center (MARC). The GEP program is presently in the fourth cycle (Table 1). Topcross performance of 26 different sire breeds have been, or are being, evaluated in calves out of Hereford and Angus dams or calves out of F_1 cross dams. These F_1 cross dams were bred to Brahman, Devon and Holstein sires in Cycle I and to Santa Gertrudis and Brangus sires in Cycle II. Semen from the same Hereford and Angus bulls has been used throughout to produce a control population of Hereford-Angus reciprocal crosses in each cycle of the program. In addition to the repeated use of semen from control Hereford and Angus bulls, new samples of Hereford, Angus, and Charolais bulls born since 1982 are being added in Cycle IV to evaluate genetic trends within these breeds. Preliminary data are presented on genetic trends for growth and carcass and meat characteristics in Angus and Herefords from the first of five calf crops to be produced in Cycle IV. Most of my comments will be based on completed evaluations of twenty sire breeds involved in the first three cycles of the program. Data presented were pooled over Cycles I, II, and III by adding the average differences between Hereford-Angus reciprocal crosses (HAx) and other breed groups (2-way and 3-way F_1 crosses) within each Cycle to the average of Hereford-Angus reciprocal crosses (HAx) over the three cycles. Data will be presented for nineteen F_1 crosses (2-way and 3-way) grouped into seven biological types based on relative differences (X lowest, XXXXXX

Table 1. Sire Breeds Used In Germ Plasm Evaluation Program

Cycle 1 (1970-72)	Cycle II (1973-74)	Cycle III (1975-76)	Cycle IV (1986-90)
F1 crosses from Hereford or Angus dams (Phase 2)			
Hereford	Hereford	Hereford	Hereford[a]
Angus	Angus	Angus	Angus[a]
Jersey	Red Poll	Brahman	Longhorn
S. Devon	Brown Swiss	Sahiwal	Salers
Limousin	Gelbvieh	Pinzgauer	Galloway
Simmental	Maine Anjou	Tarentaise	Nellore
Charolais	Chainina		Shorthorn
			Piemontese
			Charolais
			Gelbvieh
			Pinzgauer
3-way crosses out of F1 dams (Phase 3)			
Hereford	Hereford		
Angus	Angus		
Brahman	Brangus		
Devon	Santa Gertrudis		
Holstein			

[a] Hereford and Angus sires, originally sampled in 1969, 1970, and 1971, have been used throughout the program. In Cycle IV, a new sample of Hereford and Angus sires produced after 1982 are being used and compared to the original Hereford and Angus sires.

highest) in growth rate and mature size, lean to fat ratio, age at puberty and milk production (Table 2). The carcass and meat data, obtained in cooperation with Kansas State University under the direction of Dr. Micheal E. Dikeman, are presented for 15 F^1 crosses out of Hereford and Angus dams (Koch et al., 1976,1977,1979, 1981, 1982b, 1982c).

Variation Between and Within Breeds

Retail Product

Throughout the GPE program, we have obtained closely trimmed-boneless retail product, i.e., steaks and roasts (trimmed to .3 in of external fat and boneless except for the short loin and rib roasts) and lean trim (trimmed and processed into ground beef with 25% fat content based on chemical analysis). Recently, in the GPE program we have obtained data on retail product with two levels of trim. After weights for closely trimmed retail product from each wholesale cut are recorded, retail cuts are trimmed to 0 in outside fat and are made entirely boneless. The fat trim removed between the closely trimmed (.3 in) and zero trimmed(.0 in) accounted for 4.6% of the side weight of yield grade

Table 2. Breed Crosses Grouped Into Six Biological Types On The Basis Of Four Major Criteria[a]

Breed Group	Growth Rate & Mature Size	Lean to Fat Ratio	Age To Puberty	Milk Production
Jersey	X	X	X	XXXXX
Hereford-Angus	XX	XX	XXX	XX
Red Poll	XX	XX	XX	XXX
Devon	XX	XX	XXX	XX
South Devon	XXX	XXX	XX	XXX
Tarentaise	XXX	XXX	XX	XXX
Pinzgauer	XXX	XXX	XX	XXX
Brangus	XXX	XX	XXXX	XX
Santa Gertrudis	XXX	XX	XXXX	XX
Sahiwal	XX	XXX	XXXXX	XXX
Brahman	XXXX	XXX	XXXXX	XXX
Brown Swiss	XXXX	XXXX	XX	XXXX
Gelbvieh	XXXX	XXXX	XX	XXXX
Holstein	XXXX	XXXX	XX	XXXXXX
Simmental	XXXXX	XXXX	XXX	XXXX
Maine Anjou	XXXXX	XXXX	XXX	XXX
Limousin	XXX	XXXXX	XXXX	X
Charolais	XXXXX	XXXXX	XXXX	X
Chianina	XXXXX	XXXXX	XXXX	X

[a]Increasing number of X's indicate relatively higher levels of performance on older age at puberty.

Table 3. Heritability Estimates For Retail Product Yields

Source	Retail Product Weight	Retail Product Percentage
Cundiff et al., (1964)		.40[a]
Swinger et al., (1965)	.65	.24
Cundiff et al., (1969,1971)	.64	.28
Dinkel and Busch (1973)	.38	.66[a]
Koch (1978)	.38	
Benyshek (1981)	.55	.49[a]
Koch et al. (1982a)	.58	.63
Average	.53	.45

[a] Cutability: Estimated percentage of retail product from the round, loin, rib, and chuck.

1 cattle and 5.3, 5.5 and 5.5% of the side weight of yield grades 2, 3 and 4 cattle, respectively (Crouse et al., 1988). Thus, there is a high degree of association between closely trimmed and zero trimmed retail product, especially in cattle of yield grades 2, 3, and 4. In this presentation variation in growth and distribution of muscle will be assessed as reflected by variation in growth and distribution of closely timmed retail product.

The genetic variation that exists in proportions of muscle and fat of beef carcasses is vast and under a high degree of genetic control. The variation observed among steers of the same breed which are fed and managed under uniform conditions and compared at the same slaughter age is highly heritable for both weight and percentage of retail product (Table 3).

Results for retail product growth to 458 days of age are summarized in Figure 1. Means are shown on the lower horizontal axis for F_1 crosses. The spacing on the vertical axis is arbitrary but the ranking of biological types (separate bars) from the bottom to top reflect, generally, increasing increments of mature size. Breed rankings within each biological type are noted within each bar. Steers sired by bulls of breeds with larger mature size produced significantly more retail product than steers sired by bulls of breeds with small mature size.

In Figure 1, differences are doubled in the upper horizontal scale to reflect variation among pure breeds relative to a standard deviation change in breeding value $[\sigma g\_ \ (\sigma^2 p)\ (h^2)]$ within pure breeds for weight of retail product at 458 days of age (Cundiff et al., 1986). Frequency curves, shown for Jersey, the average of Hereford and Angus, and Chianina, reflect the distribution expected for breeding values of individual animals within pure breeds assuming a normal distribution (i.e., 68, 95 or 99.6% of the observations are expected to lie within the range bracketed by the mean $\pm$ 1, 2, or 3 standard deviations, respectively). The breeding value of the heaviest Jersey is not expected to equal that of the lightest Chianina and heaviest Hereford and Angus would only equal the lightest Chianina in genetic potential for retail product growth to 458 days. The range for mean differences between breeds is estimated to be about 5.7 σg between Chianina and Hereford or Angus steers and about 8.2 σg between Chianina and Jersey steers. Genetic variation, both between and within breeds is considerable for this important measure of output. When both between and within breed genetic variations are considered, the range in breeding value from the smallest Jersey steers to the heaviest Chianina steers is estimated to be 180 kg, or 88% of the overall mean. About half of the variation among breeds in retail product at 458 days of age is associated with variation in carcass weight and half is associated with composition or percentage of the carcass accounted for by retail product.

In general, breeds that excel in growth of total carcass weight also excel in percentage of retail product (Figure 2). This raises the question, has selection for growth to weaning or yearling ages within breeds had a favorable effect on percentage of retail product? Preliminary estimates of genetic trends in the Hereford and Angus breeds

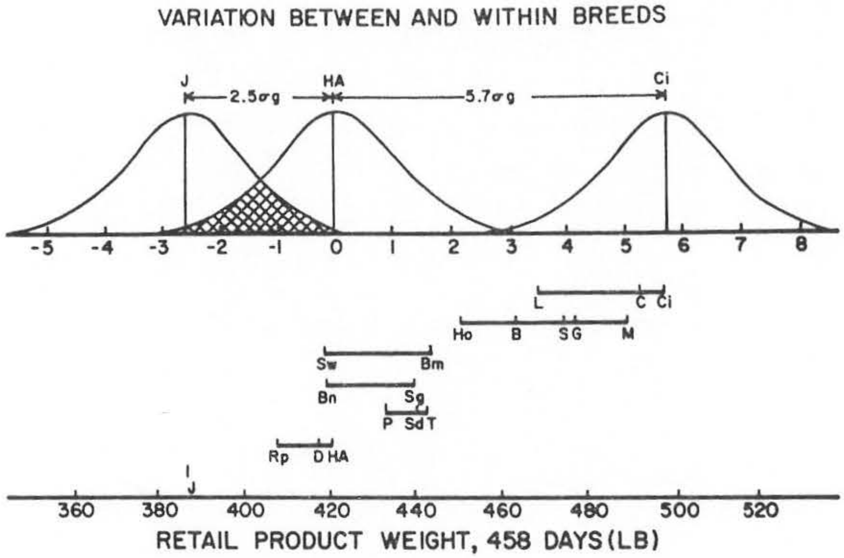

Figure 1. Breed group means (F_1 crosses, lower axis) and genetic variation between and within breeds (σg, standard deviation in breeding value, upper axis) for weight of retail product at 458 days (Adapted from Cundiff et al., 1986). See Table 2 for abbreviations.

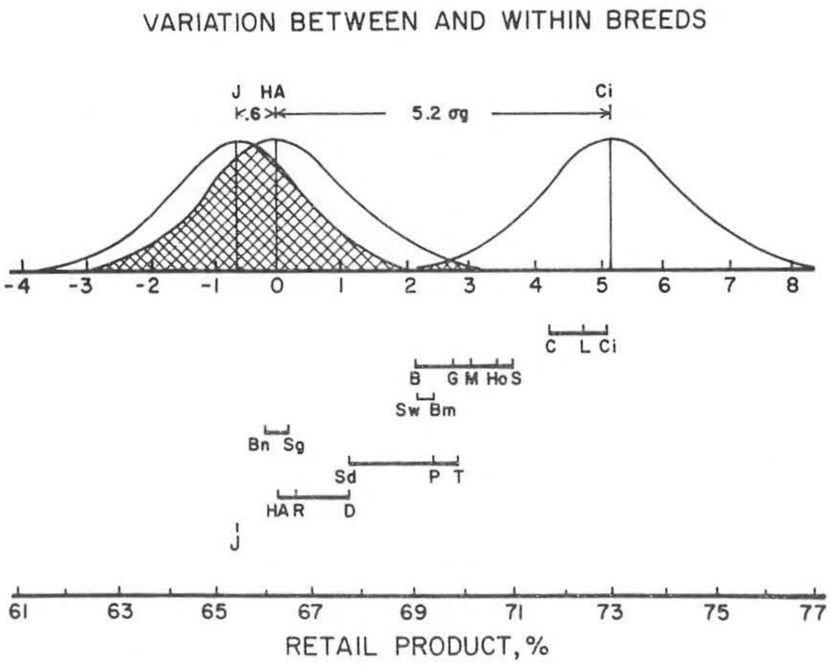

Figure 2. Breed group means (F_1 crosses, lower axis) and genetic variation between and within breeds (σg, standard deviation in breeding value, upper axis) for retail product as a percentage of carcass weight at 458 days of age (Adapted from Cundiff et al., 1986). See Table 2 for abbreviations.

are reflected in Table 4, comparing progeny of 17 Hereford bulls (9 polled and 8 horned) and 15 Angus bulls sampled broadly and born since 1982 to 11 Herefords and 14 Angus produced in the late 1960's and used throughout the GPE Program. The preliminary nature of these results must be emphasized because they are based on just the first of five calf crops being produced in Cycle IV of the GPE Program. Indications are that significant change from growth to slaughter ages has accrued in both Herefords and Angus between the late 1960's and the early 1980's. This was expected in view of the selection emphasis that seedstock

Table 4. Genetic Change in Hereford and Angus Breeds in Final Weight and Carcass Characteristics As Reflected By Progeny of Bulls Born In Late 1960's (Original) Versus Progeny of Bulls Born In Mid 1980's (Current)[a]

Breed Group	No. Steers	Final Weight lb	Dress Percent %	USDA Choice %
Hereford Sires				
Original	38	1056	61.0	75.6
Current	35	1091	60.6	44.7
Angus Sires				
Original	32	1056	61.3	77.0
Current	30	1096	61.0	78.0

Breed Group	Est. Cut. %	Fat Thick-ness in	Rib Eye Area Sq in	Kidney Pelvic & Heart Fat %
Hereford Sires				
Original	49.4	.51	10.55	2.5
Current	49.3	.48	10.23	2.6
Angus Sires				
Original	49.3	.47	10.79	3.0
Current	49.3	.48	10.74	2.7

[a]Preliminary results from first of five calf crops produced in Cycle IV of Germ Plasm Evaluation Program at the Roman L. Hruska U.S. Meat Animal Research Center, Data are averaged over Hereford and Angus dams.

breeders in both of these breeds have placed on growth rate and skeletal size during this period. However, indications to date, are that carcass composition has not changed significantly in cattle compared at the same age. Estimates for fat thickness and estimated cutability (retail product from round, loin, rib and chuck expressed as a percentage of carcass weight) are about the same for progeny of original sires as for progeny of current sires in both breeds. These results indicate that selection for weight and skeletal size will not significantly change carcass composition. This result is consistent with previous estimates of genetic trends which have been predicted on the basis of estimates of heritability and genetic correlation found within breeds (Cundiff et al., 1969; Koch et al., 1982a). Selection within breeds can effectively change rate and composition of growth, but some direct selection pressure must be applied against fatness at the same time that live weight is considered in order to change composition of growth.

Distribution of Retail Product

An evaluation of differences in distribution of retail products, bone and fat trim among the round, loin, rib, chuck and minor cuts (shank, brisket, plate and flank) showed little variation in muscle and bone distribution (Figure 3). Again, this result is consistent with findings that the genetic correlations between retail product yield in one cut are highly correlated with that in other cuts and that selection to shift the distribution of muscle from lower valued cuts to higher valued regions of the carcass would be ineffective (Cundiff et al., 1969). Even among breeds as diverse as Jersey and Charloais, there is little opportunity to shift muscle as a proportion of carcass weight from one cut into another. Similar results have been found between Bos indicus and Bos taurus breeds evaluated by Australian scientists (Berg and Butterfield, 1976).

Antagonistic Relationships

With so much genetic variation between breeds for retail product growth to a constant age (Figure 1), it is valid to ask why hasn't more been done to exploit this variation. In dairy production in the United States, Holsteins which excel in fluid milk yield have replaced the vast majority of cows of other breeds with lower genetic potential for fluid milk yield. It is estimated that Holsteins produce 90% of the milk marketed in the United States. In beef production in the United States, breeds that excel in output of retail products have not been substituted nearly to this extent for those with lower output potential--Why? In part, the answer lies in trade-offs resulting from antagonistic genetic relationships between retail product growth and other traits important to efficiency of beef production. Antagonistic relationships between retail product growth and other characteristics will be discussed in other contributions to the proceedings of this conference. In this paper, only the relationships between retail product growth and other carcass characteristics will be emphasized.

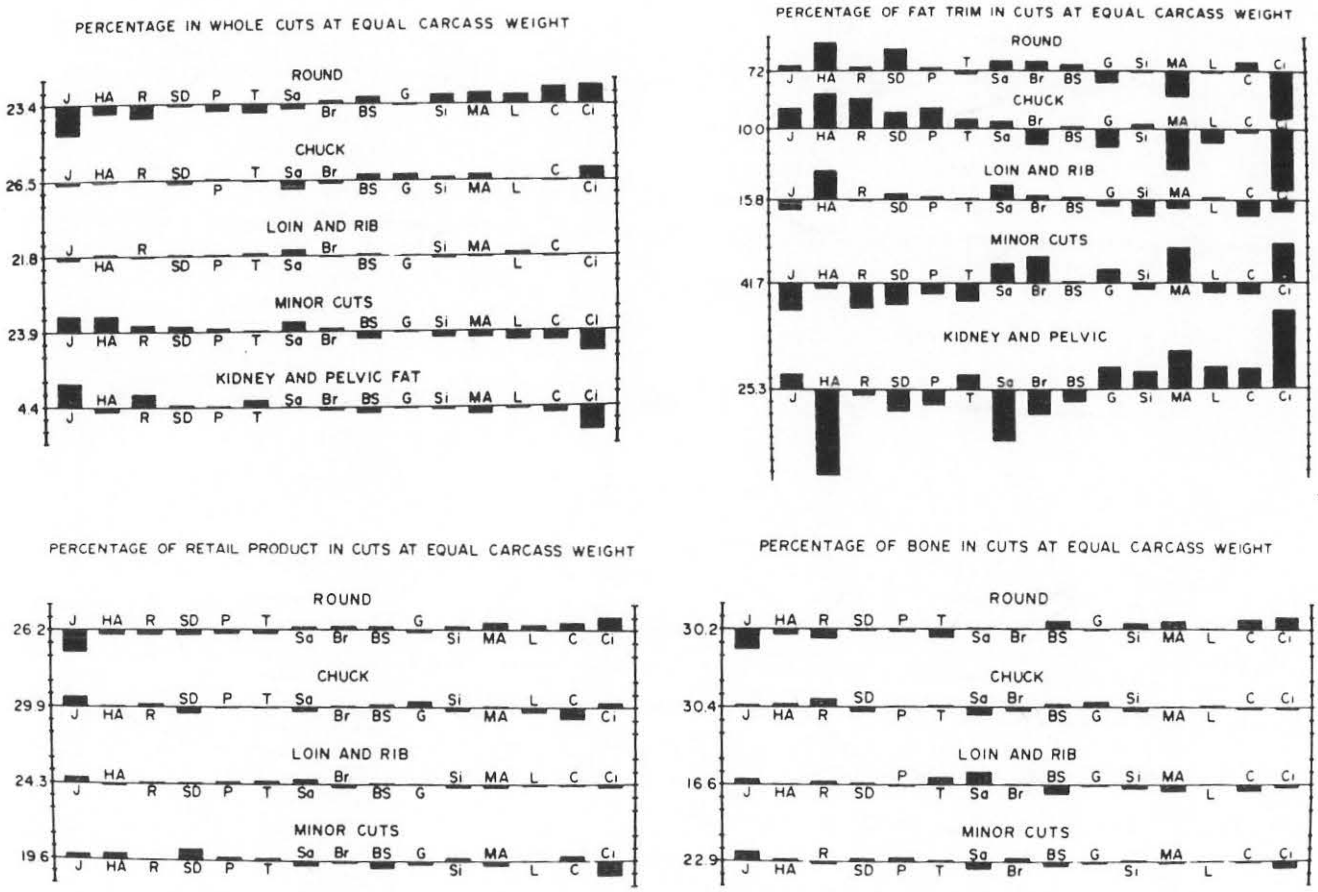

Figure 3. Percentage of carcass in wholesale cuts and percentage of total retail product, fat trim and bone in each cut at an equal carcass weight (Adapted from Koch, et al., 1977, 1981, 1982b). See Table 2 for abbreviations.

Marbling

Degree of marbling (i.e., deposits of fat interspersed in muscle) in the twelfth rib cross-section of the rib eye muscle is currently the primary determinant of USDA quality grade among carcasses of cattle of the same age. Traditionally, marbling has been emphasized because it was believed to be associated with palatability characteristics of meat. Some studies have shown a positive relationship between marbling and palatability characteristics, especially sensory panel ratings for tenderness or Warner-Bratzler shear force, while other have shown a very low or nonexistent relationship (Smith et al., 1984).

Significant genetic variation exists between and within breeds for propensity to deposit marbling (Figure 4). Again, the range for differences between breeds is about equal to the range for breeding value of individual animals within breeds for marbling. Within breeds, variation in marbling was highly heritable (.40). However, it is much easier to use information on variation among breeds than within breeds for marbling because of the difficulty of measuring marbling levels in live bulls and heifers used for breeding. Also, heritability of breed differences is high (approximately 100%), provided the breed means are estimated with an adequate sample to average out errors of sampling individual animals within breeds. The tendency for progeny from individual animals to regress to their own breed group mean is much greater than any tendency to regress to the mean of all cattle.

Unfortunately, breeds that rank highest for retail product percentage rank lowest for marbling (Figure 5). Similarly, high negative genetic correlations have been found within breeds between marbling and retail product percentage. Thus, only limited opportunity exists from between breed selection or from within breed selection for genetically increasing marbling without increasing fat trim and reducing retail product percentage. This antagonistic relationship between retail product percentage and marbling, or between USDA yield grade and USDA quality grade has deterred the substitution of breeds to those that excel in leanness and yield grade from those with lower yield grades but higher USDA quality grades.

Marbling and Palatability

Concern with the antagonism between marbling and retail product percentage is justified to the extent that a certain amount of marbling is required to insure palatability of the retail product. Sensory panel evaluations of uniformly cooked 10th rib steaks from about 1,230 steers produced in the GPE program are summarized in Table 5. High levels of acceptance were found for steaks from all Bos taurus breed groups when the steers were fed and managed alike and slaughtered at 14 to 16 months of age. In these studies, sensory scores were assigned on a 9 point scale from 1 = extremely undesirable (e.g., extremely tough), 5= acceptable, up to 9 = extremely desirable (e.g., extremely tender). Average taste panel scores and Warner-Bratzler shear determinations for tenderness did tend to improve as marbling increased when comparisons were at the same age but, the change was very small. Although, breed groups differed significantly in average marbling scores and in percentage of carcasses that had adequate marbling to grade USDA Choice or better, average sensory panel evaluations of tenderness, flavor and juiciness were acceptable for all breed groups.

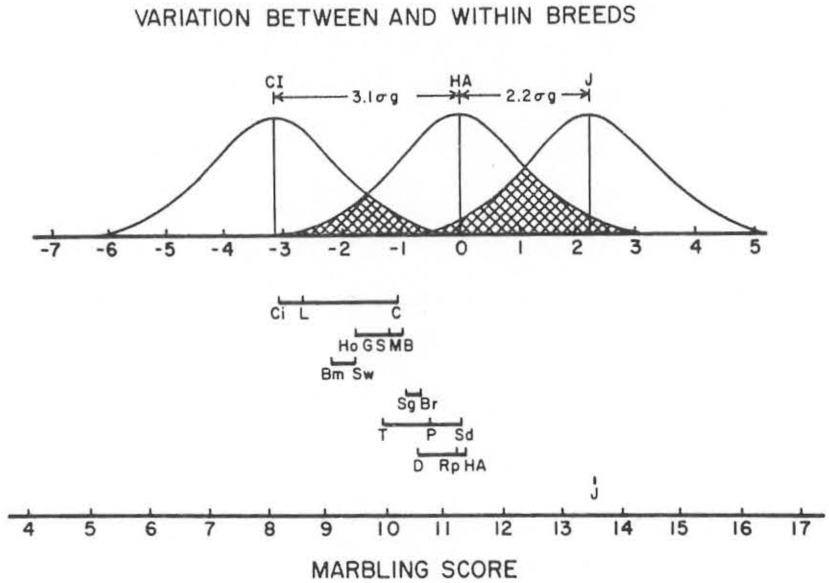

Figure 4. **Breed group means (F_1 crosses, lower axis) and genetic variation between and within breeds (σg, standard deviation in breeding value, upper axis) for marbling score (5 = traces, 8 = slight, 11 = small, 14 = modest) at 458 days of age (Adapted from Cundiff et al., 1986). See Table 2 for abbreviations.**

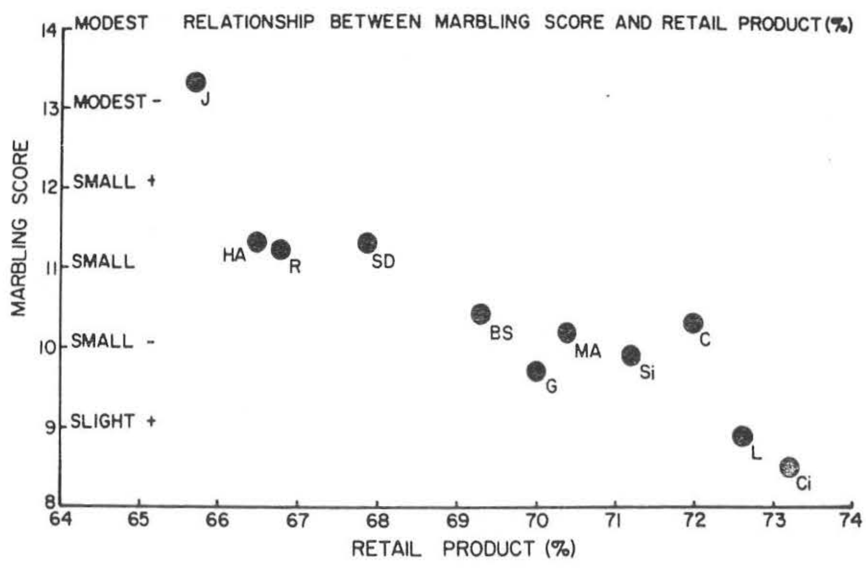

Figure 5. **Breed group means for retail product percentage versus marbling score at 458 days of age (Adapted from Koch et al., 1976, 1979, 1982c). See Table 2 for abbreviations.**

Table 5. Breed Group Means for Factors Identified With Meat Quality

Breed Crosses	Marbling[a]	Percent USDA Choice	Warner-Bratzler shear[b] (lb)
Chianina-X	8.3	24	7.9
Limousin-X	9.0	37	7.7
Brahman-X	9.3	40	8.4
Gelbvieh-X	9.6	43	7.8
Sahiwal-X	9.7	44	9.1
Simmental-X	9.9	60	7.8
Maine-Anjou-X	10.1	54	7.5
Tarentaise-X	10.2	60	8.1
Charolais-X	10.3	63	7.2
Brown Swiss-X	10.4	61	7.7
Pinzgauer-X	10.8	60	7.4
South Devon-X	11.3	76	6.8
Hereford-Angus-X	11.3	76	7.3
Red Poll-X	11.5	68	7.4
Jersey-X	13.2	85	6.8

Breed Crosses	Sensory Panel Scores[c]		
	Flavor	Juiciness	Tenderness
Chianina-X	7.3	7.2	6.9
Limousin-X	7.4	7.3	6.9
Brahman-X	7.2	6.9	6.5
Gelbvieh-X	7.4	7.2	6.9
Sahiwal-X	7.1	7.0	5.8
Simmental-X	7.3	7.3	6.8
Maine-Anjou-X	7.3	7.2	7.1
Tarentaise-X	7.3	7.0	6.7
Charolais-X	7.4	7.3	7.3
Brown Swiss-X	7.4	7.2	7.2
Pinzaguer-X	7.4	7.2	7.1
South Devon-X	7.3	7.4	7.4
Hereford-Angus-X	7.3	7.3	7.3
Red Poll-X	7.4	7.1	7.3
Jersey-X	7.5	7.5	7.4

[a] Marbling: 8 = slight, 11 = small, 14 = modest, 17 = moderate.
[b] Shear force required for a 1 in. core of cooked steak.
[c] Taste panel scores: 2 = undesirable, 5 = acceptable, 7 = moderately desirable, 9 = extremely desirable.

However, variation in sensory panel tenderness scores (see standard deviations, Table 6) tends to be greater in cattle with low levels of marbling than in cattle with high levels of marbling (Koch et al., 1988). This in turn leads to greater risk of at least some steaks having less than acceptable tenderness at low levels of marbling. In Bos taurus sired cattle with a slight degree of marbling (USDA Select), 3% of the steaks were scored as less than acceptable (sensory panel scores of <5) in tenderness. In Bos taurus sired cattle with moderate or greater degrees of marbling (USDA high choice or Prime), 0% of the steaks were scored as less than acceptable (i.e., 100% had scores $\geq$ 5). Sensory panel scores for steaks from Bos indicus sired steers were lower for tenderness than those from Bos taurus sired steers, even at the same degree of marbling.

Caloric Density of Retail Product

Dairy processors have developed and effectively marketed products with a similar range in caloric content to that found between Chianina and Jersey steers. Low fat milk (2% fat content) contains 20% fewer calories per one cup serving than regular milk (3.5% fat content). Similar ranges can be achieved in beef products by fabrication and marketing of totally-trimmed retail cuts. The key to production of low calorie beef products is total trimming. Fat contains 225 calories per ounce. Caloric content of totally-trimmed beef varies depending on the level of intramuscular fat (marbling) in the lean. Composition and estimates of caloric content in 1 oz portions of uncooked longissimus (rib-eye) muscle with different USDA quality grades and degrees of marbling are shown in Table 7. Muscle with a slight degree of marbling (USDA Select quality grade) is about 3.7% fat and contains about 40 kcal per ounce. Muscle from carcasses grading USDA Choice range from about 4.7 to 9.3% fat and contain about 43 to 51 kcal per ounce. Muscle from carcasses in the USDA Prime grade range from about 9.2 to 12.7% fat and contain 52 to 60 kcal per oz.

Breed group means for calories originating from the lean, intra-muscular fat, and inter-muscular fat components of 100 gram (3.5 oz) uncooked portions of retail product are presented in Table 8. External and inter-muscular fat (averaging 20.6% over all breeds) accounted for a much greater proportion of total fat in the retail product than intra-muscular (i.e., marbling) fat (averaging 4.0%). Variation among breeds was important for both percentage of external and intra-muscular fat (range 2.6 percentage units) and for percentage of inter-muscular fat (range of 3.2%). On the average, a 100 g portion of uncooked retail product containing a total of 280 kcal, would have 83 kcal originated from protein (29.7%), 34 kcal originated from intra-muscular fat (12.2%) and 163 kcal originated from external and inter-muscular (58.3%). Caloric content of retail products is markedly reduced by total trimming of visible fat. Total trimming will obviously favor production of carcasses with a higher percentage of retail product and less fat trim. Caloric content of totally-trimmed portions (lean and intra-muscular fat only) contained an average of 117 kcal. For totally-trimmed retail product, the range among F_1 breed groups was 14 kcal (111 for Chianina crosses to 125 kcal for Jersey crosses). Since topcross comparisons estimate only half of the difference between breeds, estimates of the range between F_1 crosses can be doubled to estimate the range between pure breeds--28 kcal or from about 99 kcal for Chianina to 127 kcal for Jersey steers.

Table 6. Effects of Marbling on Sensory Panel Tenderness in Bos Taurus and Bos Indicus Crosses (Koch et al., 1988)[a]

Bos taurus sired[b]				
Marbling degree	No. steers	Average score	Standard dev.	Score less than acceptable (<5,%)
P. Devoid	3	5.1	1.2	66.7
Traces	68	6.7	1.1	10.3
Slight	362	7.0	.9	3.0
Small	389	7.3	.8	1.3
Modest	161	7.4	.8	1.9
Moderate	59	7.7	.6	0
Sl. Abundant	24	7.8	.5	0
Md. Abundant	8	7.4	.8	0
Abundant	5	8.1	.5	0

Bos indicus sired[c]				
Marbling score	No. steers	Average score	Stand. dev.	Score less than acceptable (<5,%)
P. Devoid				
Traces	20	5.7	1.1	15.0
Slight	61	5.8	1.3	24.6
Small	50	6.5	1.2	10.0
Modest	10	6.5	1.0	10.0
Moderate				
Sl. Abundant	1	7.7		0
Md. Abundant				
Abundant				

[a] Sensory panel scores for tenderness ranged form 1 = extremely tough, 5 = acceptable, 9 = extremely tender.
[b] Angus, Brown Swiss, Charolais, Chianina, Gelbvieh, Hereford, Jersey, Limousin, Maine Anjou, Pinzagaur, Red Poll, Simmental, South Devon and Tarentaise sired topcrosses out of Hereford and Angus dams produced on Cycles I, II and III of the Germ Plasm Evaluation Program.
[c] Brahman and Sahiwal sire topcrosses out of Herefords and Angus dams produce in Cycle III of the Germ Plasm Evaluation Program.

Table 7. Composition and Caloric Content of L. Dorsi (Rib Eye) Muscle With different Degrees of Marbling (1 oz Uncooked Portion)

Quality grade	Marbling	Chem. fat[a] %	kcal	Protein[b] %	kcal	Total kcal
	Fat free	0	0	27.0	31.5	31.5
Standard	Practically devoid	.7	1.9	26.8	31.3	33.1
Standard	Traces	2.2	5.8	26.4	30.7	36.5
Good	Slight	3.7	9.8	26.0	30.2	40.0
Choice	Small	5.2	13.7	25.6	29.6	43.4
Choice	Modest	6.7	17.8	25.2	29.1	46.8
Choice	Moderate	8.2	21.7	24.8	28.5	50.2
Prime	Slightly abundant	9.7	25.7	24.4	27.9	53.6
Prime	Moderately abundant	11.2	29.7	24.0	27.4	57.1
Prime	Abundant	12.7	33.7	23.6	26.8	60.5

[a] Chemical fat, % = - .3 + .5(M) where M = 5 for traces, 8 for slight, ..., and 17 for moderate degrees of marbling (Campion et al., 1975) and fat contains 9.3 kcal per gram (Ganong, 1977).

[b] Lean is 27% protein (NAS, 1967) and protein contains 4.1 kcal per gram (Ganong, 1977).

Table 8. Breed group (F_1 Cross) Means for Caloric Content of Retail, 100 g (3.5 oz) Uncooked Portion (Cundiff,1986)

Breed group	Lean protein kcal	intra-musc. fat kcal	inter-musc. fat kcal	Total kcal	Lean and intra-musc. fat only kcal
Jersey-X	79	46	180	305	125
Hereford-Angus-X	81	42	172	294	123
Red Poll-X	80	40	177	297	120
South Devon-X	82	39	167	287	121
Tarentaise-X	84	33	159	276	117
Pinzgauer-X	83	39	160	281	122
Sahiwal-X	84	30	161	275	114
Brahman-X	84	30	164	276	113
Brown Swiss-X	83	32	164	280	116
Gelbvieh-X	84	33	160	277	117
Simmental-X	84	33	156	273	117
Maine Anjou-X	83	32	164	280	115
Limousin-X	86	26	154	266	111
Charolais-X	84	33	156	274	117
Chianina-X	86	25	155	265	111
Range (R)	7	21	26	40	14

Significant opportunity exists to breed and produce cattle which will provide for two types of beef: 1) lean beef that is low in fat and caloric content more suited to customers seeking to limit dietary intake of saturated fats, and 2) highly marbled beef that is well suited to the gourmet food trade where customers are most concerned about the risk of serving or consuming an occassional steak with less than acceptable tenderness than they are about risk of consuming too much fat.

Conclusion

The variation that exists in biological traits of economic importance to beef production, including carcass leanness, is vast and under a high degree of genetic control. Genetic variation found between breeds is comparable in magnitude to that found within breeds for most growth and carcass traits. Thus, significant genetic change can result from selection both between and within breeds.

Between breed differences are more easily exploited than genetic variation within breeds because they are more highly heritable. Also, use of genetic variation within breeds is complicated by difficulties of estimating carcass characteristics in live animals used for breeding or by the increased generation interval and other costs associated with progeny testing.

Even though large differences exist among breeds in shape of muscle, there is little variation among breeds in distribution of muscle systems (e.g., Jersey and Limousin crosses do not differ in percentage of retail product contributed by the loin and rib).

The genetic variation both between and within breeds can be used to provide an array of beef products that differ widely in fat and caloric content. Cattle with the greatest retail product growth potential produce carcasses with lower levels of marbling and totally-trimmed retail cuts with lower fat and caloric content. These cattle are especially well suited for marketing opportunities for low fat or low caloric beef with acceptable palatability characteristics. Cattle with greater marbling potential are more suited to marketing opportunities for the gourmet food trade where the risk of occasional steaks with unacceptable tenderness must be minimized.

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MUSCLE: HOW MUCH DO WE NEED? EFFECTS ON GROWTH, REPRODUCTION AND MATERNAL ABILITY

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The selection history in purebred livestock has been characterized by cycles of emphasis on various dimensional characteristics. These cycles usually began with an interest in correcting a substantial shortcoming in the livestock in existence. For example, emphasis on increased frame size in cattle came along at a time when there were too many cattle with insufficient frame to efficiently produce a lean, high quality carcass. Similarly, the emphasis in the swine industry on leanness and muscling that began 30 to 40 years ago was dictated by a prevalence of lard-type pigs in the industry at a time when the value of lard declined rapidly.

These initial good intentions produced needed changes as people recognized the need for change and identified those individuals with the desired attributes. Unfortunately, single minded selection programs may lead to dedication to extremes. This state of affairs precipitated the need for this conference. In addition, dedication to extremes has frequently lead to a biological backlash by the animals involved. Extreme emphasis on compact cattle may have been behind the problems with dwarfism in some breeds. Even though it was never clearly identified, many observers felt that carriers of dwarfism had some visual quality that lead to their selection more frequently than non-carriers. In similar fashion, extreme emphasis on leanness in swine resulted in an increased incidence of stress syndrome and its associated problems with meat quality and productivity. In this case, there was a clear advantage in leanness of the carriers of the stress gene. We may be seeing a similar pattern in the sheep industry with the current problems with spider syndrome and its possible relationship to extreme emphasis on height. It appears that genetically altering one aspect of development without adequate attention to the overall well being of the animal will ultimately lead to a revolt by Mother Nature.

Current attitudes suggest that improvement in muscling and leanness is in order in the beef industry. This is dictated by several forces, not the least of which is the move toward specification programs by many of the major beef packers. Perhaps this is an opportune time for a change since extreme emphasis on height has not (yet?) lead to the types of substantial genetic problems outlined previously. The purpose of this paper is to predict the types of changes in productivity traits that will occur as a result of emphasis on muscling and leanness.

Correlated Genetic Change. Genetic change in many traits is fairly easy to achieve, although the process is fairly slow in beef cattle because of the low reproductive rate and long generation interval. All that is needed is an accurate evaluation of the trait in question and a willingness to choose only superior individuals as replacements. Careful evaluation of several items needs to be considered when choosing traits to include in a selection program. The first item is the economic importance of the trait. Selection pressure is a precious commodity, especially in cattle, and should not be squandered on traits that do not contribute to efficient production. The heritability of the trait is also important. Heritability is a measure of the relationship between phenotype and genetic merit. As such, it provides an indication of the ease with which genetic progress can be obtained. Ease of measurement is a third consideration. Some traits may be important economically, but the expense of measurement outweighs the advantages to be gained by using them as a selection criteria. The last consideration is the relationship between traits. If traits have a genetic relationship, we must consider those relationships when designing selection programs.

Genetic relationships exist if genes control more than one characteristic. These relationships are measured with the genetic correlation. As a correlation, it may have values between -1 and +1. A genetic correlation with a high absolute value indicates that selection for one trait will cause large changes in another trait. A genetic correlation near 0 indicates little relationship and little response in the second trait due to selection pressure on the first trait. These relationships may be favorable or unfavorable. For example, selection for increased yearling weight leads to increases in weaning weight. It will also lead to increased birth weight and an accompanied increased incidence of calving difficulty. Correlated changes such as these must be considered when selection objectives are established.

The selection criterion to be considered in this discussion is muscling. The previous paper included information on correlated changes in other carcass characteristics. This discussion will center on the effect that selection for increased muscling will have on growth, reproduction and maternal ability. Three major points will be included: evidence on these genetic relationships from breed comparisons, the effects of selection of heavily muscled individuals within breeds and the ultimate problems that may arise if muscling is emphasized too extensively.

Breed differences. Part of the selection process involves choosing appropriate breeds for a particular crossbreeding system. The entire complex of traits must be considered when a breed is chosen. Each breed has distinct characteristics and will bring a different set of advantages and disadvantages to the commercial beef producer. The most extensive breed comparison study to date is the Germ Plasm Evaluation Project at the U.S. Meat Animal Research Center in Clay Center, Nebraska. A recent review of this project appeared in the Proceedings of the 3rd World Congress on Genetics Applied to Livestock Production (Cundiff et al. 1986). They summarized the results with a table of general comparisons which is shown here in table 1.

Table 1. **Breed crosses grouped in biological type on the basis of four major criteria[a]**

Breed Group	Growth Rate & Mature Size	Lean to Fat Ratio	Age at Puberty	Milk Production
Jersey	X	X	X	XXXXX
Hereford-Angus	XX	XX	XXX	XX
Red Poll	XX	XX	XX	XXX
Devon	XX	XX	XXX	XX
South Devon	XXX	XXX	XX	XXX
Tarentaise	XXX	XXX	XX	XXX
Pinzgauer	XXX	XXX	XX	XXX
Brangus	XXX	XX	XXXX	XX
Santa Gertrudis	XXX	XX	XXXX	XX
Sahiwal	XX	XXX	XXXXX	XXX
Brahman	XXXX	XXX	XXXXX	XXX
Brown Swiss	XXXX	XXXX	XX	XXXX
Gelbvieh	XXXX	XXXX	XX	XXXX
Holstein	XXXX	XXX	XX	XXXXX
Simmental	XXXXX	XXXX	XXX	XXXX
Maine-Anjou	XXXXX	XXXX	XXX	XXX
Limousin	XXX	XXXXX	XXXX	X
Charolais	XXXXX	XXXXX	XXXX	X
Chianina	XXXXX	XXXXX	XXXX	X

[a] more X's are associated with more rapid growth, higher lean to fat ratio, later age at puberty or higher milk production

Those breeds with higher lean to fat ratio (more muscling) tended to have higher growth rate and mature size. The relationships with age at puberty and milk production are less clear. The breeds with extremely high lean to fat ratio (Limousin, Charolais and Chianina) generally showed later age at puberty and lower milk production. This has lead some to conclude that the relationship between muscling and these "female" traits is strong and undesirable. However, breeds such as the Gelbvieh, Simmental and Maine-Anjou had fairly high lean to fat ratio and were average, or better than average, for age at puberty and milk production. Comparison of breeds does not lead to a clear understanding of the relationships among these traits. The choice of breeds should be made with an understanding of the relative merits of the breeds and an awareness of the selection history in each of the breeds under consideration.

Relationship between muscling and growth. Selection for increased muscling should be expected to have an impact on growth rate since the ratio of lean tissue to fat tissue should change and lean and fat are not added with equal efficiency. There have been several studies investigating the correlation between growth and carcass merit. Three of the more important investigations have been those of Cundiff et al (1971); Dinkel and Busch (1973) and Koch et al (1982). The first of these used data from the Hereford, Angus, Shorthorn crossbreeding project at Ft. Robinson, Nebraska. Some of the results are presented in table 2. Carcass weight at a constant age was their measure of growth performance.

Table 2. Genetic correlations between carcass weight and measures of carcass composition (from Cundiff et al, 1971).

		Correlations	
	fat thickness	rib eye area	Cutability
carcass weight at constant age	.34	.66	-.33

Dinkel and Busch (1973) evaluated Hereford steers reared in private herds in South Dakota. These results are presented in table 3.

Table 3. Estimates of genetic correlations between growth and carcass merit in Hereford steers (from Dinkel and Busch, 1973).

		Correlations		
	muscling score	rib eye area	fat thickness	Cutability
feedlot daily gain	.26	.49	-.25	.50
final weight	.24	.54	-.56	.74

Koch et al (1982) obtained within breed correlations from 2453 steers by 16 sire breeds in the US MARC Germ Plasm Evaluation Project. These results are presented in Table 4.

Table 4. Estimates of genetic correlations between growth and carcass merit in steers from several breed groups (Koch et al, 1982).

	retail product %	fat thickness	rib eye area
birth weight	.05	-.27	.31
feedlot daily gain	-.13	.05	.34

These studies were in general agreement that selection for increased rib eye area should lead to an increase in weight at a given age and rate of growth. The results from Koch et al (1982) also suggest that selection for increased muscling will result in an increase in birth weight. This would be expected to lead to increased incidence of calving difficulty.

A long term selection study has been conducted at Ft. Robinson and Clay Center, Nebraska (Buchanan et al, 1982a,b). The study involved Hereford cattle and included lines selected for 1. increased weaning weight, 2. increased yearling weight and 3. larger values of an index that included both yearling weight and muscling score. Results indicated that direct response to selection for yearling weight may be enhanced by inclusion of muscling score.

It can be concluded that, if muscling can be accurately measured, selection for increased muscling will not have a detrimental effect on rate of growth. In fact, if used in conjunction with selection for increased growth rate, it may aid in genetic evaluation of growth potential.

Relationship between muscling and cow traits. The literature base concerning the relationship between carcass characteristics and reproduction or maternal ability is quite small. One rather large study was conducted using cattle from seven breeds in the Germ Plasm Evaluation Project (MacNeil et al, 1984). Data from approximately four female and five male progeny each of 187 sires were used to investigate the correlations between carcass traits in steers and reproductive and maternal traits in their half-sib sisters. Some results are shown in table 5.

Table 5. Estimated genetic correlations between growth and composition traits measured on steers and reproduction and productivity traits measured on female half-sibs.

	Male traits			
female traits	postweaning daily gain	carcass weight	fat trim	retail product
age at puberty	.16	.17	-.29	.30
weight at puberty	.07	.07	-.31	.08
conceptions/service	1.33	.61	.21	.28
gestation length	-.10	.03	-.07	.13
calving difficulty	-.60	-.31	-.36	-.02
birth weight	.34	.37	-.07	.30
progeny preweaning gain	-1.02	-1.00	-1.25	-.26
mature weight	.07	.21	-.09	.25

The closest any of these traits comes to approximating muscling is measurement of fat trim. These results indicate that selection for reduced fat trim would result in delayed puberty, decreased fertility, increased birth weight and calving difficulty and increased preweaning growth of progeny. These relationships are generally not very strong, but they have sufficient strength to indicate that single-minded selection for increased muscling in breeds used primarily as components of the commercial cow herd would diminish productivity in those cows.

What happens if we move to an extreme in muscling? As indicated previously, emphasis on extremes will frequently lead to some rather major problems affecting productivity. In fact, this is a major force that dictates changes in ideal type. There is no reason to believe that selection for extremes in muscling would be any different. In fact, this is a case where we already know what happens when we go too far. We understand quite a bit about the reproductive problems that will occur when a cow has too little fat. In addition, some breeds will almost certainly experience increased incidence of double muscling if selection emphasizes extremes in muscling.

The cow, as is true of females of other species, must maintain a reasonable amount of body fat or she will tend to become anestrus (Richards et al, 1986). Selection for muscling or leanness, without adequate attention to reproductive efficiency, will probably lead to a higher proportion of cows with insufficient body condition to maintain regular calving intervals. It may be that genetically reducing body fat will be accompanied by a reduction in the amount of fat a cow must maintain to be reproductively efficient. However, without incorporating reproductive performance into the selection criterion, the reduction in body fat resulting from selection for muscling will likely be more rapid than any changes in the ability of the cow to maintain reproductive status with reduced body fat.

Several breeds of cattle have, at low frequency, a gene leads to the condition referred to as "double muscling". This condition was recently reviewed in a thesis here at Oklahoma State University (Tinker, 1987). Double muscled cattle are noted for extremes in conformation and very lean carcasses. It is generally agreed that the condition is determined by genes at a single locus, but it is not a clear dominance-recessive relationship. Therefore, the heterozygote has some of the double-muscled characteristics. If selection favored heavily muscled individuals, it is probable that some heterozygotes would be selected and the frequency of the gene would increase in those breeds where the gene is present. This would lead to a fairly rapid change in muscling and rate of fat deposition. There are, however, some problems. Double-muscled cattle experience larger birth weights with increased incidence of calving difficulty. There is a tendency for double muscled cattle to be less adaptable to stress. Carcasses from double muscled cattle have been slightly more likely to be dark cutters, the low amount of fat cover makes the carcasses more likely to be dry and marbling is decreased. Cows that are double muscled tend to have smaller pelvic areas which compounds the calving difficulty problems caused by larger birth weights. Delayed puberty, reduced fertility and a decrease in milk production have also been reported.

If selection objectives include an advantage for heavily muscled cattle, care must be taken to avoid the problems associated with extremes in leanness and muscling. These problems will be particularly damaging if they occur in breeds that are major contributors to the commercial cow herd. Reductions in reproductive efficiency in the cow herd would completely eliminate any advantages that might be obtained from leaner cattle going to slaughter.

Guidelines for a balanced program. Selection theory tells us that the most efficient route to improvement is to establish our selection objective and then derive the index of performance traits that has the largest correlation with that objective. This process assumes that we have a clear understanding of the economics of the objective and that the genetic parameters for the traits in the objective are estimated well. These assumptions are met only partially but enough is generally known to make some recommendations.

There are apparently some who believe that emphasis on large framed cattle has accomplished much of what it was originally designed to do (perhaps more). Current economics may justify more emphasis on muscling and leanness than has previously been the case. Does this justify single-minded selection based on muscling? The clear answer is no! The selection objective, even with an increased emphasis on muscling, should still include other traits that contribute to efficiency of production. This brief review indicates that some of those traits, particular those associated with reproduction in the female, would not be enhanced by single trait selection emphasizing muscling.

One approach might be to decide that muscling is important enough to establish it as our sole criterion for selection until some improvement is made. This approach would, apparently, lead to a decline in reproductive efficiency. We might ease our fears by telling ourselves that we will stop when we reach optimum muscling. The history of defining type in livestock tells us that we are not very skilled at knowing when to stop. The correlated decline in reproductive efficiency is also unnecessary. This approach is still single trait selection, even if we tell ourselves that we will change the program once we get where we are going.

More appropriately, a selection objective will be defined that includes muscling as a major component. A complete definition of the selection objective is beyond the scope of this paper. This definition is difficult to obtain because of the numerous characteristics that contribute to economic efficiency in the cattle business and the fact that there are numerous segments, each with its own economic objectives and those objectives are not always compatible. However, some suggestions can be made concerning the effect that increasing the emphasis on muscling should have on other components of the selection objective.

Undesirable genetic correlations with birth weight and reproductive characteristics suggest increased attention to these traits if selection emphasis is placed on muscling. Bulls that sire calves that cause calving difficulty should not be tolerated. Similarly, heifers that are unable to calve as two-year-olds and cows that do not calve at regular yearly intervals should be discriminated against. Bulls that regularly sire heifers that become inefficient cows, should not be retained once such identification is made. Care taken in these areas should reduce the probability that problems caused by "going too far" will arise.

What about extremes? It is frequently said that there need to be some cattle that are too large to bring up the level of the cattle that are too small. The corresponding statement for muscling would be that there need to be some cattle that are too heavily muscled to bring up the level of the cattle which are light muscled. There would be absolute truth in these statements if these were the only important characteristics. The amount of truth in them is reduced proportional to the number of other characteristics that are important and the degree of any adverse relationships among the traits in question. There are, apparently, undesirable genetic correlations between muscling and several traits that are components of cow herd efficiency. These genetic correlations, along with the possibility of double muscling, should lead producers to be wary of individuals that are extremely heavy muscled.

An individual with extremely heavy muscling may be a major contributor to improvement if the other keys check out. Was it too large at birth? Does the dam calve easily at regular intervals? Do calves by the sire lead to increased calving difficulty? Is reproductive development normal in the individual and its sibs? Is growth performance appropriate? Is there evidence that the heavy muscling may be due to the gene for double muscling? This may be a truly outstanding individual if the correct answer is obtained for each of these questions. If not, this individual may contribute but should not be the center of any organized breeding programs.

Selection of extremes without regard to other traits is analogous to running down a hill while trying to navigate through a mountain range. It was an easy slide down but you must climb back up if the pass is at high elevation.

What about selection in different breeds? It was established earlier in this paper that our numerous breeds of beef cattle do not share the same characteristics. This fortunate situation leads to use of breed complementarity when crossbreeding systems are designed. Growth rate and carcass merit can be provided in the calf through the sire without having much of an effect on the maintenance requirements or reproductive efficiency of the commercial cow herd. Commercial cows can represent breeds with smaller size, higher fertility and adequate levels of milk production.

This diversity among breeds leads to the question: Should the selection objective be the same in all breeds? The answer is surely negative, although probably only in the sense that the relative importance of various traits should be different. Reproductive performance is still important in a breed that is used only as a terminal sire since someone must own the cow that produces that sire. Similarly, growth is an important consideration in breeds that are major contributors to the commercial cow herd since an appropriate balance must be maintained between optimum size for efficiency of the herd and the fact that the cow still contributes half of the genes to the calf.

Some breeds can be identified as terminal sire breeds, while others excel in those traits associated with efficient cows. Despite such arbitrary classifications, it is probably in the best interest of each breed to emphasize a balance of traits while ensuring that nothing is done to damage their primary utility. Historically, those breeds of livestock that cannot serve broad segments of the commercial industry, have become novelties.

Summary. A change in the focus of selection in beef cattle leads to an array of questions concerning the effects on overall productivity. Muscling, as a selection criterion, would have some desirable effects on carcass merit and lean growth efficiency, but without a balanced selection program, would have adverse effects on cow herd efficiency. With muscling, perhaps more than with many other traits, avoiding extremes is critical because of possible adverse effects on cow fertility and the possibility of increasing the frequency of the gene that leads to double muscling. Cattle breeders must be certain that if steps are taken to identify individuals with superior muscling, attention is also paid to adequate fertility, growth, calving ease and maternal ability.

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The National Cow Herd -- The National Cow Herd

Southeast Region

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I'll be discussing the Southeastern portion of the national cow herd: the 11 states from Louisiana and Arkansas up through Tennessee, Kentucky, and Virginia and down through the Carolinas into Florida.

This area, home to 346,500 producers and more than eight million beef cows, takes in 13 percent of the land, 24.9 percent of the cows, and 24.5 percent of the producers in the United States (Table 1).

Operations and cattle inventory vary within the area. In Florida, 61 percent of the inventory is in herds of more than 500 head; in Tennessee, only 4 percent of the cattle are in herds of more than 500 head. In Tennessee, 85 percent of the operators have less than 49 head; in Florida, 3.4 percent of the operations have more than 500 head.

In the Southeast, we raise a lot of chickens, peanuts, cotton, soybeans, pecans, rice, tobacco, vegetables, hogs, cattle, wildlife, and pine trees.

The land varies from mountains to ocean and from delta to swamp, with a little bit of everything else in between. Rainfall averages 40 to 55 inches a year. Southeastern soils run from deep sand to heavy clay; they tend to be acid and have low fertility.

Part of the Eastern area is divided into Coastal Plain, Piedmont and Mountain areas. Forage include fescue, bermuda grass, orchard grass, bluegrass, bahia, clover, pangola, millet and winter annuals. Producers in the region grow 18,860,000 acres of fescue.

Stocking rates depend on location, grasses, soil types, climate and other variables within the region. Beef produced per acre can vary all over the area, depending on the kind of forage, the amount of fertilizer, the grazing method and the class of cattle.

Winter feed in the southeast is hay, silage, winter annuals, fescue, molasses and all forms of protein. The calving season runs from October through March, with a high percentage of calves born from November through February. We still have too few producers on a controlled breeding season. Expenses for running brood cows vary from low investment native pasture in the Virginia mountains and Florida flatwooods to investments, white-board-fence operations. The bottom line needs to be profit, regardless of the amount produced per acre.

As you can see, the region spans a variety of conditions. That's what makes the beef cow great -- she can adapt to all kinds of conditions.

Table 1

	Cattle on feed	Beef Producers	Beef cows	Milk Cows	Land Sq. Miles
Ala	30,000	39,000	875,000	40,000	50,708
Ark	12,000	29,000	945,000	72,000	51,945
Fla	20,000	18,000	1,086,000	179,000	54,090
Ga	12,000	30,000	703,000	102,000	58,037
Ky	25,000	47,000	1,017,000	218,000	39,650
La	9,000	21,500	615,000	87,000	44,930
Ms	14,000	29,000	706,000	68,000	47,296
NC	25,000	28,000	320,000	105,000	48,798
SC	20,000	15,000	284,000	43,000	30,225
Tn	30,000	60,000	966,000	204,000	41,328
Va	40,000	30,000	690,000	145,000	39,780
11 States	237,000	346,500	8,207,000	1,263,000	506,787
% of US	2%	24.5%	24.9%	12.25%	13%

Back in the 1950's and 60's, we had three or four beef breeds and the dairy breeds. Now it's a little different. New breeds are about as common as new breakfast cereals. In my lifetime, breeds have ranged from dwarfs to giants; and both were wrong. Researchers have done alot of studies on cow size and efficiency, but cattle adaptability and productivity, consumer acceptance, and profit on your ranch or farm may be the best tests.

In our departmental staff meetings, or driving to and from meetings, I guess we get to talking about cow size, breeds and a lot of other things that don't relate to the cow business. Some people have the idea the whole world is frame 8 or bigger, and that all cows are one color. Most of the time somebody will recommend a visit to the auction barn to see the real world.

I didn't call all the states and ask them about their cow herds. I decided to get some information about Georgia that is not guesswork or speculation. So I asked the Market News Branch of the USDA to help us with a cow profile study. Ernest Morgan of the Federal-State Livestock Market News & Grading Service and his staff collected the data. Market livestock specialists at 23 selected markets selected data (Table 2). These data included the marketing of both slaughter and feeder/replacement cows.

The study covered six weeks, from the week of February 22 through the week of March 28. There were 14,279 cows in the data base. We asked the specialists to record cows in five weight breaks, three frame sizes and seven breeds/colors (Table 3).

The results of the profile are in Table 4. As you can see, we still have a lot of small-framed cows in our state; however, most of the cows were in the medium frame group, and I would guess a high number of cows in the large frame group were Holstein cows.

Dairy or dairy cross/Holstein made up 17 percent of the total. This is not too far off, since 13 percent of our total cow population in Georgia is milk cows. The interesting thing to me is that a high percent of our cows are still English-base cows, with only 7 percent to 9 percent being Charolais, exotic or Brahman influence cows. Now, I know some overlap exists among what might have been exotic crosses, dairy cows, blacks, red necks, etc.; but I'm not sure anybody could do much better recording breed of cows. So Georgia cows are mainly medium frame, and most of them are English cross.

In the 11 Southeastern states, breed variations will exists from south to north, with Brahman influence having a higher percent in the south. Florida will have a higher percent Brahman influence, and Kentucky and Virginia will have a lower percent. Also, a lot depends on the number of dairy producers in a given state and the number purebred breeders in the state.

I don't doubt we need to do a better job educating people about crossbreeding systems. Mongrelization is going on in the country. Obviously, a large percent of the cows in our study are crossbred, but

Table 2

Auction Locations

Table 3
Georgia Cow Herd Profile

Weight	Under 800 lbs. 805 - 900 905 - 1100 1105 - 1295 1300 - up
Frame	Small Medium Large
Breed or Color	Black (Angus) Black White Face Hereford-Redneck Charolais-Charolais Cross Exotic Cross-Limousin-Simmental, etc. Dairy or Dairy Cross-Holstein Earcross-Brahman-Brahman Cross

Table 4
Georgia Cow Herd Profile
6 Weeks Feb. 22 - April 1
14,279 Cows

Weight	Number	Percent
Under 600	3999	28
805 - 900	2909	20
905 - 1100	4384	31
1105 - 1295	1890	13
1300 - up	1097	8
Frame	**Number**	**Percent**
Small	4181	29.3
Medium	7048	49.4
Large	3050	21.3
Breed Color	**Number**	**Percent**
Black (Angus)	3677	25.5
Black White Face	1863	13
Hereford/Red Neck	3068	21.5
Charolais and/or Cross	1280	9
Exotic-Lim-Sim-,etc.	987	7
Dairy and/or Holst.	2417	17
Ear Cross-Brahman and/ or Brahman Cross	987	7

I'm not sure it's as bad as Bob Hiller's ad indicates. It's hard to plan crossbreeding systems and get adaption when 84 percent of your operations have fewer than 49 head of cattle. That has been our excuse.

As Dave Pingrey said at a CSRS review in Mississippi last month, "These people are there, they have always been there, and will always be there, so let's get after helping them instead of making excuses." Well said, I thought, and it sure hit home for us in Georgia.

Now, in my opinion, EPD's are going to really help us do this. We will know more about the bulls we use, the accuracy of a given trait will be higher, and we can plan with confidence. There's no question that the EPD's of carcass traits are just around the corner and will be just as usable.

We get excited about forage when we discuss the future in the Southeast. A new bermuda, 30 percent better than coastal, is being developed; and a new bahia grass has been released. A fescue for the lower south is being developed, and a millet cross that lasts the whole season is in its third year of testing. All this, plus Endophyte - free fescue really get you excited about the future of cattle in the Southeast.

In summary, don't pour us all from the same mold. Cattle are adaptable; they are products of the land and of the breeding programs, not of a feedlot or a packing house. When the cattle won't work for the land owner, under his environment, the rest will not exist.

The Basic Resource - The National Cow Herd

Northeast Region

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The northeastern region of the United States for this paper includes 20 states which might logically be divided into two subregions based on feed resources and management practices. The North Central subregion consisting of Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin has 5,074,000 beef cows as of January 1, 1988. This represents 15.4% of the nation's beef cow inventory. The Northeast subregion consisting of Connecticut, Deleware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia, has 669,800 beef cows as of January 1, 1988. This represents 2.0% of the nation's beef cow inventory.

Henry C. Gilliam Jr. of the USDA, included the North Central region in the Agricultural Economic Report No. 575 published in 1984 entitled the U.S. Beef Cow Calf Industry. This publication proved to be a valuable resource. In order to update the material and to include data from the Northeast subregion, a survey was conducted of beef cattle specialists in each of the 20 states. Their replies have been summarized and are reported in the following tables. Without their help and cooperation this characterization of the northeastern U.S. beef cow herd would have not been possible.

The northeastern region has been described by Gilliam (1984) as an area of fertile farmland and abundant feed supplies. It includes the central and eastern Corn Belt, the Lake States, the northeastern Appalchians and New England. Annual rainfall increases from 30 inches in the western part to 50 inches in the southern part of the region. The growing season ranges from 7 months in southeastern Missouri to 5 months in the central Lake States and New England. Much of the area is partially wooded and pastures include bluegrass, native prairie grasses as well as improved seeded pastures of bromegrass, orchard grass, timothy, fescue, and legumes including alfalfa, red clover and white clover. Corn and soybean crops are grown on many of these farms especially in the North Central region. Thus corn silage and crop residues such as corn stalks are readily available in addition to hay.

Our survey indicated that the primary feed resources were hay or hay and corn silage, (Table 3) and only 7% percent or less of the herds were utilizing corn silage as the primary winter feed. Crop residues were used more extensively in the North Central Region. Iowa reported that hay and corn stalks were the predominant winter feed resource for beef cows. Estimates for the land area required per cow unit averaged 3.5 acres for the Northeast and 4.5 acres for the North Central (Table 4). This reflects the increased use of crop residues in feeding the cow herd.

Table 1. North Central Region Beef Cow Inventory, January 1, 1988

State	No. of Cows
Illinois	525,000
Indiana	370,000
Iowa	1,201,000
Michigan	130,000
Minnesota	370,000
Missouri	1,866,000
Ohio	412,000
Wisconsin	200,000
Total	5,074,000

(15.4% of the U.S. Beef Cow Inventory)

Table 2. Northeast Region Beef Cow Inventory, January 1, 1988

State	No. of Cows
Connecticut	5,000
Deleware	2,000
Maine	8,000
Maryland	53,000
Massachusetts	10,000
New Hampshire	5,000
New Jersey	11,000
New York	112,000
Pennsylvania	206,000
Rhode Island	800
Vermont	9,000
West Virginia	248,000
Total	669,800

(2.0% of the U.S. Beef Cow Inventory)

Table 3. Primary Winter Feed Resources For Beef Cow Herds

Source	North Central	Northeast
Hay only	53%	70%
Corn Silage Only	7%	6%
Hay and Corn Silage	26%	21%
Crop Residues	14%	3%

Regarding the management of the cow herd, both subregions reported that March and April were the months of highest calving frequency. However, Missouri reported that 35% of their calves were born in September and October. All states indicated that heifers were mated at 15 months to calve at 24 months of age with a few calving for the first time at 30 to 36 months of age. Labor resources available at calving time were considered adequate to assist cows as necessary. Most of the labor was provided by family due to the part time nature of these enterprises.

The average cow weight and frame size were 1125 lbs. and 4.50 for the North Central and 1140 lbs. and 4.75 for the Northeast region. The breeds reportedly used most frequently by the commercial cowherds were Angus, Charolais, Hereford (both horned and polled), Simmentals and the respective crosses of these 4 breeds. Crossbreeding predominates in the North Central region (77%). The Northeast region reported a much higher percentage of the herds were using a straight breeding program (48% vs. 23% for the North Central Region). This might be attributed to the higher percentage of purebred or pedigreed breeders in this region.

In order to estimate the pedigreed cow herd for the region, a number of assumptions were made:

1. Breeders recorded 65% of the heifer calves and 25% of the bull calves produced in their herd.

2. Average calf crop weaned was 80%

3. Using the above assumptions and the number of calves registered per state, we developed a multiplier factor of 2.78 X registrations, to estimate the number of pedigreed cows required to produce the recorded number of calves.

The 1987 annual report of the National Pedigreed Livestock Council indicated that 626,330 beef cattle were recorded. Our estimate of the pedigreed cow herd would be 1,741,197 cows or 5.2% of the 33,779,000 beef cows in the January 1, 1988 inventory.

The data reported in tables 7 and 8 were calculated from registrations reported by the breed associations for fiscal 1987 and expressed as a percentage of January 1, 1988 U.S. Beef Cow herd inventory values for each state. The activity of pedigreed beef cattle breeding appears to be highest in the Northeast subregion, but the North Central region is also above the national average.

Regarding the marketing of cattle from the commercial beef herds, (Table 9) the highest percentage of calves in each region were sold at weaning time (50% for the North Central and 53% for the Northeast). The next most frequently used marketing strategy was to winter the calves and sell them in the spring as feeders. The North Central region reported that a higher percent of it's calf crop was retained and fed for slaughter than the Northeast region (21% vs. 16%). While we did not ask the question in our survey, we believe that the majority of these

Table 4. Management Characteristics Of Beef Cow Herds

	North Central	North East
Land Acre/Cow Unit	4.5 Acres	3.5 Acres
Age at First Calving	2 Years	2 Years
Peak Calving Months	March-April	March-April

Table 5. Physical And Breed Characteristics Of Beef Cow Herds

	North Central	North East
Cow Weight	1125 lbs.	1140 lbs
Cow Frame Size	4.50	4.75

Breeds Most Frequent Reported - Angus, Charolais, Hereford, Simmental and various crosses of these four breeds.

Table 6. Breeding Systems Used In Commercial Beef Cow Herd

Systems	North Central	North East
Straightbred Cows With Straightbred Calves	23%	48%
Straightbred Cows With Crossbred Calves	19%	21%
Crossbred Cows With Crossbred Calves	58%	31%

Table 7. Estimated Pedigree Beef Cow Inventory, January 1, 1988

State	North Central Region No. of Pedigree cows	% of Total Beef Cows In In The State
Illinois	40,335	7.6%
Indiana	26,065	7.0%
Iowa	57,488	4.8%
Michigan	10,689	8.2%
Minnesota	22,710	6.1%
Missouri	94,787	5.1%
Ohio	26,988	6.6%
Wisconsin	13,019	6.5%
Total	292,081	5.8%

Table 8. Estimated Pedigree Beef Cow Inventory, January 1, 1988

State	Northeast Region No. of Pedigree cows	% of Total Beef Cows in the State
Connecticut	948	19.0%
Deleware	306	15.3%
Maine	1,576	19.7%
Maryland	5,552	10.5%
Massachusetts	1,518	15.2%
New Hampshire	420	8.4%
New Jersey	1,649	15.0%
New York	8,148	7.3%
Pennsylvania	12,535	6.1%
Rhode Island	142	17.8%
Vermont	1,273	14.2%
West Virginia	10,172	4.1%
Total	44,239	6.6%

cattle are fed for slaughter and marketed within this region as opposed to sending them to other regions of the U.S. for finishing and slaughter.

Summary

The Northeast and North Central regions of the U.S. are characterized by abundant feed resources and rainfall above the U.S. average. Hay is the primary winter feed resource. Approximately 3.5 to 4.5 acres are required per cow unit. The peak calving period is March - April but some areas also use fall calving. Most females are bred to calve at 2 years of age. Average cow size is 1100 to 1150 lbs. and frame size 4.5 to 4.75. The breeds used most frequently are Angus, Charolais, Hereford, Simmental and the respective crosses of these 4 breeds. Both subregions use crossbreeding system more than straight breeding but almost half of the cows in the Northeast subregion are straightbred. An estimation of the pedigree cow herd shows that activity in both regions is above the national average. Since seedstock produced in these regions are used nationwide, the match of cattle type and feed resources may not be exact across all regions of the U.S. Most of the calves produced in these regions are sold at weaning time but a significant number are retained and fed for slaughter on the farm or ranch where they were born.

Table 9. Primary Marketing Methods Used By Beef Cow Herds

	North Central	North East
Calves Sold At Weaning	50%	53%
Wintered and Sold in Spring	21%	17%
Wintered, Grazed and Sold In Fall	7%	14%
Retained and Fed for Slaughter	21%	16%

References

H.C. Gilliam, Jr. (1984) The U.S. Beef Cow-Calf Industry Agriculture Economics Report No. 515. USDA

Annual Report (1987) National Pedigree Livestock Council

Survey Respondents:

Connecticut - L.A. Malkus, University of Connecticut
Deleware - R.A. Barcewski, University of Deleware
Illinois - D.F. Parrett, University of Illinois
Indiana - K.S. Hendrix and L.A. Nelson, Purdue University
Iowa - D.R. Storhbehn, Iowa State University
Maine - O.L. Wyman, University of Maine
Maryland - S.M. Barao, University of Maryland
Massachusetts - J.P. Tritschler, University of Massachusetts
Michigan - H.D. Ritchie, Michigan State University
Minnesota - J. Meiske, University of Minnesota
Missouri - J.C. Whittier, University of Missouri
New Hampshire - F.C. Ernst, University of New Hampshire
New Jersey - D.M. Kniffen, Rutgers University
New York - D.G. Fox , Cornell University
Ohio - R.P. Bolze, Jr. The Ohio State University
Pennsylvania - E.H. Cash, Pennsylvania State University
Rhode Island - W.A. Gross, University of Rhode Island
Vermont - P. Saenger, University of Vermont
West Virginia - W.R. Wagner, West Virginia University
Wisconsin - R.A. Kemp, University of Wisconsin

The Basic Resource - The National Cow Herd

Southwest Region

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I really appreciate the title of this section of the conference - The Basic Resource, because it pays proper homage to our national cow herd. I only wish I could do equal justice in describing the cow herd of the Southwest.

Only four states are included in the Southwest area: Arizona, New Mexico, Oklahoma, and Texas. These four states comprise about 15 percent of the total U.S. land area.

The diversity of environment, temperature, rainfall, and topography is tremendous. In northern New Mexico and in the Panhandles of Texas and Oklahoma, January temperatures may average 0 to 20 degrees F. Daytime July temperatures may average 90 to 115 degrees over much of the four - state area.

The average annual rainfall also has great variability. Along the Gulf Coast and in extreme eastern Texas and Oklahoma, rainfall may average up to 64 inches per year, and it may go to zero in some parts of West Texas and Arizona. The decline in rainfall is relatively predictable across Texas. As you move from the Louisiana border to El Paso, for every 15 miles west you travel, the average rainfall declines about one inch.

In the heavier rainfall areas, depending on the cost of fertilizer, cattle prices, etc., producers have profitably managed a cow per acre or a cow per two acres. During the drought years, many 100-300 section ranches in the west were completely destocked.

Although the southwest area represents about 15 percent of the land area of the U.S., it represents about 24 percent of the nation's cow herd.

Arizona	-	260,000
New Mexico	-	527,000
Oklahoma	-	1,842,000
Texas	-	5,260,000
Total	-	7,889,000

The heaviest concentration of rainfall, forage and cows in the southwest area are found east of I-35, from Oklahoma City to Dallas to Austin. A majority of the producers in this heavily populated area have small acreage and uneconomical cow herds of 5-40 cows. Low level management is the rule, since the cow herd is not a major source of income. Most of their beef cattle management information is derived from a coffee-drinking buddy or their wife's hairdresser's husband's uncle, whose dad worked at the local auction barn two days in 1967. There is also a goodly number of ranches with 100-600 cows that do an excellent job in management.

Approximately 80-85 percent of the cattle in this area have some Brahman blood. Most have less than 1/2 Brahman, with a portion of straight Brahman. The influence of the American breeds is exceptionally strong in this section, as it is over most of the southwest area.

The most productive cow in our area is the F-1 Brahman X English cross cow mated to a growth bull of a third breed, to maximize heterosis, environmental adaptation and maternal characteristics. This "system" is supported by research from Florida, Louisiana State, Texas A&M, as well as Clay Center and Manyberries, Alberta. In many cases, the herd weaning weights will average 550-625 pounds.

In the Hill Country and Rolling Plains of Texas, Herefords reign as the predominant breed, as they do in northern Oklahoma, northern New Mexico and northern Arizona. Many of these Hereford cows have been crossed with Angus to produce black-baldies, or with Black Brangus to produce a "Super-Baldie" (with a touch of ear). Just as popular are the calves sired by Red Brangus and Beefmaster bulls, particularly where replacement heifers are saved.

The influx of the continental breeds has gradually crept into many cow herds over a majority of the southwest area. This is particularly true in northern Oklahoma and in all areas where Brahman cross cows are prevalent. Many of our cow herds now contain 1/4 - 1/2 Simmental, Limousin, Charolais, or Gelbvieh, etc.

Individuals will be individualistic and independent. This is especially true for ranchers. The cow herd in the Southwest is black, white, red, tan, tiger-striped, ring-eyed, red-necked, and spotted. There are uniform herds and herds with variability equal to the entire area's. Recently, I visited a 260-cow-herd that had seven breeds of bulls running in the pastures. Pretty well managed, and a pretty good program --- but lots of variability in the calf crop, which averaged 540 lbs. the previous year.

Needless to say, with the wide variation in environment, temperature, rainfall, and people, there is a wide and variable difference in cow size. Many of the commercial cull cows coming to slaughter will weigh in the 850-1050 pound range. Of course, there are some 1200 - 1500 pound cows. There are also some 650 pound cows. The average pasture cow in the Southwest today in the fall of the year will probably weigh from 950 - 1100 pounds.

The Basic Resource - The National Cow Herd

Northwest Region

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When asked to participate in this conference and describe the commercial cow herd in the northwest quadrant of the U.S., I thought it was probably an impossible situation. After a considerable amount of investigation and thought, I have concluded that my original thought was correct. A person can probably find as many different frame sizes, breeds (and combinations of crosses), nutritional and management programs in the Northwest as you can find anywhere in the U.S. However, in this discussion I will attempt to describe the predominant or "average" situation and potential trends. The reader must realize that hard data is often not available to support the exact description of the various parameters discussed in this paper. Information has been drawn from key individuals in the various states to which I am grateful for their input. For the purpose of this presentation, the Northwest states included in this discussion will be bounded by the eastern and southern borders of Kansas and run northward to Canada and westward to the Pacific Ocean. This tremendously diverse region varies from coastal mountain area to desert rangeland and contains approximately 35% of the U.S. land mass.

The large majority of producers in this portion of the country obtain their entire income from the cattle business. They utilize various beef cattle production systems to convert a forage resource into dollars. The most successful managers of these production systems optimize their level of production in order to maximize net dollar return.

There are a couple of unique aspects about this area of the country as it relates to beef production. First, is the general lack of water. It is obvious that you must have water to produce a forage resource. The more water that is available, the greater the number of feed alternatives. Enough available water to produce feed grains often allows for economical supplementation as well as nutritional alternatives using silages and crop residues. In addition, water will affect grazing distribution on the more arid rangeland. The second unique aspect about this Northwest area is the fact that it is largely composed of public land. Public lands comprise a rather large proportion (Table 1) of the western-most states of this region:

Not all of this public land is used for grazing of livestock. National Figures indicate that approximately 75% of the public land is administered by Forest Service and Bureau of Land Management (BLM) and would be available for grazing livestock.

Where public grazing in utilized, management efforts must be concentrated during the approximately eight months when the cattle are <u>not</u> on public land. Typically, salt is all that can be supplemented while cattle are grazing public lands. In addition, public grazing is often on a common allotment with other producers.

Table 1. Percentage of Public Land in 9 Northwestern States[1]

State	%
Nevada	86
Idaho	65
Utah	63
Oregon	54
Wyoming	48
California	45
Colorado	36
Montana	30
Washington	29

[1]Public Land Statistics, U.S. Department of Interior, 1982.

Cow numbers have decreased in the Northwest (Table 2) since the peak year of 1975 by approximately 25 percent as compared to 27.5% nationally. In January, 1988, this area supported approximately 11 million beef cows, down 2% from a year previous. This represents 33.4% of the U.S. beef cow population. However, in many areas where the decrease in cow numbers have occurred, yearlings are being utilized to market their forage resources. In other instances, when interest rates rose, culling rates became uncommonly high in order to reduce debt and improve cash flow. As of January, 1988, heifer replacement numbers are up approximately 6.8% in the Northwest from the previous year. However, national replacement figures remain unchanged from January, 1987.

Table 2. Beef Cow Numbers in the 13 Northwest States as of January 1[1].

State	1975	1988	% Change From 1987
	(1,000 Head)		
Nebraska	2,374	1,680	0
South Dakota	2,129	1,448	-3
Kansas	1,978	1,466	0
Montana	1,692	1,275	-2
North Dakota	1,235	871	-4
California	1,097	895	-6
Colorado	1,050	778	+3
Wyoming	806	630	-3
Idaho	721	510	-2
Oregon	617	547	-4
Washington	403	359	-10
Utah	349	318	-1
Nevada	338	246	-8

[1]USDA, National Agricultural Statistics Service

The liquidation of the cow herd may have had an impact on its genetic makeup in the Northwest. When the economy tightened, there is indication that the loss in cow numbers took a greater toll on straightbred commercial cows.

The use of the crossbred cow is increasing with figures ranging from 50 to 80% reported in the various states in the Northwest. Where available hard data existed, a lesser number actually had a planned system of crossbreeding. The most predominant crossbred cow was the Angus X Hereford, more commonly known as the black baldy. Simmental, Limousin, and Gelbvieh were included at a lesser frequency than the baldy with Salers becoming more prominent in recent years.

The amount of water available to the environment appears to exert the most pressure on cow size although a portion of the size difference may be in differences of condition. In areas of greater amounts of available water, more alternatives are available in terms of feedstuffs. Cow size varies from average estimates of approximately 1000 pounds in the drier areas to the 1150 pound range in farming areas where more feed resource alternatives are available. However, 850 to 900 pound cows also exist in some desert areas. On the other hand, frame size appears to range from 4.0 to 5.5 with the larger frame cows typically being associated with more water and feed resource alternatives.

The primary feed resource used for wintering rations in the Northwest is hay with crop residues used extensively where available. The cost of hay production has gotten to the point where consideration is sometimes given to moving the cows to areas where crop residues can be grazed during less-critical nutrition periods such as mid-third of gestation. Harvesting hay or crop residue increases costs considerably as does the transportation of energy supplements to areas where their production is not possible. The first choice is to build a nutritional program around home-grown forages with alfalfa or alfalfa/grass hay furnishing the required protein where possible. In general, mineral supplements supplying phosphorus would be the primary additional purchased supplement. The successful producers have effectively constructed a biologically efficient cow to utilize the nutrient resources available with minimum required supplementation.

Again, the land area required per annual cow unit varies tremendously with available water. Some desert areas will require over 100 acres per cow unit while irrigated or high rainfall area might get by with 3 or 4 acres per cow unit. A typical acreages in the semi-arid range country appears to be in the range of 30 to 35 acres per cow unit.

The average culling rate per year varies depending on available feed, cattle prices and debt load. The range appears to be from 10 to 20% with 12 to 15% being average for a typical year with open cows and physical problems being culled as first priority.

The highest frequency calving months for the majority of the area appears to be March and April with some activity commencing by mid-February and ending by mid-April. Fall calving is an alternative in the southern areas of the region as well as in approximately 70% of

California. In those areas, September and October appear to be the most concentrated calving months.

Heifers are bred to calve at approximately 24 months by more than 95% of the producers in the Northwest. Economics dictate that a producer must get the heifer into production as soon as possible. However, because of limited feed resources, heifer development is often a problem area and a key component to the successful cow-calf operation in range country.

As a general estimate, labor is a limiting factor (behind water) in determining what management practices are conducted and therefore the level of return from a production system. Often times producers realize the value of a management practice but simply don't have available labor at the appropriate time to institute the practice. Typically, a herd of 300 to 400 cows will be approaching the labor limit of a single family operation. As the cow herd approaches 400 in number, often an additional person is hired at least during the labor intensive periods of the year. In order to obtain dependable people with the needed degree of skill, a producer will tend toward numbers that will support full time assistance if the operation is more than family labor can support. An estimate is that half of the operations rely totally on family labor.

Marketing of the calf crop is trending toward ownership past weaning although estimates still suggest that approximately 50% of the calf crop is marketed at weaning. Again, economics conditions largely determine the marketing scheme. Producers with structured genetic improvement programs tend to retain ownership to some point past weaning if the associated conditions indicate that it might be a feasible economic decision. They realize they will not maximize return from their improved genetics by selling at weaning. Unfortunately, the IRS becomes involved in these marketing decisions since a producer tries to avoid marketing two calf crops in the same tax year. A feasible alternative appears for producers to split marketing so a portion of the calf crop is sold in the fall with the remainder retained for some length of time longer than weaning, depending on feed and market conditions. Even though there has been a shift in longer ownership, it is estimated only 5-8% are owned through the finished product in the feedlot. The remaining 42 to 45% are estimated to be fairly evenly split with a slight tendency for more to be marketed in the spring.

In summary, it is apparent that we have considerable diversity in the commercial cow herd in the northwest 13 states. Cow size and genetic make-up is largely dependent on what the environment will support. A feasible alternative appears to match the cow to the environment and the bull to the market. However, this is easier said than done when cow herds often spend part of the breeding season on public land. Where water is more abundant and more alternative feed resources exist, there are generally heavier, larger frame cows with less certainty about what is optimum. In the drier range area, the functional cow is one that weans a calf every year and is palpated pregnant in the fall with a minimum of supplemental feed.

Bull Power
Purebred Bull Specifications: Carcass and Retail Products

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The cattle industry was sailing along in the 1970's, 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, the wheels fell off the wagon. All of a sudden something was wrong with beef as a food. Between 1976 and 1983, retail 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).

What happened? First, a boycott by consumers protested its high cost; then, a flurry of reports claimed that beef was unhealthful--to 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 that its chemical composition had to be 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 for the two segments 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 around the external borders, from beef, 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). The beauty of the latter procedure was that no longer would dressing percentage (which increases almost directly with increasing animal/carcass fatness) drive the logic at the price-discovery interface between feedlot operators and packers since--in its eventual chronology--all subcutaneous fat in excess of 1/4-inch on the carcass would be removed physically before payweight was determined.

Research was conducted (again funded by the beef industry and performed by the Texas Agricultural Experiment Station) that proved the technical feasibility of the procedure and 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 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 their food consumption data (and recommendations to the public there from) 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 Retail Market Basket Study (NRMBS).

Conducted by the Texas Agricultural Experiment Station, the latter investigation involved purchase of a prescribed list of retail beef items from 8 or more supermarkets in each of 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 NRMBS 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) an 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. 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, (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 emphasizes 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 are willing to sacrifice something in 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 (TDAO 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 please nearly all of the 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 fine 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 three production and/or carcass targets, identified, for example, by the Texas Agricultural Experiment Station 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), 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 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 heritable trait which can be selected for both within and between breeds, and that actually leanness of a given animal is some product of a feed X animal X leanness interaction. Important, too, is the fact that leanness in beef cattle is related to 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 places like Southern Arizona conditions (drought, 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 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, it appears necessary that the Chicago Mercantile Exchange institute 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 (at or about the year 1992) will be needed to rectify supply/demand imbalances. That period provides an enormous "window of opportunity" for those in the beef cattle industry to clean up their act; 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 differences and determinations) 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, .55; marbling score, .45; 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. Inasmuch as cattle differ in the predominant-type of fibers--red vs. white--in their ribeye muscles and in that red fibers use fatty acids as a primary source of muscle contraction/relaxation energy while white fibers do not (their source of energy, cattle (e.g., Jersey, Longhorn, Angus, Shorthorn) with predominantly red muscle fibers store fatty acids in intramuscular depots (as marbling) dispersed among their muscle fibers while other breeds of cattle (e.g., Charolais, Maine-Anjou, Limousin, Gelbvieh) 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 very little marbling in their ribeyes. Because white muscle fibers are substantially larger in diameter 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 versus 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 th 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, NB) suggests that, within a breed, to improve tenderness (by decreasing Warner/Bratzler Shear Force by 1 kilogram) by selecting 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 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 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--is that it is presently advantageous to all concerned to mix the Selects and Standards so that the latter can be effectively merchandised. TAES research data proves 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 necessity to mix together some "pretty good" and some "pretty bad" beef just to get rid of the "pretty bad" stuff 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. 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 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), (3) Determine the targeted end-point (beef Quality/Yield Grades), and (4) Select a bull or 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 750 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 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 done, 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 will make possible the creation of any number 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. 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 the 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 <u>beef's</u> great taste) and <u>eat it</u> to (without fear of <u>diet</u>/health/nutrition consequences).

Bull Power
Purebred Bull Specifications: Stocker and Feedlot

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Purebred cattle producers, commercial cow-calf producers, and university professors get upset and out of sorts with stocker and feedlot operators for their negative attitude toward selecting superior breeding stock. The aforementioned groups cannot understand why a participant in the production chain will not stand up and applaud genetic improvement and then be willing to pay more for superior genetics.

The beef industry has to realize that stockers and feeders have had their most notable financial successes purchasing good weighing conditions and the results of someone else's bad management. In turn many of the real bad "deals" feeders can call to mind involved big, fleshy, heavy weaning calves that had superior genetics but no ability to perform in the feedyard or on pastures. These "superior genetic packages" often have very little immune system to prevent or recover from sickness and no compensatory gain available. Indeed it could be said that this type of calf has a negative compensatory gain and a predisposition to sickness.

Therefore, the cow-calf producer becomes bitterly disappointed when he is offered average or lower prices for heavy weaning calves. He then begins to question the practicality of paying for purebred bulls with high EPD's for weaning weight. Cow-calf producers must realize that if they are going to produce a new kind of product such as a heavier weaning calf, the traditional management techniques that worked for lighter weight calves will need to be modified. The heavy weight calves may need to be weaned and held on the ranch in order to have time for some immune system development as well as getting the "walk and bawl" syndrome over with before being sent to a feedyard. Cow-calf producers will argue that they can't afford to use these types of management techniques because of the resulting loss in weight that their calves would suffer during this period. They are right-- it's also the same reason they are being bid less money for their calves by stocker operators and cattle feeders.

This dilemma can be resolved to almost everyone's satisfaction. In many cases, the selection process that has produced heavier weaning calves has only emphasized weight and not composition. Weight was increased as frame size was increased because dual purpose breeds were used to increase frame size. Thus, many heavy milking cows produced heavy weight calves. If selection were directed to a greater degree toward the amount of muscle that is present in the weaned calf, heavier weights can be achieved and still produce calves with the ability to go into the feedyard and maintain acceptable rates of gain and feed conversion. The conversion ratios of feed to muscle versus feed to fat will help these cattle perform in the feedyard. The heavy muscled, heavy weaning weight calves might not gain much faster than other calves, but feed conversion should be significantly better. We know from economic analysis that feed conversion is several times more important in calculating bottom line profit than is average daily gain. The resulting calf has more appeal to the packer buyer when the feeding period is over because a higher percentage of the live weight is available for sale as closely trimmed retail cuts. We can begin to pass economic incentive down the production chain only if the product (calves) will perform to a greater advantage at each step in the production chain.

The bulls that will need to be selected at the purebred level in the marketing chain need to be evaluated for muscling as well as all of the other characteristics which will help other segments of the industry realize a profit. I not only do not advocate single trait selection for muscling, I would warn against it. I do however, strongly urge the purebred beef cattle producers to include muscling in their current selection schemes. In order to accomplish this, EPD's for muscling (ribeye area) will have to be developed on substantial numbers of bulls in the next few years.

The future of stocker operations will be determined to some extent by the price of feedgrains and the ability of grass to compete with the cost of gains in the feedyards. Stocker operations will be used to move lighter weight calves to heavier weights to make them more useful in the feedyards. Stocker operations will also help spread out the supply of calves to make them available on a year round basis to feedyards. Traditional yearling operations will come back into favor whenever high feedgrain prices cause cost of gain to be higher than selling price per pound.

In summary, selection should not concentrate on any one trait, but should include all of the economically important traits talked about today by this panel with a little extra attention paid to muscling.

Bull Power
Purebred Bull Specifications: A Commercial Cow-calf Perspective

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Two disclaimers should open this discussion: The views expressed are my own, not those of the sponsors, which I am sure will be a great relief to them. Secondly, as the title is meant to convey, these thoughts are one perspective, not a summary, for there probably are almost as many viewpoints as there are cow-calf producers.

Son John and I represent the fourth and fifth generations to ranch in Texas from before the War between the States. We have used the XXX and Running M brands since 1872, when my grandfather ran Longhorns, subsequently using Durham (Shorthorn) bulls and then Herefords. I grew up in a registered commercial Hereford operation followed by 20 years with registered Angus together with and later separate from my father. We were charter members of Performance Registry International, weighed every calf, and kept individual performance records for many years. Since 1967, I have run a commercial crossbred cow-calf and stocker operation. During this time we have used four breeds of bulls extensively and six other breeds of bulls to a lesser extent. I certainly must be color-blind, and hopefully not very prejudiced.

We have evolved into a spring calving, four breed rotational cross using Angus, Brown Swiss, Hereford, and Santa Gertrudis sires, mostly on native tallgrass rangeland with 41% bulk cottonseed cake or whole cottonseed as protein supplement or small grain grazing when available. When we do things well, we averaged a 94% weaned calf crop percent from all cows exposed over a four year period. When we do things less well, that percentage drops. At weaning and yearling time, we run budget projections to decide whether we should own the cattle longer, or let someone else. Whether for ourselves or others, we are very concerned that our cattle perform well at every stage to the consumers' plate. We try to take optimum advantage of new technology from researchers themselves and from extension and industry people and publications in a lifelong learning mode.

Regardless of breed, our criteria for bull selection to meet our needs and those of our customers have remained fairly stable over the years. Show judges can change their minds on traits between shows or seasons, but cow herds cannot and should not change that much nor that often.

Our first concern is functional and reproductive soundness in the broadest context. Don Dwyer's detailed animal behavior studies indicated that range bulls travel twice as far as cows and grazed only half as long during the breeding season. We check eyes, teeth, feet and legs for functional soundness. The forelegs should be relatively straight from both front and side views. The hind legs should be relatively straight from the rear, but only enough curve from the side to provide a spring effect without being either post-legged or sickle-hocked. Feet and leg problems increase with increasing age and weight.

Reproductive soundness would include internal and external examination of reproductive organs with special attention to scrotal circumference or size in proportion to age and sheath attachment with no extended prepuce. A satisfactory semen exam and indications of libido with strong expression of male secondary sexual characteristics would complete this area of concern.

There are two other major categories of economically significant characteristics that relate back to reproduction and forward through production to quantity and quality of the product. In economic priority, the next concern would be to discern the maximum growth rate or level of performance that would not result in increased birth weight to the point of calving difficulty, that would not produce a replacement heifer whose requirements exceed our resources, and that would not result in a desirably finished carcass too big to fit the boxed beef trade.

To be more specific, in our area that bull would have a birth weight of 80 pounds or less, a 205 day adjusted weaning weight of 530 plus or minus 20 pounds, an A.D.G. on feed of 3.5 plus or minus 0.5 pounds, and a 12 month weight of 1000 plus or minus 50 pounds with a frame score of 5 to 6. At maturity he would weigh 1800 pounds. These weight ranges would be higher for cooler, drier regions and lower for hotter, more humid regions. It is important not to confuse genetics and environment related to growth and size.

His steers would wean at about 500 pounds, gain 2 pounds per day on high quality forage, at least 3 pounds per day in the feedlot, and at 1050-1200 pounds liveweight have a high percent of choice YG 2 carcasses weighing 700-750 pounds. His heifers would conceive at a 90% rate at 13 to 15 months of age, calve easily, milk well, and weigh 900 to 1100 pounds at maturity.

Since we need all the flexibility we can get to adjust to widely varying and rapidly changing conditions, and since half our calves are heifers, we have no interest in a bull, breed, or cross that will not produce good steers <u>and</u> good replacement heifers for ourselves or someone else. A normal (whatever that is) spread between steers and heifers as calves and yearlings is $2.00 per hundred weight, when there is replacement interest competing with stocker and feeder buyers. When that interest is absent due to declining female numbers or the heifers are not desirable as replacements, that spread widens to $8.00 to $15.00 per hundred. At that spread, only the heaviest heifers will even repay their cost of production at weaning.

The matter of body size and growth rate reflect directly in the amount of nutrients available above those requirements for reliable reproduction in both bulls and females as shown in Table 1. I repeat for emphasis that for efficiency and economy, performance data and E.P.D.'s should be used to select not for maximum growth, milk production and size, but to select the optimum range of performance levels commensurate with resources, management level, and desired weight and size of end product.

TABLE 1. Priority of Nutrient Use

Breeding Female	Bull	Steer
Fattening	Fattening	Fattening
Breeding	Breeding	
Growth	Growth	Growth
Lactation		
Fetus Development		
Maintenance	Maintenance	Maintenance

The third major category of selection in terms of economic priority is conformation. In bulls, we select for a shoulder that is muscular, but not coarse, and smoothly laid in at an angle that contributes not only to soundness and easy movement, but easy calving as well. The back should be rounded or quinset-shaped when in breeding condition, rather than flat. The rump should be long from hooks to pins and wide between hooks and between pins. The hindquarter should be deep, as measured from pins to hocks, and with a good cross-section from hook to hock and pin to stifle. From the rear, the hindquarters should be widest through the stifle with good width between the legs.

Notice that those dimensions emphasize muscle mass in length of muscle versus bulge of muscle that increases calving difficulty. No one has yet sold a big, muscle-bound calf that died at birth, perhaps taking his dam with him. The length of rump and depth of hindquarter with the hind leg placed in the center of the hindquarter contribute not only to desirable muscularity, but also to soundness and a more rectangular side view related to reproductive efficiency.

Reliance on bone structure to indicate muscularity and familiarity with particular sites of fat deposition will help differentiate between muscle and fatness. Increasing refinement of ultrasound and other techniques will provide a giant step forward in objective measurement of muscularity and fat deposition in live animals instead of the gross visual estimates most often used. Excessively large ribeyes may become more of a liability than asset.

In the current emphasis on lean end product, we must not overlook the functions of fat in production and reproduction as insulation and stored energy. In the cow, a desirable level must be restored at least from weaning to next parturition with some carryover reflected in a condition score of 5 to 6 for reliable rebreeding. In colder climates, the energy requirement and fat level is higher for maintaining body temperature. Previous reference to bulls' lower intake and higher energy use during breeding requires that bulls gain sufficient fat levels before breeding to provide an adequate reserve of energy during breeding.

The history of the beef cattle business is one of immoderate overreaction from too small to too large and, unless we are careful, now from too fat to too lean. We must determine and maintain the fat level necessary for consistent reproduction in breeding animals and for consistent eating quality in slaughter animals. Those who study Mother Nature, ecologic, and economic principles will join Plutarch in remembering "Moderation is best, and to avoid all extremes." Hopefully, our industry is maturing to the point that we will not go overboard this time on lean meat and muscularity, but strive for the balance of characteristics that produce high quality beef most efficiently, economically and consistently.

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Bull Power
Purebred Bull Specifications: Purebred

Martin Jorgensen
Ideal, S. Dakota

We are at the crossroads in our decision making process in selecting a genetic road map that will in fact create the beef animal for the changing market. The present mix on our commercial genetic pool reminds me of a cake batter formulated without a recipe. We need to review this situation and attempt to redirect our efforts towards the development of a product possessing great appeal at the market place with predictable uniformity for qualities and somewhere near a uniform slaughter weight. The question, can we do these things with the tools we have at hand today? I say yes we can and we must address this course in great haste.

For too long the beef industry has struggled as though each segment could be indifferent about the financial health of other beef segments even though it takes only a very short time for shock waves to emerge throughout the beef industry when red ink emerges somewhere along the line of production, processing or marketing. The purebred seedstock breeders for the most part have no idea what kind of animal they are producing for several very important traits and rarely are they mentioned; I make reference to feed efficiency and carcass merit. For example, I recently reviewed some feed efficiency test data from a state test center where 33 Angus bulls were compared for gain, feed efficiency, and frame. The range for feed efficiency was 12.43 to 1 with a ratio of 60 to the most efficient bull posting a 5.32 to 1 with a ratio of 140. It was interesting to note the bulls with the highest frame score did not necessarily relate to the best feed efficiency scores.

The same range of extremes exist in product cutout when we compare carcass weights. These are several of the major value differences we must address along with production traits such as maternal and growth.

I realize the existing carcass data is very limited in most breeds; however, the responsibility of generating this data clearly rests with the purebred breeder and it should be a part of his genetic data bank for the benefit of his bull customers. We are at a time in production history when a mechanical measurement system on live cattle with a high degree of accuracy would serve the industry well. We simply don't have time playing catch up realizing a bull is three years of age before his progeny are old enough for carcass evaluation, and worse yet when only a small group of breeders show concern for carcass data.

The present system of buying cattle on averages through the finishing phase should in no way be construed to mean that all cattle are similar for value at a given weight. Fortunately, most breed associations are equipped with measurement procedures similarly designed for ease of application. The nationally recognized system of measuring predictability within a breed makes it possible to accurately select sires by trait comparisons.

It is difficult to accept the fact that many breeders continue to use adjectives rather than documented trait records when presenting their production to the beef industry. A good example of this was the 1988 Western Stock Show, where bulls representing one of the major breeds were sold without performance data, simply because only a small percent of the lots offered had supporting performance data. This will change as more and more commercial producers out bid the so called purebred producer for the bulls with genetically superior traits of meaningful value. The printed Expected Progeny Difference plus the accuracy level presented in national sire directories will be the moving force in directing the industry to rapid changes. Simply put, we as breeders now have a road map to create seedstock that can and will enhance the industry for a stronger competitive position.

When I started producing a few purebred Angus in 1956, it was like having a machine break down and being unable to locate repairs when searching out a new sire. If you were not a student of pedigrees you possessed no knowledge about breeding cattle. How many of you remember how small they had to be to make the winning end of the show strings? Cattle with growth records were very rare and only a few breeders persistently pursued the possibilities from performance records. The pendulum reversed when the common sense commercial cattleman refused to continue the compress contest. Thirty years later we find the industry in the final stages of a reversed cycle where excellence was measured with a yard stick. Again, the commercial producer waved a flag of resistance for the sake of practicality. I dare say the above scenario would apply to birth weight, muscling, leanness and milk if we exert all selection pressure for either the minimum or maximum. There is an optimum level for all traits and the variable is mostly determined by environmental and managerial control.

Can we have optimum EPD's for the purebred cow herd and herd sires? I say yes, however, with qualifications. The optimum level for EPD's will vary a great deal for most traits from region to region in this country. Coming from thirty two years of continuous performance selection, it is my belief we have nearly reached the optimum balance of EPD's in our Angus herd. The average on the 99 bulls cataloged in our most recent production sale had the following averages:

Birth EPD	Weaning EPD	Milk EPD	Yearling EPD
+5.3	+25.8	+5.4	+52.6

This herd is managed very similar to top commercial herds in central South Dakota. The reproduction response is acceptable and the growth level will support our goal of selling finished cattle at 12 to 13 months of age. We are using a two and three way cross program in our commercial herd with optimum production results. The life cycle of these progeny can easily achieve the finish stage in the 12 to 13 month time span.

I have serious doubts about the influence of EPD's at the major cattle shows as the EPD concept continues to make inroads with the general cattle industry. However, the forward thinking seedstock breeder will make haste to be totally identified with supporting records identifying breed comparison EPD's.

In the process of searching out the proper balance on our trait selection we must first determine our most likely bull market. I personally choose to favor the commercial producer as the most stable and continuous market for selling bulls. This has been the primary reason why we track our sires through their progeny to a finished product.

The business cow/calf producers are very familiar with the value differences of EPD's and this trend will accelerate from this time forward. I find this to be our most important merchandising tool. Our latest calf crop was computer mated, primarily to produce a larger supply of acceptable bulls with optimum figures on important traits. We are pleased with the results and of course are anxious to follow them through their development period. I don't expect to produce purple ribbon winners with computer mating; however, I have never had much flare for ribbons unless they were awarded in a carcass contest.

I made reference earlier to the phenotype race and now we run the risk of concentrating too much selection pressure on a given trait such as milk. This is a direct result of over emphasizing a single trait and creating an animal that is sadly lacking in traits that suddenly become very important when they are out of balance for total optimum production. It is for this reason I believe seedstock breeders should be very informed about the total beef industry and meet the challenge of breeding for efficiency and finally develop the product to the demands of the consumer.

The Role of the Purebred Industry In the Beef Chain

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Leader . . . Innovator . . . Progressive Cattlemen . . . Spokesman for the Beef Industry! One would hope that at least some of the above would apply to today's purebred breeder. Perhaps it's asking too much to expect him to meet all these demands in a changing world. In years past, it was generally accepted that the purebred breeder, and the association of which he was a part, were at the very forefront of industry change. Today, in the fierce crucible of rapid change and challenge, purebred breeders find themselves struggling to define their role, to find their niche.

This comes at a time when the industry is on the verge of dramatic genetic change, a veritable explosion of genetic impact. Armed with a battery of new tools, in addition to the old and proven ones, the purebred operator can now turn to embryo transfer, sire summaries, detailed carcass information, computerized matings, stacked pedigrees, EPD's and somewhere in the future, new horizons through gene splicing. Not only is the future exciting, but it is currently fueled by higher cattle prices and purebred sales beyond expectation.

Some producers have responded, have capitalized on the new information. In Henry Gardiner's herd at Ashland, Kansas, average weaning weights have increased by over 200 pounds since 1980, and similar stories can be found in herds of Martin Jorgensen of South Dakota, and John Stewart-Smith of Alberta. The opportunity to reap the rewards and benefits of these remarkable opportunities is NOW. Will the purebred industry take up the challenge?

Facing the Challenge

It's now secret that purebred breeders, and the associations they represent, face real problems with staff and budgets. Registrations have dropped in most associations while costs have shot up. Reductions in work force are common; in one major association the registrations have declined over 50% in the past decade, the staff and work force has been cut from 18 to 7 individuals.

Meanwhile, dozens of new breeds, synthetics and crossbreds have appeared on the scene; some estimate as many as 70 breeds or crosses now appear on the books. Keeping the major breeds "pure" is no small chore, despite present tools for blood typing and identification. Maintaining purity and high standards within a breed, once relatively simple with few and rather distinct breeds, has become a nightmare for some. All this leads to a simple question: Why do we need "pure" breeds for today's industry? Can our needs be met by carefully designed seedstock, with or without the purebred label?

It is commonly held that we must have homozygosity to effect the greatest genetic improvement in beef cattle, or to make the crosses that lead to most profitable production. Yet the professional cattlemen today can carefully craft the mating program he needs, drawing on reservoirs of genetic material as never before and producing a uniform product.

Lessons From the Outside

Valuable lessons can be learned by studying other classes of livestock and poultry. With poultry, 6-7 layer crosses, each carefully designed for specific combining ability, and 6-7 broiler lines dominate the production scene. None are purebreds, each is a synthetic produce and merchandised by a large business operation. With swine, the trend is somewhat similar. The move for decades has been to employ crossbreeding, often in rotational patterns. Recently, outside agribusiness has attempted an inroad by producing a set of crossbreds, each designed for commercial production and capable of maximizing performance and carcass merit.

Witness, also, the developments in dairy cattle. Here, of course, the Holstein dominates the dairy scene. The product, milk, is fairly uniform, the trait highly heritable, and the environmental conditions much more uniform than with beef. The facts are clear; through massive use of A.I. to produce over 75% of all calves, DHIA records, astute mating via computer, plus improved feeding and management, the average yield of dairy cows has doubled since the 1950's. At present, registered breeders are exploring the possibility of tapping into the vast genetic pool of commercial cattle, identifying heritage and making three successive crosses before registering. Thus they would open the herd book, so to speak. By using extensive classification system, they attempt to avoid unsoundness and fix type. Embryo transfer from proven females has been accepted, with over 20,000 calves recorded last year. Computerized matings can predict with amazing accuracy the outcome in terms of offspring performance.

Are Purebred Breeders Ready for Change

The beef industry may not be ready for such dramatic change, but the examples cited do fit well into the specialization going on throughout U.S. agriculture. Based on this, one might envision a beef chain that would be serviced by specific lines or strains of superior cattle, few of them purebred, but with distinct differences in production and performances traits. They would be carefully woven into a planned crossing program to yield a superior product all the way to the retail counter. This source of basic genetic material to start the cross may be well outside of purebreds, as we know them today. The entire operation may be designed, financed and controlled by agribusiness firms from the outside, marketing their breeding stock under the company name.

And this may be just the beginning! Exciting new horizons await the progressive breeder. Through gene splicing, it may be possible to produce a unique genetic package. Recently, Harvard scientists produced a mouse with unique characteristics, and promptly applied for a patent. Obviously, this brings up questions of proprietary interests and poses legal tangles. But the results of the technique are startling and the application may be here before the end of the century. How will purebred association respond? Even with embryo transfer we have encountered problems in obtaining accurate performance data.

These are developments that must be addressed at both the association and breeder level. The immediate challenge, of course, is to produce superior breeding stock, using all the tools of A.I., EPD's, sire summaries and computer-directed matings to provide the beef industry with cattle that can perform, and meet consumer demands. If we are to breed the fat off, rather than feed it off, still depending on the cow herd to produce under a wide range of environments and management, we face no small challenge in the years ahead.

How do we present the commercial buyer with the right kind of information? Where, for example, do cattle shows and other displays fit in. There are many critics. Meaningful data on the probable performance of young bulls, i.e., use of EPD's is largely ignored and only a few measurements or records are now employed in the final placings. Is it possible, in the future, that the computer will assist the live judge in the final placing? A small step in this direction was featured at the last International Stockman's School at Houston, with modest acceptance. Given the impressive and accurate data available to commercial buyers, is it unreasonable to expect that the final show ring placing can be based on 75% from the computer, using the best data at hand, and 25% from the judge, largely as a means of spotting unsoundness and to assure breed type? With beef females, the show ring should not be used to try to estimate future productivity. Possibly it should be restricted to cow/calf pairs alone.

Looking to the Future

Above all, purebred breeders must be able to spot trends, be aware of probable change in the beef industry, much more than in the past This is all the more important as we concentrate on fewer sires through A.I. Looking back, we have seen dramatic changes in the beef industry, and only a few astute breeders spotted them in the early stages. Probably the real turning point was IBP and boxed beef, narrowing the specs of the end product. All the while, exotics were appearing on the scene, widening the genetic base. Grading standards were changed to better reflect true carcass merit and public concern about animal fat vs. a healthy diet. Large commercial feedlots, then, had the unenviable task of producing a remarkably consistent product - within a rather uniform set of specs as to carcass weight, lean content, quality grade, fat cover and maturity. The consumer has expressed strong preference on the right kind of beef, although varying from coast to coast.

To meet this changing picture, cattlemen redesigned their pure breeds, turned to crossbreeding, improved their management and business approach. It is heartening to see two major breeds now advertising and promoting a crossbred mating, and the resulting offspring, as the ideal. If the trend toward uniformity of end product continues, as it will, how many breeds or crossbreeds do we need? From the large number available today, likely we will reduce to six to eight major ones. Each will be carefully structured and bred to fit a specific need to the industry.

The commercial cattleman will, of course, make the final decision, based on solid data and good judgment. Past preferences for breed and idealistic views will fall away. Through A.I., marked increase in performance will become commonplace. Genetic antagonisms that hamper progress will be spotted early, and avoided. Thus, for example, the conflict of rapid growth and mature size vs. female fertility and productivity will be addressed early in the game. And having developed the superior beef animal, the professional cattleman will want to share in the returns, either through retained ownership, joint partnerships, or a premium for a superior product.

Survival of the Purebred

Given this set of conditions for the 1990's, what kind of purebred industry will survive? Very likely, following the pattern will established in other sectors of U.S. agriculture, the future will belong to the larger, more sophisticated units, able to take full advantage of genetic superiority and to merchandise effectively. Small to moderate - size purebred herds, those unable to tie in with, or align themselves to, a specific breeding program will fall by the wayside. The larger units will make a handsome return to investors, keeping the capital flowing into the beef breeding sector.

Yet there's a note of nostalgia worthy of consideration in this change. The smaller breeder represents a broad pool of diverse genetic material, a best reservoir so to speak. Often, he is close to the commercial industry and understands its problem. Breeding stock are produced close to the regions and herds in which they must perform. And history would illustrate that because of their genetic diversity, they can supply the needs of the breed if conditions change. An example that easily comes to mind is recovery from the dwarfism and compact cattle of the 1950's. Further, they may be less influenced by wide swings in type and conformation, maintaining a steady course. Yet the future belongs to those who can best put to use all the tools of selection and merchandising.

In the purebred industry, there's always the tendency to respond to the immediate, to warp existing breeding programs to fit the times. Encouraged by show ring winnings or immediate demand, many solid and constructive purebred programs have been shifted out of position. The current trend toward increased height and frame size, which will be so well debated at this conference, is a case in point.

These trends will come and go, and emphasis on single traits will take its toll of both purebred breeders and the industry as well. Sound and constructive moves, triggered in response to industry needs and the demands of the consumer, will have to be made early and constructively for all sectors of the beef business to prosper.

Based on all this, what's the future for the purebred breeder? Will he survive and, if so, in what form? Will he be largely replaced by commercial seedstock producers, operating outside the associations and developing and merchandising specific lines? Given the short life span of many purebred herds, and brief opportunity to turn generations, a longer-range approach will be needed. We are likely to see the emergence of corporations and businesses that will capitalize on the demand for excellence, even worldwide. The impact of A.I. and embryo transfer is a signal in this direction.

Emphasis on the Tools Available

Purebred associations will spend less time on keeping breeds "pure" and place emphasis on records, EPD's and outstanding commercial cattle of the breed, or to other breeds introduced to perform a certain function. Crossbreds, fashioned to deliver the right genetic package, may become acceptable in breeding herds. By opening their books, under carefully controlled conditions, the sleight-of-hand introductions from other genetic stock might be controlled.

Strong emphasis will continue on overall "doing ability," even though the feeder and packer, with more limited vision as to what the industry needs, may protest.

As an example, the use of Brahman blood will continue in hot, humid climates, even though feeders and packers may discourage it. The questions will be how much, and in what combination. The almost universal move toward sire summaries and EPD's among breed associations bodes well for their survival and effectiveness. Despite the reduction in registrations and total purebred breeders, members as well as commercial cattlemen are going to ask more from the association. The word "service" will take on added meaning in a computer age. The prospect of combining all the tools for selection now at hand is exciting indeed.

To tackle this job effectively, purebred associations must not only be staffed with the brightest and best, but breeders must be sure that they elect directors up to the task, in step with the times. The change now under way, and those to come, will demand a whole new spectrum of thought in the boardroom. Land grant universities, through research and extension, will be called on as never before, and much of the increased cost must be borne by the breeders and cattlemen themselves, through checkoffs and direct grants. The proprietary nature of patented genetic stock will cause management and legal difficulties as yet known.

Facing the Challenge

Perhaps no other facet of the beef chain faces as great a challenge as the purebred sector. It will take full bore effort to keep up with the times, to say nothing of leading out with necessary changes. In a broad sense, the following might be worthy of consideration:

* Do not ignore the past - there are too many time proven lessons to be learned from history to pass over lightly.

* Spot emerging trends early, but be sure they are logical and well-founded. Identify the role your cattle will play and stay with it, building on the strengths of the breed.

* Look for the beef industry to "stabilize somewhat around the present specifications after two decades of dramatic change. Thus, one can more clearly and consistently emphasis the important factors.

* Be aware of trends and changes in other industries. What's happening in swine, dairy, poultry, and even crops can signal changes in our industry. Beef does not stand alone.

* You <u>must know</u> the genetic capability of your seedstock, not only to better serve your customer, but to be able to effectively use the tools at hand, to plan ahead.

* Emphasize the importance and "earning power" of the top sire - both purebred and commercial. As much as 80% of genetic progress traces to the sire and the genetic "reach" offers some amazing opportunities.

* Develop a long-range and productive relationship with the new type of progressive and professional cowman coming on the scene; a dual approach and partnership is in the best interest of both parties.

* Be cautious of the show ring - the wide swings in the pendulum can unravel a solid breeding program. While signaling change, they may not benefit the overall industry.

* Don't except acclaim by the industry for your efforts. Few breeders in history have received their just dues while still alive. The work of most "master breeders" is appreciated only after they have left the scene. In this computer age, the data bank and its use may be more important that the individual.

It's not easy to meet the challenge of the lead paragraph, but for a few gifted individuals it can happen. The purebred breeder and his association can lose their leadership role by default...not by competition. The beef industry will find the seedstock to prosper and make needed change. The big question: Who will do the job?

PUREBRED CATTLE - AN HISTORICAL OVERVIEW

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The history of modern beef cattle breeding began in the British Isles in the mid 1700's when farmers began recording ancestry and developing local breeds. The same trend occurred later on the continent of Europe. The early British cattle were used mainly for draft and milk. They were large framed, late maturing and were not finished until 3 to 4 years of age. The British breed improvers reduced frame size, hastened maturity and the ability to fatten earlier. This trend continued until the 1960's.

Since visual appraisal and comparative evaluation at livestock shows were the primary criteria for selection of breeding animals until the mid twentieth century, we have chosen paintings and photographs to depict the purebred cattle trends over the last two centuries. They represent the "ideal" beef cattle of their respective eras.

Early explorers brought cattle with them to feed their soldiers and settlers when they came to North America. The early cattle, mostly of British origin were used by the colonists for draft and milk.

Shorthorn cattle were exported from England to Virginia in 1783. The first herdbook to record ancestry of Shorthorn cattle was established by George Coates in 1822. Henry Clay imported Hereford cattle from England to Kentucky in 1817 and George Grant imported Angus cattle from Scotland to Kansas in 1873. James Davis imported the first Zebu cattle to South Carolina in 1849.

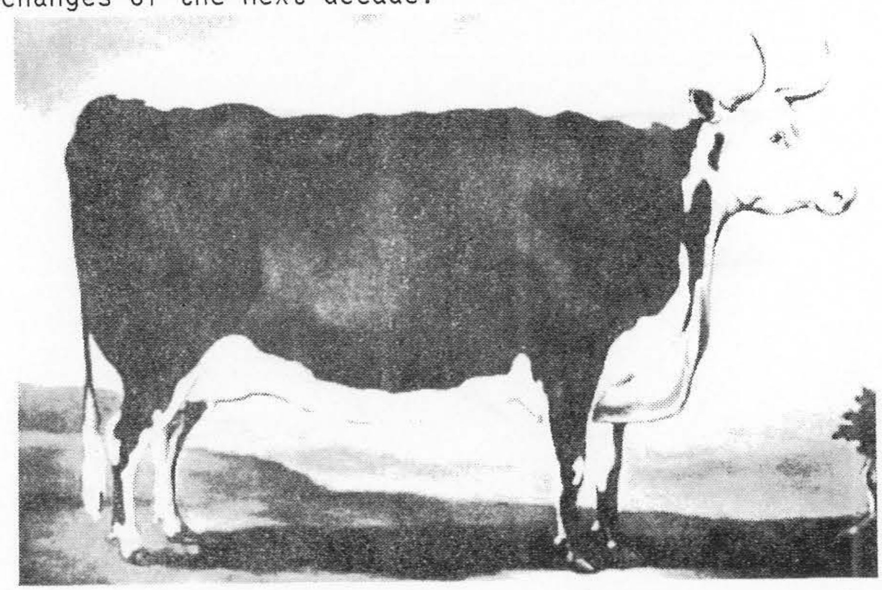
The descendants of the Spanish Longhorn cattle populated the western ranges in the 1800's. Trail drives started after the Civil War and Americans acquired a taste for beef. In the late 1800's several of the American British beef breed associations were organized (American Hereford Association 1881, American Shorthorn Association 1882, American Angus Association 1883, American Polled Hereford Association 1900). Simmental cattle were introduced in 1896, but had little impact on the industry at that time.

During the first third of the twentieth century a gradual trend developed toward the earlier maturing smaller framed cattle. From the mid 1930's to the late 1950's intense selection pressure occurred for the smaller, earlier maturing, earlier fattening cattle. The term "baby beef" came into use. Surplus feed and an increased demand for grain fed beef led to the start of the commercial feedlot era following World War II. "Snorter dwarfism" was reported in 1951, which is generally believed to have been the result of the intense selection for extremely small framed cattle.

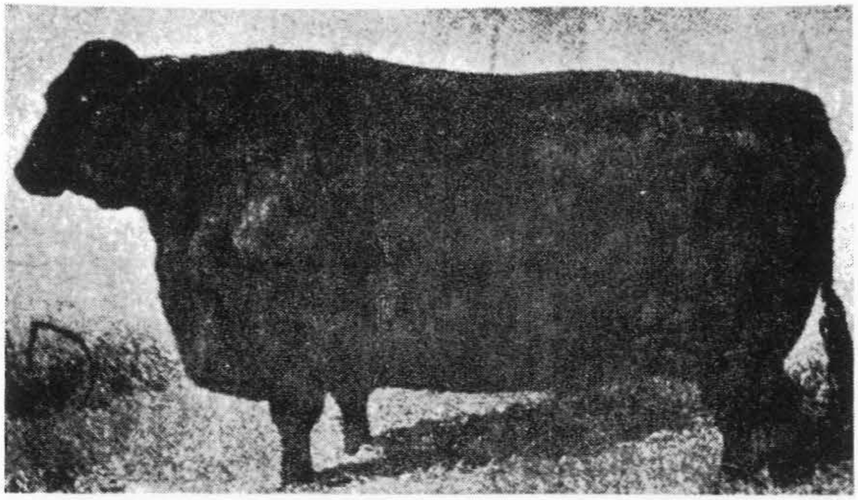
In the mid 1960's, the beef cattle industry began searching for cattle that could be pushed to desired slaughter weights without becoming over fat. The carcass yield grading system was adopted in 1965. Charolais cattle had been imported to the U.S. from Mexico in 1936, but the feedlot performance of the Charolais crossbred steer in the 1960's created on awareness in the American cattleman for the lean growth potential of some of the Continental European breeds. In the late 1960's the breeders of all breeds began selecting within their breeds for larger framed, growthier and leaner cattle. Simmental cattle were reintroduced in 1966 and other breeds including Limousins were imported at that time.

The intense selection for large framed lean cattle over the last two decades has caused concern among many segments of our industry regarding increased carcass size, carcass grade, maintenance cost and efficiency of resource utilization. Selection trends appear to be moderating selection for extremely large framed , late maturing, hard doing cattle. Increased selection emphasis for easy fleshing, muscular cattle of moderate frame and stature is occurring.

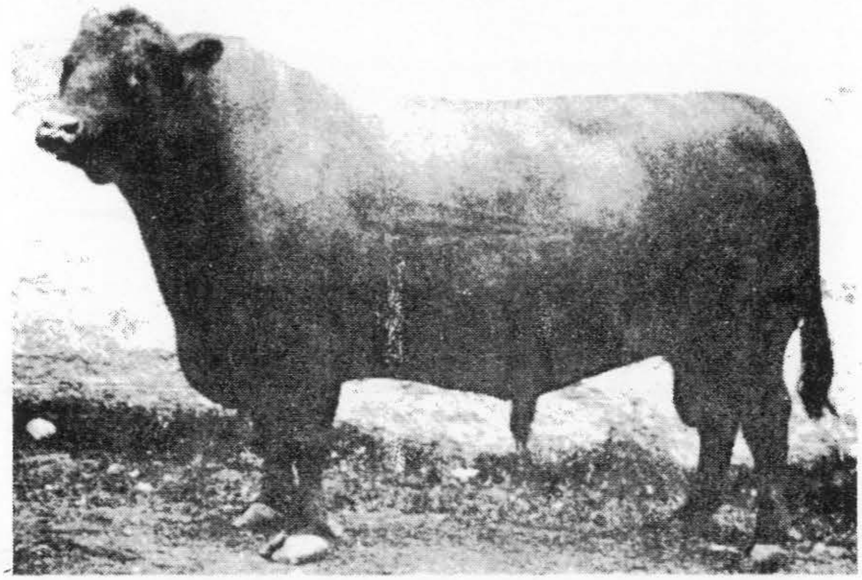
The advent of computers and the first National Sire Summary published by the American Simmental Association led the way toward the development of breeding programs for specification beef. The success of branded beef products has increased awareness of beef carcass qualities on the part of the cattle producer. These will likely impact the type trends and changes of the next decade.



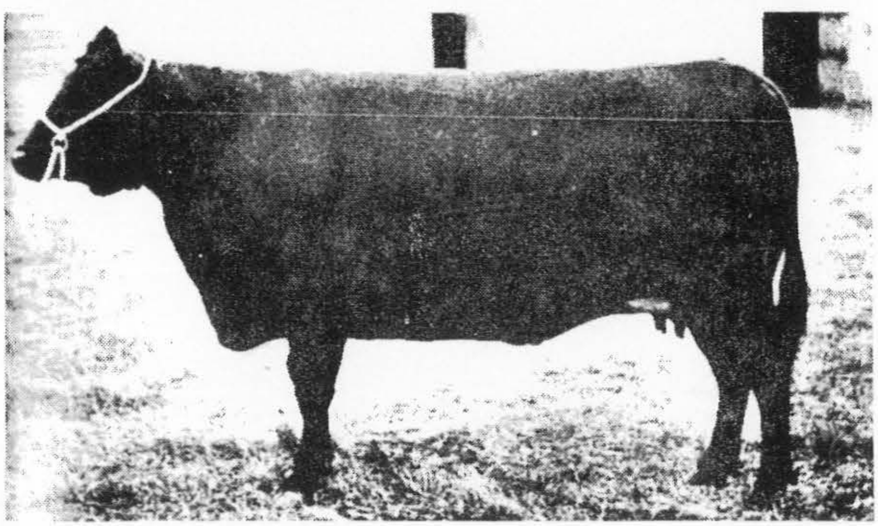
A - Oil painting of the "Silver" cow. Foundation cow of the Hereford breed. Benjamin Tompkins breeder, 1742.



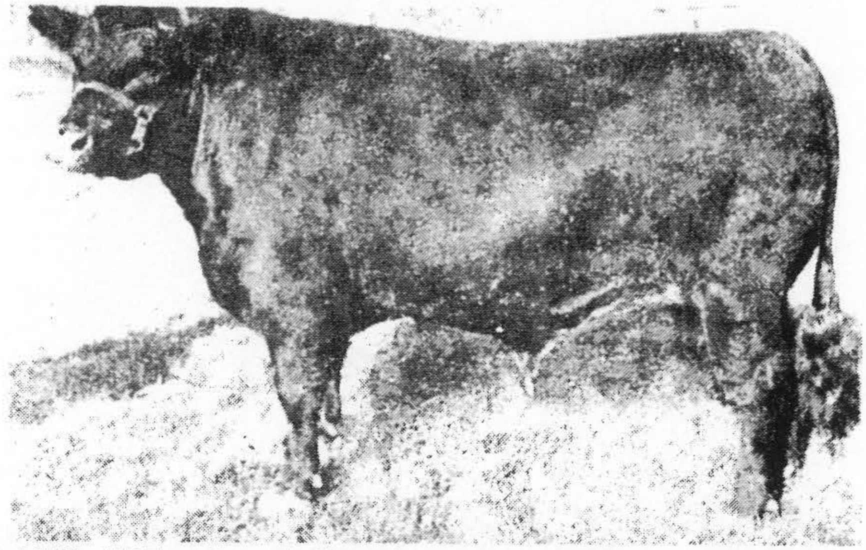
B - BLACK PRINCE - Grand Champion Steer at the 1867 Smithfield Royal Show. 2,200 lbs. at 4 years of age.



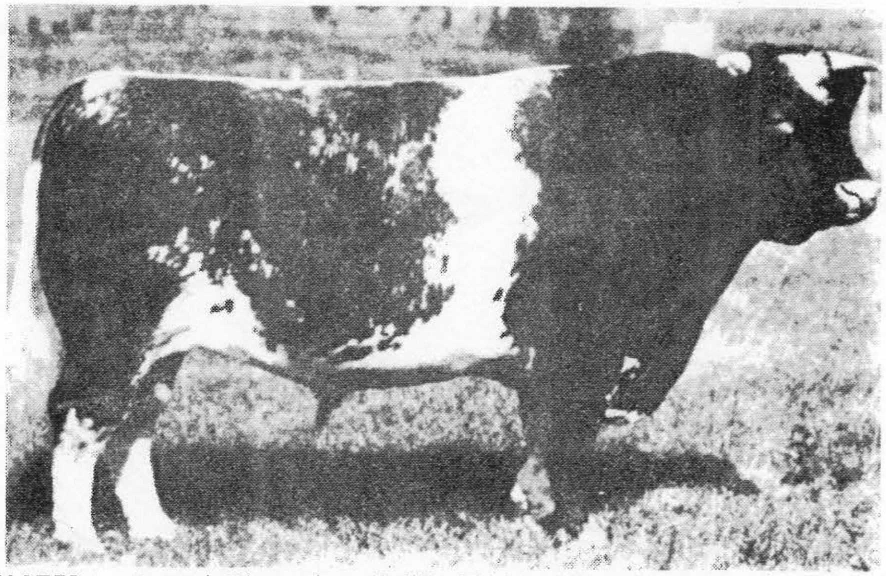
C - THE BLACK KNIGHT - Grand Champion Bull at the 1883 and 1885 Royal Highland Show. Born in 1880.



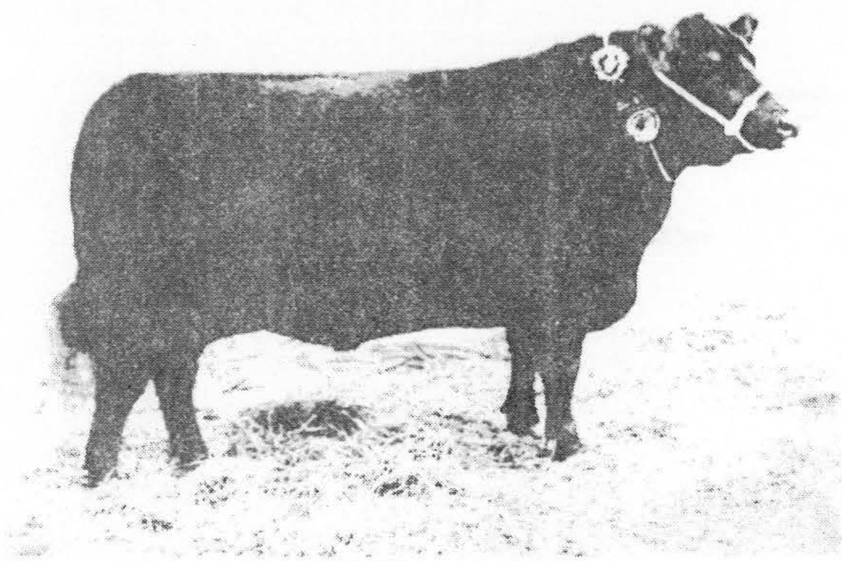
D - MISS PRETTY - Grand Champion Female 1892 at the Royal Highland Show at 6 years of age. Owned by Queen Victoria.



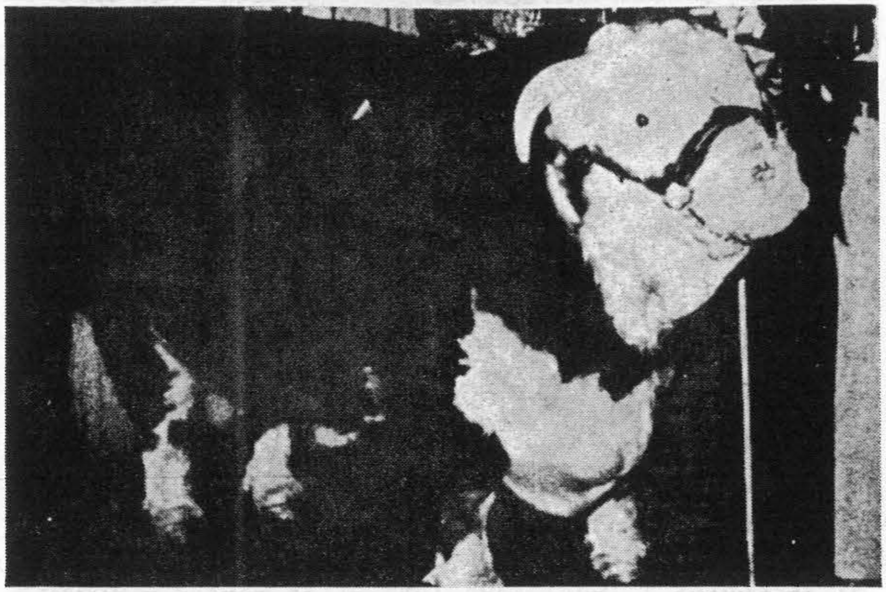
E - CLEAR LAKE JUTE - Grand Champion Steer 1904 International Livestock Show. Exhibited by Minnesota Agricultural Experiment Station. (1050 lbs. at 14 months - 1902; 1895 lbs. at 38 months - 1904.



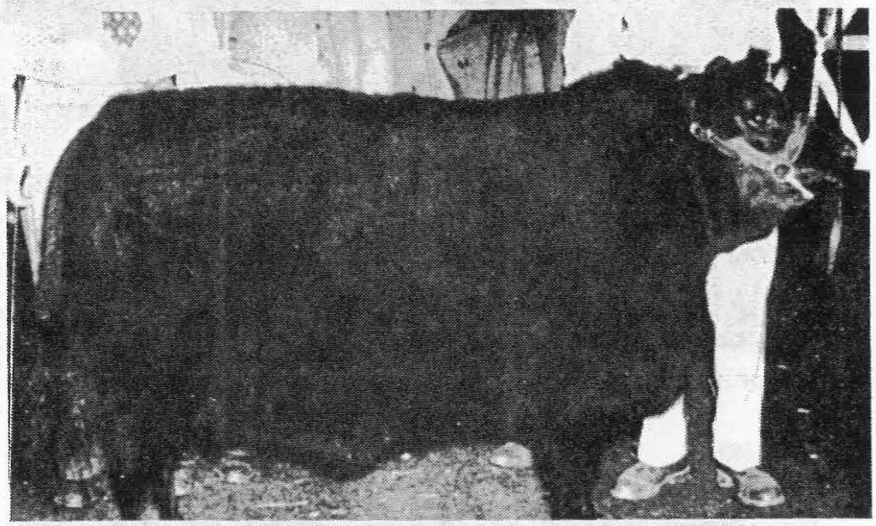
F - RINGMASTER - Grand Champion Bull 1910, 1911 International Livestock Show.



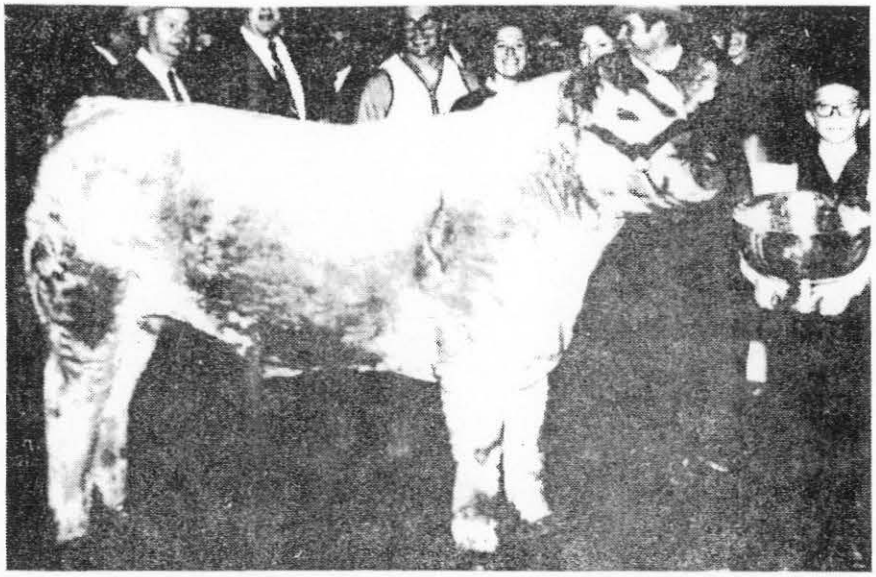
G - NEBRASKA - Grand Champion Bull 1915 Aberdeen, Scotland; Grand Champion Steer 1916 Smithfield Royal Show.



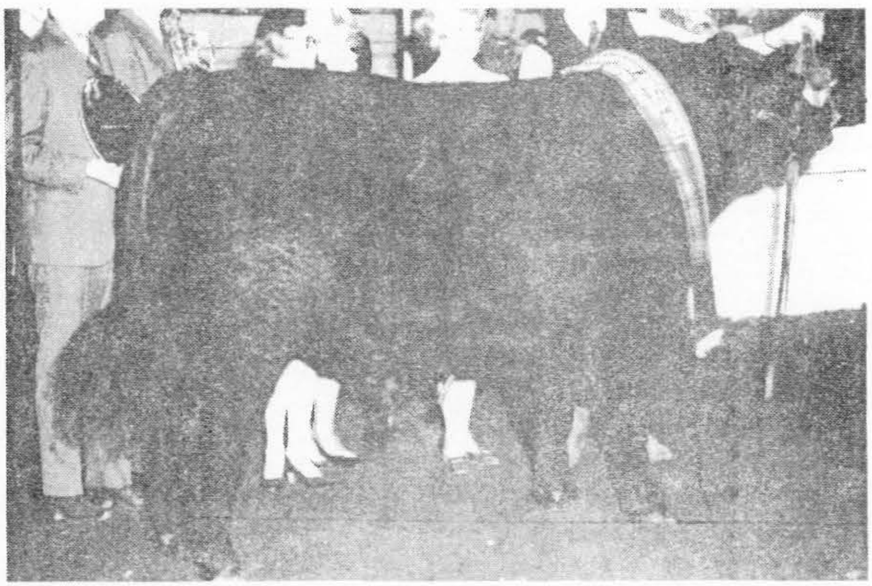
H - HILLCREST LARRY 62 - Grand Champion Bull 1952 International Livestock Show. A 2-year-old bull that came to the belt buckles of his handlers.



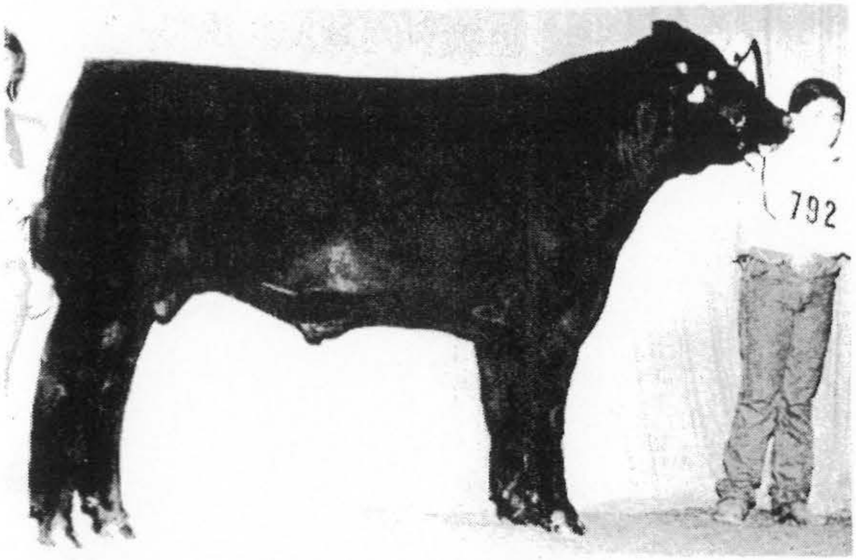
I - SHADOW ISLE BLACK JESTRESS 2 - Grand Champion Female 1953 International Livestock Show. She depicts the trend to extremely small cattle at its zenith.



J - CONOCO - 1969 International Grand Champion Steer. This Charolais Angus crossbred weighed 1250 lbs. and graded Choice, yield grade 2. Dr. Don Good helped to change the direction of the industry when he selected this outstanding steer - the first crossbred to win a major show.

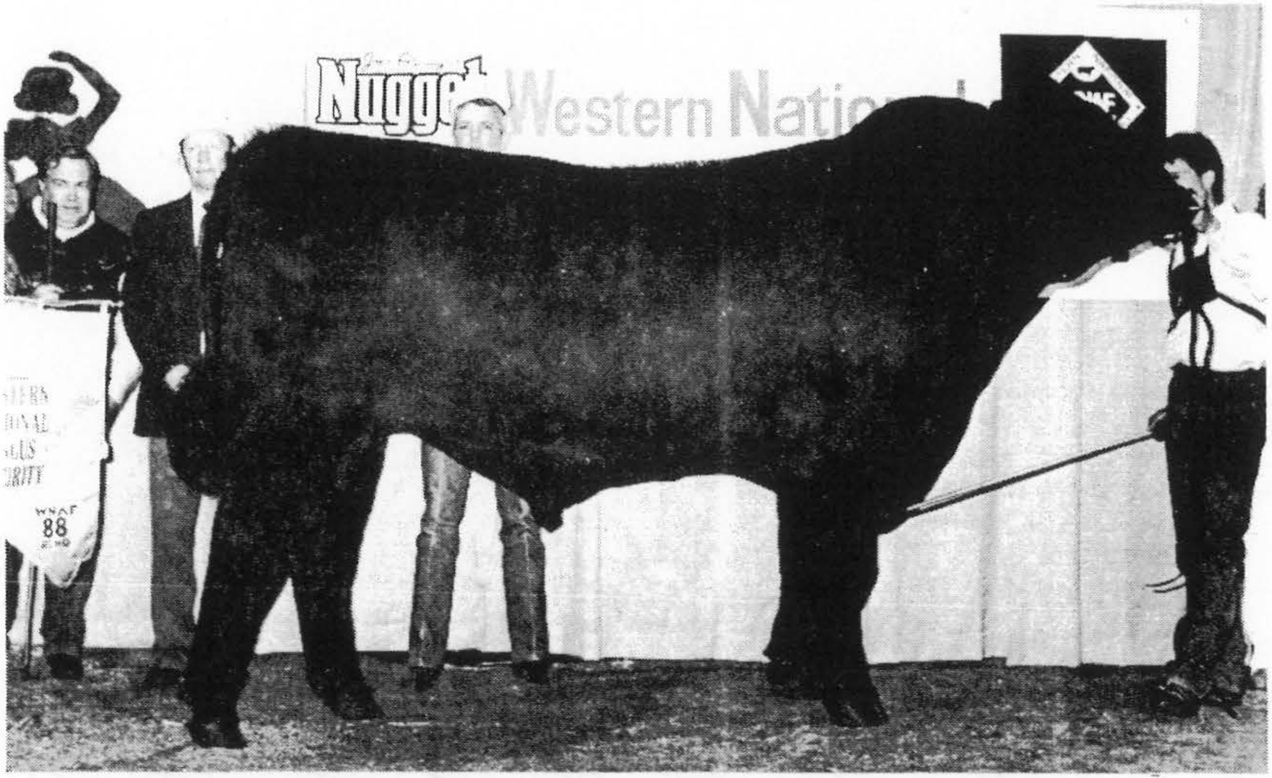


K - GREAT NORTHERN - 1969 International Grand Champion Bull. This Canadian bull was the largest trimmest bull of his time when Dr. Robert Totusek selected him and set a trend toward larger, growthier cattle.



L - Reserve Champion Angus Steer 1985 Houston Livestock Show. He weighed 1180 lbs. The crossbred steers were larger yet.

M - TOP MSU KNIGHT RYDER - Reserve Senior Champion Bull 1987 National Polled Hereford Show.



N - DAMERON LINEDRIVE - Grand Champion Bull 1988 National Western Stock Show. He weighed 2,527 lbs. at 32 months.

O - Grand Champion Steer 1988 National Western Stock Show on foot and on the rail. Live weight 1272 lbs. Hip height 54.5 inches. 0.3 inch fat. 16.4 square inch LEA. Average Choice. Yield grade 1.9.

Do Breeding Programs Exist or Is It Simply Frame?

Burke Healey
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"Yesterday's formula for success
is tomorrow's recipe for failure."
--Arnold Glasow

My topic was given to me by the esteemed planners of this seminar, and I'm supposed to discuss this subject for approximately thirty minutes. Not being from the academic world let me just say I can talk on this subject for as long as they-- or you--would like, but I can answer the question asked in the title of my topic in about one minute. On second thought, having admitted that, perhaps I do belong in academia.

Let me answer the question first, so we'll all understand from the outset just where I'm coming from and what my prejudices on this matter are. Then I'll attempt to justify my answer. The answer is--"Yes, breeding programs still do exist out there--or they better, and in my opinion no competent (or successful) breeder can long endure building a breeding program on just frame!" I'm supposing in this day and age that we're assuming "frame" means "bigger", but my answer would be the same whether it meant large, small or in between!

No innovation in animal breeding ever swept the beef industry as fast as the concept of linear measurements. Certainly none was ever abused so quickly. I guess it was inevitable it would be abused. For over a century purebred beef producers have operated under the principle that "more of a good thing is better." Once the so called experts point out what the "good thing" is we stampede in typical herd fashion towards the goal. The reception that our introduction of bovine growth curves and linear measurements received in the 1970's was no different...just a whole lot faster.

From the very start most of us who advocated and developed the use of frame scores in animal evaluation only considered it as just one tool in evaluating the growth traits... and please keep in mind there are many other important traits in this industry beside the growth traits such as fertility, milk, disposition and carcass characteristics, to name but a few.

When I think of growth traits in general I think of three traits at once...weaning weights, yearling weights, and frame size. In my mind they go together. In my books weaning weights tell 20% of the story and yearling weight and frame each tell 40%. That's just a wild estimate but that's about how, on my part, I evaluate their importance as tools to get you wherever you want to go in size and weight.

As I'm sure most of you are aware, weaning weights have been with us for about thirty-five years. Yearling weights came to the fore front about twenty-five years ago. It wasn't until the Madison Conference in 1969, however, that we began to see the correlation between frame and weight. It's even more shocking when you consider that there were three conferences at Madison in 1969, '70 and '71--one sponsored by the Hereford Association, one by the Angus and one by the Charolais. At those three conferences the frame scores were described and agreed upon as a frame three being the average of the British breeds with frame five being the average of the Continental breeds! Amazing, isn't it? The British breeds are now exhibiting frame 10.0 cattle and some of the Continental breeds have surpassed even that!

Seven years after the first Madison Conference, when I gave my presentation on the bovine growth curve at the American Hereford Association's Judging Conference at Stillwater in 1976, I was attacked from all sides by amongst others, three past AHA presidents and one of the industry's most esteemed and venerable animal scientists. At first no one believed...then almost overnight everyone believed. By the time of our World Hereford Conference at Calgary that same summer of 1976, I had crowds of both Canadian and American Hereford breeders following me around taking notes when I measured herd bulls on the tours and at the show up there.

The news was traveling fast. Hereford breeders were not the only ones to take up this new tool. Skepticism as to the merits of linear measures was beginning to give way to debate and demands for academic discussion and research. Measuring devices were everywhere. Amazingly, the performance people split wide open. Some accepted the tool; others refused to consider it at all. In fact, some performance people were as close minded about this new tool as an aid in selection as the show ring people had been about weight measurements thirty years earlier.

By May 1979 the principle of the frame score had been pretty well developed. Skip and I at Flying L as well as Missouri University had both published frame score charts, calculated bovine rates of growth, and computed a set of adjustments. Several prominent academic researchers had developed a frame score system to enable feedlot operators to better feed their cattle to the proper finish weights. In May of 1979 I was asked to address the Beef Improvement Federation at their annual meeting on the subject of linear measurements. I remember it was a task I accepted with some trepidation.

I realized only too well that many of the skeptics in the audience doubted that linear measurements had any value whatsoever. Nevertheless, I set out to convince them of the merit of this technique as a valid tool in selecting and fixing performance at certain desired levels in a herd. For those that weren't convinced I think that in many cases I at least planted a seed of curiosity.

I tried in my oral presentation that day at BIF to touch on some of the more important papers that had so influenced Skip and me in our endeavor. In the prior decade our industry had seen a flood of good scientific research in these and other areas. Research had been pouring in from such distant shores as Scotland, England, Australia, Rhodesia, and South Africa as well as from Canada and our own universities and other government research facilities here in the states. These facts coming in a deluge as they did began to dovetail together amazingly. You'd be amazed at how many of those papers could aid us in answering the very questions we're asking here.

I presented a wealth of this research data that Skip and I had amassed to show that all animals of a species are quite alike in terms of skeletal composition, muscle placement and muscle proportion. In other words, anatomy is constant. The skeleton of one grown beef cow is very similar to that of another grown beef cow...except perhaps for overall size. No one denies today that two bones on one skeleton attach the same as they do on another skeleton. Similarly, the same muscles or muscle groups exist on each, and they attach to the same bones at the same points. A judge could no longer say with authority, for instance, that one bull's stifle carries down lower than another's.

Dr. Rex Butterfield's work in Australia, for instance, showed that the various muscle systems between animals of the same species are proportional. The USDA work at the Meat Animal Research Center at Clay City, Nebraska, had reinforced Butterfield's work dramatically.

I have heard researcher after researcher say that this project at MARC was one of the most beautifully designed and executed experiments in both statistical and genetic terms that's ever been conducted. Yet everyone appears to be ignoring this work now in our new quest for carcass data. Most of what we want to know was answered there and answered with numbers and statistical validity we'll have trouble ever again approaching.

The carcass studies on over 1,100 steers in that project at MARC involved many different breed crosses. Their data encompassed such extremes in sizes as Jersey sires crossed on both Hereford and Angus cows as well as Simmental and Charolais sires crossed on these same cow breeds. Straight Herefords and Angus as well as Hereford Angus crosses were also used. All of these steers were slaughtered at the same physiological age...that is when, as nearly as possible, each animal had a 5% chemical fat composition in the rib eye muscle (corresponding to the USDA choice grade).

Naturally, the various breed crosses had to be killed at different weights to obtain equal degrees of fat. When they were, however, we saw that the body composition of all the crosses were almost identical. (See Table 1.)

Table 1: This Study Involves Data From 1121 Steers Published by USDA Animal Research Center (Progress Report No. 3 - April 1976)

	Live Weight	Carcass Weight	% Bone	% Lean	% Fat	Muscle Bone Ratio
Straight Hereford	970	609	12.7	67.5	19.8	5.4:1
Jersey x Hereford & Angus	886	550	12.9	66.9	20.3	5.2:1
South Devon x Hereford & Angus	992	632	12.6	68.1	19.2	5.4:1
Charolais x Hereford & Angus	1107	704	12.9	70.9	16.2	5.4:1
Simmental x Hereford & Angus	1109	699	13.1	69.7	17.2	5.3:1
Average	1008	638	12.8	68.8	18.4	5.4:1

All of these steers were killed at the same physiological age--when they had 5% chemical fat in the rib-eye (Choice Grade).

Dr. Bob Koch's work at the University of Nebraska again bore out this research from MARC and Butterfield. Koch's study involved breaking down one half of each of these same carcasses by their various retail cuts. The proportions of each cut (when trimmed) against total percent of lean meat was unbelievably uniform. (See Table 2.) Again this work was based on data from over 1,100 steers ranging over at least three different frame sizes.

Table 2: Percent of Total Retail Product In Each Wholesale Cut

	Round	Loin	Rib	Chuck	Roasts & Steaks
Hereford x Angus	25.8	14.8	9.3	30.3	51.6
Jersey x Hereford x Angus	24.7	15.1	9.7	30.7	52.0
South Devon x Hereford x Angus	25.7	15.1	9.5	29.9	51.2
Limousin x Hereford x Angus	26.6	15.1	9.3	29.8	51.1
Charolais x Hereford x Angus	26.5	15.1	9.4	29.8	51.2
Simmental x Hereford x Angus	26.4	15.0	9.2	30.1	51.2
Average	26.0	15.0	9.3	30.1	51.4

*Retail Product is red meat with bone removed and fat trimmed to .3" outside fat.

Data presented by Dr. Robert M. Koch, Univ. of Neb. at the Range Beef Cow Symposium, Chadron, Nebraska 1977.

Dr. E. J. Warwick's work feeding identical twin calves at the USDA Animal Research Center at Beltsville, Maryland, under different types of rations proved once again this same fact...that every animal is a predisposed genetic package to grow to a certain size and carry so much finish at a certain weight regardless of when he gets there.

Dr. Judge's work with Holstein and Angus steers fed to the choice grade and Dr. Lidvall's work at Tennessee University feeding steers of various breeds and frame sizes to a constant grade all proved that there is really only one basic factor responsible for the difference in the growth or body composition of any two steers, bulls or heifers at a given age. That difference is the MATURE SIZE which the animals will attain if they are left alive to grow and develop.

Because of this amazing mass of background data, all of which dovetailed so well, my brother, Skip, and I had set out in 1970 to incorporate linear measurements in our records to help us fix performance. Please note--I said to help us "fix performance"--no more than that! The first fact we discovered about how cattle grew was hard to believe...yet it's the key to using linear measures. AT A GIVEN AGE BULLS OR HEIFERS GROW AT ALMOST THE SAME IDENTICAL RATE REGARDLESS OF FRAME SIZE. The work at Missouri University showed this also. The ration can vary the growth rate slightly, but it's so little as to be almost negligible unless the animals are so underfed that stunting occurs. To prove this point at BIF I calculated and showed them the daily growth rate from 205 days to 365 days on the tallest ten bulls and the shortest ten bulls in each of our last four calf crops. I then averaged the results for each group of bulls and the growth rates didn't vary 1/1000 of an inch!

I also ran the same figures on the shortest and tallest ten heifers over the same years. The average figures for growth per day were again identical to 1/1000 of an inch. Granted, in our herd in the early '70's those figures involved only a spread from frame size 3.5 to 5.5 animals. The work by the Extension Service of the University of Missouri, however, bore out this phenomenon over thousands of cattle ranging from frame size 1 to frame 7.

After some 20,000 measurements at our ranch taken at monthly intervals on the same animals, we were prepared to draw up growth charts for hip heights on bulls and heifers at all ages clear to maturity. Understand, the arbitrary decision that there would be a two inch spread between each frame size of bulls at a year of age was made by Missouri University. The rest of the industry had just followed along. These were the frame size charts for bulls and heifers that were generally accepted after I gave my paper at BIF.

I presented another fact often overlooked when I showed those frame charts at BIF. Our beef animals attain most of their skeletal growth at a relatively young age. Heifers, for instance, have 80% of their total growth at weaning. At a year they've attained 90%. At two years of age they are almost through growing. At somewhere between 2 1/2 and 3 years of age all skeletal growth is completed. This is true for both heifers and bulls. Steers, of course, due to castration continue to grow throughout life.

As we mentioned before, maturity comes much quicker than most expect. The myth that big cattle are late maturing, achieving a lot of their growth at two, three or even five years of age was just that...a myth. There may be some little difference in when cattle mature, but it's relatively small.

At the conclusion of my speech at the BIF Meeting in 1979, I waved a big, red warning flag. In fact, I have never made a presentation on frame scores and growth curves since then to any group without making the same warning. For years, however, everyone was so captivated by the new concepts that few heard or remembered the warning. In recent years my warning portion of the speeches or slide presentations became more emphatic. I was actually showing pictures of real elephants in my slides by 1980!. Finally, I quit giving the speech anywhere. I had created a monster.

I had always pointed out to my audiences that if slaughtered at the right point in his individual growth curve any beef steer of any frame size can have just about ideal carcass characteristics. True, as those 1,000 steers killed each year had shown in the MARC work, the weight at which this occurs varies with each frame size (as we saw in Table 1), but most steers can be killed at some point in their life to have a yield grade 1 or 2 and choice marbling. When they do, they'll cut out about as well as any other steer. They'll also express as much muscling, as good a muscle-bone ratio, and nearly equal performance or efficiency of gain.

This is one of the main points to me of the work that Dr. Larry Cundiff and Dr. Bob Koch pioneered in that great MARC work. So many of the answers we and the packing industry are seeking right now are already proven in that project--and proven statistically in numbers too large to dispute and probably too large to ever again duplicate.

At what point then are we going to start drawing the line concerning what we'll call a "good yearling weight of measure"? So far, for instance, at the bull tests we are still saying the animal that wins the test is the best. You can bet he's usually also one of the biggest. Shouldn't we consider drawing a line somewhere? For several years now I've thought it was time we start classifying the performance of our cattle on test according to what frame size they achieved coming off test...without declaring a winner or passing judgment on what performance level is best. The present design of our bull tests is instead exerting ever upward pressure on frame size.

All our breed averages are steadily increasing...so our bases are moving. As our base moves up our need for further change upward in frame and the degree of change needed is diminishing. The target's changing and many of us are losing our perspective.

We all know bigger animals gain faster, mature larger and fatten less at equal weights with the smaller ones. Most will also admit the big animal in a fertile breed is just as fertile as the smaller animal if it gets feed. It's usually improper maintenance that causes fertility problems. For three decades now bigger has been better. We've got to change our attitude of always shooting for the maximums in our selections. Always bigger can't continue to always be better.

Our colleagues who live and die by the show ring are just as bad. Since the pendulum swung it's been a continual stampede to bigger and bigger cattle at the shows. Since 1955 the cry at ringside has been, "Get 'em bigger!"...and with disastrous results!

This craze for tall cattle in the show ring has now fostered an economically ruinous Embryo Transplant program. No one can afford it, but it's almost impossible because of the growth hormone levels of the recipient cow for the natural calf out of his own dam to come within a frame size of his ET brothers. Consequently, no one's showing. There are no cattle in the ring!

The pressure for frame is so great in the ring that breeders will hardly even fit anything less than a frame 7. There aren't many of them. Probably every 60" horned Hereford bull in America eligible the last two years to show in Denver has been at Denver! It creates a false impression. Everyone runs around looking for a 60" bull thinking there are lots of them. They probably saw most of them at Denver if they were halfway structurally sound (and how many others have we all seen out there that weren't). This madness has to stop--in the show ring and at the bull tests.

We constantly hear it said "the box dictates" cattle size and performance in our industry. In reality what we mean is "the packer dictates." The packer in turn tells us what his customer and the economics of the business dictate. The truth is if the box dictates, the packer can always change the dimensions of the box in which he packs these cuts. We best never forget that.

If the specifications for the box as it is today dictate, then we should be breeding frame 4.5 to 5 plus cows to bulls of equal size! Did you get that? Frame 4.5 to 5 plus! That's what it takes to have yield grade 2 animals grading low choice that fit the packer's weight range.

As purebred breeders we can justify somewhat larger cattle in our herds because most herds are still considerably smaller than this and nature has an annoying habit of trying to regress all species to their average in every trait. In addition, three or more very credible research studies have shown that with today's economic conditions you can get the best overall return of investment in a program of breeding what once were larger size bulls (frame 5) to larger size cows (frame 5) if you keep the cattle all the way to slaughter.

We must start identifying the most efficient performers within each frame. The research and correlations I've seen seem to point out to us...<u>Over 60% of the difference in cattle performance isn't due to frame size.</u> That 60% is due to other factors. It's true, frame size gave us all a fast jump in performance. Now that we have significant numbers of our cattle in the acceptable range of frame sizes to perform satisfactorily, we need to refine the process. We need to find the cattle within these ranges that perform the best and then stack their pedigrees. Keeping frame and performance constant and rolling generation after generation at those levels will give us genetically superior cattle with a high degree of repeatability.

Now in my opinion, that's what a breeding program is all about. There are always certain traits we've got to keep in our cattle. Things like fertility, optimum levels of milk, structural soundness, good disposition, the ability to survive in blizzards, droughts or other weather extremes--these seem to me to be the kinds of traits we have to keep in our cattle. They endure forever. The fat or lean levels we want, the size we want, yes even the muscle-bone ratios--these fads come and go. Most of our breeds are flexible. We can select and mold them up and down for slaughter weights and carcass content. These other traits, however, are with us forever, and some of them are not very heritable, which means either your breed's got them or it doesn't, because in the case of a lowly heritable trait, you can't live long enough in one lifetime to alter it very much by selection.

So I would suggest the good breeding programs start with strong cow families strong in these enduring traits. Selected properly, our cows can get us through a lot. Anyone who throws away these major qualities of such economic importance for fast improvement in these fads and fancies is doomed to failure.

We have to keep our perspective. Performance in general is no fad, but whether we are selecting right now for big or little, for this weaning weight or for that yearling weight--these things are fads in the sense that those kind of goals, up 'til now anyway, have always been temporary and subject to change, if you take the long view. We seldom stay on these trends for much over 15 to 20 years--then they change.

Skip and I were able to survive in this business for 38 years, which has been all of our adult lives, up to now at least by staying flexible where these temporary fads are concerned. We always tried, however, to maintain a cow herd of good milking, structurally sound cows that were fertile and that had good dispositions. Those things make it a whole lot easier and profitable to select for the other traits as they come along.

In summary, I'd say frame score is an important trait to help you fix many traits, but it's only that--certainly no more. Remember this also, as our fads change the desirability of one frame score over another can change, too. Tomorrow, frame scores may be employed to help us select for cattle of medium or small mature size. Never were frame scores intended--at least on our part--to be a "breeding program."

If I don't get as excited about each new tool of performance as being the ultimate and an end in itself, but only regard it as a tool and perhaps a means to whatever end I choose, please keep in mind that my views are coming from a perspective of almost 40 years in the business, and as Emerson said, "The years teach much that days never know." I understand what Emerson meant a whole lot better now than I did in 1950 and 1960. He may just be right.

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Live Animal Evaluation for the Determination of Carcass Traits

by R.A. Long
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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 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 slaughter 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 two 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, 682 days. Carcass weight, dressing percentage, carcass composition, chemical composition and physio-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 old 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 accumulate and use a complete -- and accurate 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 use the records in selection. The procedure in performance selection 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 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, 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 evaluations 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 has nothing to do with desirability of their carcasses.

I would hope that your conclusion would be something like mine which simply stated is: Why anyone would use frame size in the evaluation of cattle for composition is beyond me. 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 in 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 requires 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" of "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 "Doubled 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 animals body and it is 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 muscling such as dilution techniques, ultrasound measurements and, of course, magnetic response. However, each of these methods has a 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.

Conclusion

When it is all said and done, there are only four measures of production worthy of consideration in evaluation 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 strain which is the answer to everyone's prayer and takes over the world.
2. The development of identification so several breed strains each 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 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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Performance Programs
What Do We Know About Cattle Today

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The concept of beef cattle genetic improvement programs began with research in the 1930's. Central to the concept has been the transfer of genetic change in the purebred industry to the commercial industry. Research continued through the 1940's and the first central bull test stations were established in the early 1950's. Central test stations provided commercial producers as well as purebred producers a method of comparison for bulls tested under the same environmental conditions. One problem with central test stations was, and is today, that only a number of bulls can be tested each year. State Beef Cattle Improvement Associations were organized in the mid 1950's within herd information which provided an educational system and computerized record systems. In the 1960's ranch performance testing programs were nurtured and began to flourish providing sound objective within herd information which breeders could use in making selection decisions. In 1968 the Beef Improvement Federation (BIF) was formed and this organization began to provide the framework for standardized and systematic procedures for collecting beef cattle performance data. BIF Guidelines became the performance "bible" for the beef industry.

In 1971-72 the first National Sire Summary was published by a national beef cattle breed association. At this time the idea of extending beef performance records into a national progeny testing program was indeed revolutionary. Only a few far ranging thinkers really understood what the publication of this document would mean to the future of the beef industry. Until 1972 truly accurate comparisons of bulls could only be made within a herd-year-season contemporary group. The first and subsequent National Sire Summaries compared bulls across herds and/or generations. Beef cattle breeding had entered the twentieth century! Today almost all major breeds of beef cattle publish a National Sire Evaluation (NSE) which was just the beginning of a rapid technological development leading to complete breed genetic evaluation programs.

Most researchers working in the area of national genetic evaluation had contended National Sire Evaluation was a means to an end rather than the ultimate in a genetic improvement program. Three major problems existed with NSE from the industry's point of view. First, bulls had to produce progeny before entering the program which resulted in published evaluations of old bulls. Older bulls were usually available only through AI which made them impractical for use in much of the commercial industry. Furthermore, the purebred industry tends to seek young bulls rather than old bulls in an attempt to reduce the generation interval and make faster genetic change. Thus, while the evaluations in National Sire Summaries were and still are very accurate, both the purebred and commercial industry struggled in the late 70's and early 80's with how to effectively use the published results. A second problem with NSE was breeders, particularly purebred breeders, contended some bulls in NSE were being mated to superior cows causing a serious bias in the evaluation of those bulls. Fortunately, research has shown this second problem was more perception than reality. The third problem was NSE programs did not use the individual's own performance record in the analysis. The third problem was not serious for bulls with a substantial number of progeny; however, for a young bull with only a few progeny it meant neglecting a very important piece of performance information. Another deficiency of NSE was that it provided genetic values on males only, thus the females which provide half the genes in the population were ignored.

In 1984-85 a major breakthrough was accomplished with application of something called the "Reduced Animal Model" termed RAM for short. Application of this mathematical model to beef cattle performance records provided genetic evaluations free of all problems associated with National Sire Evaluation. Application of this model merged on farm and ranch testing programs with NSE to form what is now called National Cattle Evaluation (NCE). Today, NCE is a reality for most of the major beef breeds in the United States.

National Cattle Evaluation programs have several distinct advantages over NSE programs:

1) NCE provides a genetic value for an individual which incorporates any combination of progeny, pedigree (sire and dam) and individual record information. Thus, the individual's own record, if available, is incorporated into the analysis.
2) The procedure adjusts for the superiority or inferiority of the mates of the individual. This reduces, if not totally eliminates, bias introduced by specific matings for both sires and dams.
3) The program provides maternal genetic values for those traits which are maternally influenced such as weaning weight.
4) The procedure accounts for genetic change over time in a breed providing more precise comparisons of individuals from different generations.
5) National Cattle Evaluation computes genetic values for all animals in the breed, i.e. for sires and dams plus young animals (males and females) which have not yet produced progeny.

It is of <u>major importance</u> that producers realize that the genetic values for young animals not yet producing progeny and for dams are <u>comparable across herds and/or generations</u> just like sire values from NSE programs.

Commercial producers may be asking, "What is an EPD?" or "How can I use an EPD in making selection decisions?". For a complete explanation producers should consult the National Sire Summary for the breed they wish to use in their operation. The following brief example will provide some insight into the usefulness of the EPD. Expected Progeny Differences are plus or minus values of original measurement (eg. weaning weight in pounds). The EPDs are used to make comparisons among bulls from which the breeder wishes to make a selection. The comparisons are made one pair of bulls at a time. For example, two bulls, A and B, where bull A has a weaning weight EPD of +20 pounds and bull B has a weaning weight EPD of +5 pounds. The EPDs for these two bulls tell the producer that if he were to select both bulls for this breeding program and mate them to a large number of comparable cows he could expect a 15 pound difference between the average weaning weights of the calves from the two bulls. Thus, if weaning weight is important in the producer's program, selection of bull A is obvious. The EPDs provide the producer a means of predicting differences between any two bulls without having to breed the bulls in his program. The difference between EPD's for bull A and B (20 - 5 = 15 pounds) is the difference a producer would expect in his own herd. In breeds which have NCE programs, there are thousands of bulls evaluated and it is possible, although, perhaps not practical to make this pairwise comparison for all of them. Expected progeny difference provide a prediction of future performance of progeny from an individual is based on information currently available.

Traits available for comparison vary from breed to breed. Traits evaluated are birth weight, weaning weight, milking ability expressed as pounds of weaned calf, yearling weight, hip height, scrotal circumference and calving ease. Other traits such as carcass traits will be added in the near future.

Best linear unbiased prediction procedures (BLUP) used in National Cattle Evaluation programs are complex to say the least. Let us now examine how factors such as the contemporary group influence the computation of an individual's expected progeny difference (EPD).

First, an example of a contemporary group effect. Remember the definition of a contemporary group is a set of animals of the same sex and similar age which have had equal opportunity to perform (same management, pasture, year, etc.). As an example, suppose we have two contemporary groups (these could be herds also) which have the same two sires, say A and B, represented. Each sire produces ten bull calves in each contemporary group. The performance of each sire's progeny in each group is summarized in the following table:

	Contemporary groups (herds)		
Sires	1	2	Average
A	$500^{(10)}$	$550^{(10)}$	525
B	$400^{(10)}$	$450^{(10)}$	425
Average	450	500	

The averages by sire across contemporary groups gives one the difference in progeny performance for the two bulls A (525) and B (425) with bull A's progeny having a 100 pound advantage (sire differences). The averages by group across sires quantitates the difference between contemporary groups. As you can see there is a 50 pound advantage for group 2. This is the contemporary group effect. If one assumes the females are similar for both groups then the 50 pound advantage for group 2 must come from some environ-mental source. Whatever the cause of differences between contemporary groups is of little concern; however, these differences may bias the evaluation of animals in those contemporary groups. Therefore, analysis procedures used in NCE adjust for these contemporary group differences which result in genetic evaluations (EPDs) computed as though all the cattle were raised in one giant contemporary group. If the contemporary groups were for some reason improperly identified, say for example, 5 of bull B's progeny in group 2 were in a different pasture, the estimate of the contemporary group effect could be wrong and perhaps bias the sire evaluations.

In order to understand the computation of an individual's weaning EPDs for growth let us examine several of the factors involved. First, remember all that is available to us for the identification of superior genetics are the records on individual animals. All of the analytical procedures are designed to separate the environmental and genetic factors affecting an individual's record thus providing a prediction of the individual's genetic worth. Thus, as one thinks about factors affecting the EPD of an individual we are actually considering the genetic and environmental effects on the record of the individual.

The first factor to consider is the genetic makeup of the individual which is referred to as its breeding value (EPD = 1/2 Breeding Value). Obviously, this is the factor one is most concerned about because it is directly related to the EPD of the individual. Another factor which comes to mind immediately with respect to a weaning record is the milking ability of the individual's dam. The milking ability of the individual's dam can be represented by her milk breeding value (2 times her milk EPD). Milking ability EPDs or breeding values are expressed as pounds of weaned calf. The milk breeding value of the dam represents her genetic potential for milking ability. A cow may have tremendous genetic potential for milking ability but may never exhibit that ability due to environmental effects (eg. suppose a high milking cow contracts mastitis). Thus, a third factor affecting an individual's weaning record might be any permanent environmental effect decreasing or increasing the milking ability of the individual's dam. The final factor which was discussed above is the contemporary group effect. These four factors explain much of the variability in weaning weight records; however, not all of the variation is explained by these factors thus there is a fifth factor which we will simply refer to as unknown or error.

Now that the factors affecting the weaning record of an individual have been identified it is possible to develop a mathematical model representing the record in terms of these factors:

Weaning Weight Record = Contemporary Group Effect
+ Breeding Value of the Individual
+ Milk Breeding Value of the Individual's Dam
+ Permanent Environmental Factors Affecting the Milking Ability of the Individual's Dam
+ Unexplained Factors or Random Error

This equation can be expanded to the following:

Weaning Weight Record = Contemporary Group Effect

$$\left.\begin{array}{l} + \text{ EPD of the Individual's Sire} \\ + \text{ EPD of the Individual's Dam} \\ + \text{ Mendelian Sampling Effect} \end{array}\right\} \begin{array}{l} \text{Breeding} \\ \text{Value of} \\ \text{the Individual} \end{array}$$

+ Milk Breeding Value
+ Permanent Environmental Effect
+ Unexplained Factors or Random Error

Notice in this second equation that the individual's breeding value is represented by the sum of its parental EPDs and a Mendelian sampling effect. The mendelian sampling effect accounts for the fact that an individual receives 1/2 of his genetic makeup from each parent in a random fashion. The Mendelian sampling effect is the reason that even full-sibs (offspring of the same parents) show considerable differences.

An equation similar to the above is developed for every individual in the breed which has a legitimate weaning record. These equations are solved by iterative techniques providing values for each entry in the equation to the right of the equals sign including the breeding value of the individual. The EPD is given by dividing the breeding value of the individual by two.

Keeping in mind that an individual's EPD is equal to 1/2 his breeding value, the following gives an individual's weaning growth breeding value:

Breeding Value	=	Weighting Factor x	[Record of the individual - contemporary group effect - milk breeding value of dam - permanent environmental effect of the dam.]
	+	Weighting Factor x	[Sum of breeding values for relatives of the individual (note: this includes sire and dam and/or any progeny of the individual).]
	-	Weighting Factor x 1/2	[Sum of breeding values for mates of the individual (note: this applies when progeny are available).]
	+	Weighting Factor -	[adjustment for the relationship between growth and milk (note: in some breeds assumed to be zero).]

Subtracting the contemporary group effect, milk breeding value of the dam and the permanent environmental effect of the dam adjusts the record for those environmental factors. After these factors are subtracted the portion remaining more adequately reflects the genetic makeup of the individual for growth. Weighting factors provide for the proper relationship between each piece of information contributing to the individual's breeding value. Note that any combination of the possible information may be used to compute the breeding value. Notice also the procedure goes backwards in the pedigree to the sire and dam of the individual or forward in the pedigree to any progeny available. Mates of the individual are adjusted for by subtracting 1/2 of the mate's breeding value when progeny records are available. Finally if there is a relationship between milk and growth it can be accounted for in the procedure.

A numerical example will show the importance of each factor in computations of an individual's EPD. The following example is for two young calves not yet producing progeny which are full-sibs (same sire and dam) and it is data taken from one of the breeds presently being analyzed at the University of Georgia:

	Weaning weight (lb)	Ratio	Contemporary group effect (lb)	Breeding Values Sire (lb)	Breeding Values Dam (lb)	Dam's Milk breeding value (lb)	Dam's P.E. (lb)
calf A	645	120.9	469.96	70.0	14.2	15.6	15.5
calf B	570	102.9	486.96	70.0	14.2	15.6	15.5

Breeding
Value = {.143 (645 - 469.96 - 15.6 - 15.5) <-----Record contribution
calf A
+ .429 (70 + 14.2) <-----Pedigree contribution

= (20.56 + 36.09) = 56.65

$$EPD_A = \frac{56.65}{2} = 29.32 \text{ lb}$$

Breeding
Value = {.143 (570 - 486.30 - 15.6 - 15.5) <-----Record contribution
calf B
+ .429 (70 + 14.2)} <-----Pedigree contribution

= (7.44 + 36.09) = 43.53

$$EPD_B = \frac{43.53}{2} = 21.76 \text{ lb}$$

As you can see only individual records and parental values enter into the computations since these two animals have not yet produced progeny. In the case of these full-sibs the only differences in the computations are the records and the contemporary group effects. Calf A has a larger weight (645) than calf B (570) but in addition the contemporary group effect (which might be thought of as an adjusted contemporary group average) for calf A (469.96) is smaller than the one for B (486.80). Calves in B's contemporary group had a 16.84 pound environmental advantage which is given by the difference between the contemporary group effects (486.80 - 469.96). Thus calf B had a somewhat better environment in which to make his record. The effect of this better environment is adjusted out when the contemporary group effect is subtracted from the calf's record. Calf B did not grow as well as calf A, plus B had a better environment than A, therefore the record contribution to the breeding values for the two calves was 20.56 versus 7.44 pounds for A and B, respectively. Notice the pedigree contribution for both calves is larger than either record contribution which may not always be the case. Obviously, the pedigree contribution to an individual's EPD depends on how large the EPDs (breeding values) are for its parents. Breeders should also note that the 18% difference between performance ratios translates to only a 6.56 pound difference in EPDs for these two calves. Ratios and weights may be misleading with respect to actual transmitting ability. In the case of these two animals selection on weight or ratio would have retained the genetically superior individuals selection based on EPDs will more often retain the genetically superior individual than either weights or ratio.

The following table contains information for sire A (breeding value = 88.4; EPD = 44.2 lb) and sire B (breeding value = 132.2; EPD = 66.1 lb).

Individual bull ID	Average weaning ratios of progeny		Number Weaning Contemporary Group	Individual Weaning Performance Pounds (Ratio)	Sire Breeding Value (lb)	Dam Breeding Value (lb)
	Number	Average				
A	408 males	105.0	178(9703)*	703(124.5)	65.4	20.0
	369 females	103.9				
B	424 males	105.8	71(3547)*	729(136.5)	150.4	45.8

*Number of contemporaries raised with progeny of A and B.

Notice the average progeny ratios do not reflect the difference in EPDs for sires A and B. The following will show why these averages are not indicative of the EPDs for the two sires. First, examine the following table which gives the contribution (in pounds) of each available piece of information to the sires' breeding value and subsequent EPD:

Sire ID	Sire's own record	Sire's parents	Progeny	Adjustment for mates	Breeding value (lb)*	EPD (lb)
A	.1103	.2219	94.4230	- 6.3611	88.3941	44.2
B	.1813	.5179	171.0545	-39.5536	132.2000	66.1

*Sum of the previous four columns, EPD = 1/2 Breeding Value.

The EPD for A is given by (.1103 + .2219 + 94.4230 - 6.3611) - 2 - 44.2. The EPD for B is given by (.1813 + .5179 + 171.0545 - 39.5536) - 2 + 66.1. It is readily seen that the major contribution to each sire's EPD comes from their progeny (94.4230 and 171.0545). A sire's own record and his ancestor's account for a very small part of his EPD when large numbers of progeny are available and particularly when the progeny are far above or far below average.

Note there is a larger adjustment for mates of sire B than sire A (-39.5536 _vs_ -6.3611, respectively). The reason for this is that sire B was mated to cows superior to those of sire A. The average breeding value for sire B's mates was 39.8 lb whereas sire A's mates averaged 6.4 lb. Even after adjustment for superior mates B still had the best EPD.

Observation of the table including the adjustment for mates does not yet answer our question as to exactly why B's EPD is so much larger than A's. The answer is found in the genetic competition within the contemporary groups in which the progeny of these two sires were raised. Average breeding values for the sires and dams of other progeny in the contemporary groups in which sire A's progeny were raised are 40.6 and 13.4 lb, respectively. The averages for sires and dams of progeny raised contemporarily with sire B's progeny are 61.4 and 34.4 lb, respectively. This simply says that the genetic merit (measured as breeding value) of the contemporary groups in which sire B's progeny were raised was greater than those in which sire A's progeny were raised. This coupled with the fact that sire B's progeny averaged 46.1 lb more than their contemporaries while sire A's progeny averaged only 2.2 lb more than their contemporaries results in the large difference seen in progeny contribution to their EPDs. This genetic competition within contemporary groups is not reflected in performance ratios thus reducing their value as an aid to selection, particularly in comparisons across herds. Clearly, NCE accounts for this and other factors making the EPDs more precise for across herd comparisons.

The following, outlines the complexity of weaning weight by showing the various factors influencing the trait:

I. Genes received from the individual's sire
II. Genes received from the individual's dam
III. Milking ability of the individual's dam
  A. Dam's genetic makeup for milking ability
    1. Genes received form her sire (maternal grandsire of the individual)
    2. Genes received from her dam (maternal granddam of the individual)
  B. Permanent environmental factors affecting the dam's milking ability (example: loss of a quarter to mastitis)
  C. Age of dam
IV. Other environmental factors
  A. Contemporary group environment (example: creep fed _vs_ noncreep fed
  B. Age of calf
  C. Other factors which are usually unknown (season, disease, temperature, humidity, rainfall, etc.)

Factors such as age of dam and age of calf have been researched and quantified, thus, they are routinely adjusted out of weaning weight records in most performance testing programs. Environmental factors, other than permanent environment affecting the dam's milking ability, are usually dealt with through contemporary grouping. That is individuals are compared within a contemporary group which contains animals for the same sex, similar age and born in the same season, each given equal opportunity to perform. The importance of proper contemporary group identification cannot be over-emphasized particularly as it relates to using weaning weight as an indicator of the dam's ability to produce milk and subsequently the genetics she possesses for milking ability.

National Cattle Evaluation programs use mixed model BLUP procedures and the reduced animal model to compute EPDs for both weaning growth and milking ability, each measured as pounds of weaned calf. Actually the procedure provides real values (ie. pounds) for most of the factors in the above outline. The values for those factors in the above outline referring to genes are called breeding values. Breeding values are computed in units of original measurement such as pounds. For example, a breeding value for milking ability is computed as pounds of weaned calf resulting from milk produced by the dam of the calf. Remember EPDs are equal to breeding values divided by two.

It is important to realize that milking ability EPDs indicate the individual's ability to transmit genes for milk production and may not reflect exactly the current producing ability of a cow. This is because environment has a marked effect on a cow's milk production (eg. climatic conditions, disease, etc.). That is a cow may be genetically superior of milk production but environment (eg. disease) may never let her express that ability in the record of her calf.

A cow's EPD for milking ability expressed as pounds of weaned calf is given by computing her breeding value for milking ability according to the following equation and then dividing by two:

$$\text{Milking ability Breeding Value} = \text{Weighting factor} \times \left| \underbrace{\text{Cow Calves' weaning records} - \text{Contemporary group effect} - \text{Calves growth breeding value} - \text{Permanent environmental effect of the cow}}_{\text{<summed over all the cow's calves>}} \right|$$

$$+ \text{Weighting factor of the individual} \times \left| \text{Sum of the milk breeding values for relatives} \right|$$

$$- \text{Weighting factor of the individual} \times 1/2 \left| \text{Sum of the milk breeding values for mates of the individual} \right|$$

$$+ \left| \text{Adjustment for the relationship between growth and milking ability} \right|$$

For a cow, the first part of the above equation adjusts the records of her calves to reflect her milk production. First, the contemporary group effect is adjusted out of the record removing any environmental factors which may have influenced the record positively or negatively compared to all other calves' records in a particular contemporary group. Second, the calves' growth breeding values are subtracted from the records. This second subtraction removes the effect of the calves' innate genetic ability to grow leaving the portion of the record reflecting the cow's milking ability. This is the portion of the record the cow would influence through her milking ability regardless of the genetics possessed by her calves. Finally, to get the records to more adequately reflect the cow's genetics for milking ability, the permanent environmental effect is subtracted from the record. The weighting factor adjusts for the heritability of the trait and the relationship between this piece of information (records of her calves) and other possible sources of information (relatives of the cow).

The second part of the equation brings the pedigree of the individual (a cow in this case) into the computations. The procedure moves backwards and forward through he pedigree. It picks up information (breeding values) on the ancestors of the individual, particularly the sire and dam. However, if progeny are available it will gather the information (breeding values) on each progeny. The third part adjusts for mates of the individual removing any bias caused by non-random mating. The final entry in the equation adjusts for any genetic relationship between growth and milking ability.

An example from a recent breed analysis conducted at the University of Georgia will show the contribution of each piece of information to the computation of a milk EPD for a cow with one calf.

Available Information							
Record of the calf (lb)	Contemporary group effect (lb)	Calf's breeding value (lb)	Cow's permanent environmental effect (lb)	Sire of cow milk breeding value (lb)	Dam of cow milk breeding value (lb)	Progeny of cow breeding value (lb)	Sire of calf milk breeding value
505	486.8	56.2	-7.2	6.2	16.4	7.6	7.8

The contribution of the cow's own record for milk (weaning weight record of her calf) is given by .074 (505 - 486.8 - 56.2 + 7.2) = -2.3 lb. Remember, here the weaning weight of the cow's calf is taken as a measurement of the cow's ability to milk. The contribution of the cow's sire and dam is .37(6.2 + 16.4) = 8.4 lb. The progeny contribution is .37(7.6) = 2.8 lb and the adjustment for the sire of the calf is (-.37) (.5) (7.8) = -1.4 lb. Summing the contributions provides the cow's breeding value for milking ability (-2.3 + 8.4 + 2.8 - 1.4) = 7.5 lb. The cow's EPD for milking ability expressed as pounds weaned calf is 7.5 - 2 = 3.75 lb. Note here that the largest contribution is from the pedigree (sire and dam) which will not always be the case particularly if the pedigree information is only average.

Sire EPDs for milking ability are computed in a similar manner; however, because milking ability is a sex limited characteristic the first part of the equation is never used for sire computations. Sire EPDs for milk are based primarily on their pedigree and any female progeny which are in production.

An accuracy value is computed for each EPD which provides an indication of the reliability of the EPD. Accuracy values range from zero to one with values closer to one indicating greater accuracy or reliability of prediction. Unfortunately, accuracy values are only approximations and may sometimes underestimate or overestimate the true accuracy of the EPD. Basically, the accuracy values indicate the amount of information available for the EPD computation. For example, one individual may have pedigree information and another may not; this would be reflected in the accuracies of EPDs for those two individuals. For individuals with progeny, both number and distribution will affect the accuracy of the EPD. An individual producing 50 progeny in 10 herds will have a larger accuracy than an individual producing 50 progeny in 2 herds. In the case of sires, accuracy is affected by the number of direct comparisons made in contemporary groups with other sires. Thus, a young sire can attain reasonable accuracy if he is used in several herds against several sires already published in the breed's national sire summary. Non-parent EPD (eg. young bulls not producing progeny yet) accuracies are affected by the accuracy of their parents' EPDs because the pedigree plays an important part in the computation of non-parent EPDs.

The theory of mixed linear models (BLUP) is finding widespread application in the beef cattle industry. The procedures provide a most accurate method for making selection decisions. Today's cattlemen, both purebred and commercial, who learn to use the genetic information available in a creative breeding program will achieve greater profitability over time. This is because genetic stability will allow for sound management decisions including those decisions with respect to marketing and merchandising.

EPD Fact or Fiction

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Concerning the subject of Estimated Predicted Differences or EPD's and how they can be utilized in breeding programs today, I would first like to reflect back on some of the things that have happened in the beef cattle industry. When we look at selection in beef cattle for the economically important traits or for any population, there are three ways that we can change a population of cattle. Selection, migration or gene migration, and mutation. Needless to say, beef cattle selection utilizing mutation has played a very small part because very few positions mutations happen within population. Migration probably has had more effect on populations of cattle especially beef cattle, than any other particular way of improving cattle. There has been two or three times where gene migration has had a major impact on the American cattle scene. The first time, would have been the importation of the European breeds of cattle in the United States in the 1800's and early 1900's. The second time would be the importation of the Bos Indicus cattle in the 1900's through mid 1900's. The third actually started with the Charolais cattle back in the 1930's but the greatest impact occurred in the 1970's with the opening up of the quarantine stations. This made it possible to move many of the European cattle into the United States at that time.

Interesting enough, when I observe selection in beef cattle for the economically important traits, I feel that we have accomplish very little. Most of our selection in beef cattle has always been from a phenotypic standpoint. From the years 1700 to 1900's, we basically had a Longhorn-base herd of national cattle and dual purpose cattle. During this time, the first breed associations were formed. Interestingly enough in Europe and here, selection was primarily based for fat, because fat was worth more than beef at that particular time. In 1801, this steer was exhibited and weighed 3,000 pounds. This is the white heifer that traveled in 1806 and weighed in excess of 2,800 pounds. This was a Grand champion Steer in 1867 at the Smithfield's Show, a 4 year old that weighed 2,200 pounds. Between the 1900's to 1970 era, it was really the British breed era. We went from large to small type cattle. All selection was basically done from a phenotypic standpoint. During this period performance testing and within herd selection and central test stations were developed. We did a lot phenotypically to the cattle at that time. Pictured here is the 1926 International Champion Angus Bull - Quality Marshall. We drastically changed frame size on these cattle and pictured here is the 1953 International Champion Female. As you can see from these two pictures we drastically changed the size. Between 1970 and 1980 was another era in which we had the introduction of European Cattle. The breed associations all started establishing data bases. Artificial insemination was utilized, very widely across purebred cattle operations. Other major changes occurred. Embryo transfer became popular, the feedlot industry moved west, grain became more expensive. This became the performance tested bull era and intense selection for both growth and frame size occurred. All of this resulted in some drastic differences in our population shown by these two animals, a heifer weighing 835 pounds and a steer weighing 1,930 pounds. Because of the emphasis on the European breeds of cattle and our tremendous emphasis on growth and frame size, we started to see a major difference in the cattle population for these two particular traits.

As we move to the 1980's, the first sire summaries were published and there was a greater acceptance by breeders to utilize sire summaries. Crossbreeding became accepted, the animal model was introduced to beef cattle selection, and we had intense selection for growth and frame. Box beef and specification beef became a reality because of labor, expenses and a tremendous consumer resistance to fat. When we take into consideration all of these particular aspects, it influences me on how I will discuss EPD's or Estimated Progeny Differences. The particular traits that we are looking at can all be described when we talk about EPD's. To most of you in the industry, as far as your breeding programs are concerned today, you feel about as mixed up as this old boy. He doesn't know whether to go with the show ring, the EPD's, pedigrees, type, 205 day weights, 365 day weights, etc. I think this slide depicts what I like to think about when we are talking about breeding cattle.

This is Lord Kelvin's saying "When you can measure what you are speaking about, and express it in numbers, you know something about it. But when you cannot measure it, when you cannot express it in numbers, your knowledge is a meager and unsatisfactory kind. It might be the beginning of knowledge but you have scarcely in your thoughts advanced to the stage of science." I really feel that is where we are in the cattle breeding industry today. Available to us now are some very factual numbers that predict what cattle will do from a performance standpoint. Not only for growth but also for some of the other economically important traits such as milk production and birth weights. Certainly in the next few years, I am certain that many of the carcass traits will be refined and we will be printing EPD's on the different carcass traits for particular animals.

There has been a tremendous amount of discussion concerning if EPD's really work. As we all realize, the EPD's on a young animal is made up of the prediction using his sire information, his dam information, and his own performance information. If we are predicting milk production on an animal we strictly use the sire's information and the dam's information. For many years, many of us in the cattle breeding industry have tried to get a better handle on whether the offspring of a particular sire will milk. Through the use of the new Animal Model, we can now separate out the two components called growth and pure milk.

The evaluation of progeny data utilizing the Reduced Animal Model produced the first Angus Summary that could separate the maternal components.

These maternal components are Growth and Pure Milk. There has been much discussion concerning whether the Pure Milk EPD on young sires that do not have daughters in production should be reported or not.

Many individuals stated that because of the great inaccuracies of the data it should not be printed since it might influence breeders decisions and they would not use the bull. The Board of Directors of the American Angus Association went on record and removed from the 1986 Sire Summary the data on bulls that did not have an accuracy value of .50 or higher.

Many breeders ask me if young bull has an accuracy of .20 why do you even print the data? After much discussion and thought, I felt we needed to take a look at the projected data and see how it compared to the actual data once it became available. This was accomplished by looking at the progeny data on all bulls with high accuracy values for Milk and then looking at their Pure Milk EPD projection resulting from data on their sire and their dam. My procedure was as follows.

I requested from the American Angus Association Performance Pedigrees on all bulls in the main report that had accuracy values of Pure Milk of .70 or higher. The reason for this was that these bulls would have a large number of daughters in production and at .70 accuracy much of the pedigree value is washed out of the data. I then went through the Performance Pedigrees and calculated a projected EPD for Pure Milk on all of the bulls. This was accomplished by taking their sire's EPD and their dam's EPD adding them together and dividing them by 2. If the sire or dam did not have an EPD for Pure Milk I did not include them in the evaluation. The following results were obtained from the data that I evaluated.

There were 257 bulls that had a projected EPD for Milk and had accuracy values of .70 in the 1987 Sire Summary. Analyzing what happened to these bulls from their original projections, I discovered that of the 257 bulls, 82 went up from the original projections and 175 went down from original projections.

The standard error figure for young non parent bulls with an accuracy of .20 is $\pm$ 7 lbs. 193 bulls fell within 1 standard error of their projection or within $\pm$ 7 lbs. 50 bulls fell within 2 standard errors or $\pm$ 14 lbs. of their original projections. 14 bulls fell within 3 standard errors or $\pm$ 21 lbs. of their original projection. Looking at the % breakdown of 257 bulls, 75.2% were within one standard error, 19.4% were within 2 standard errors and 5.4% were within 3 standard errors. The average Milk EPD of 257 bulls was +1.74 lbs. and their actual progeny data was -1.25 lbs. Of the 257 bulls, 117 were sired by minus sires for Milk and 71 bulls had minus dams for Milk.

Breaking down and grouping the bulls into 5 lbs. groups and comparing their original projections to their proven EPD values, there were 13 bulls that had a projected EPD of +10 lbs. or higher. The original projection of these bulls was +13.30 lbs. They ended up having progeny data of +11.98 lbs. None of these bulls were below 0 lbs. for Pure Milk and therefore were 100% above average.

The next group of bulls had projected EPD's of +5 lbs. to +9.9 lbs. There were 53 of these bulls and their original projection was +7.06 lbs. and ended up having progeny data of +6.67 lbs for Milk. 46 of these bulls were above 0 lbs. and 7 were below 0 lbs. for Milk. 87% of them were above 0 lbs. and 13% were below 0 lbs. for Milk.

The next group was for 0 to 4.99 lbs. There were 110 bulls in this group. Their original projection was +2.16 lbs. and after they were progeny tested they averaged +.05 lbs. 52 of the bulls were above 0 lbs. and 58 of the bulls were below 0 lbs. which resulted in 47% being plus bulls and 53% minus bulls.

The next group went from 0 to -4.9 lbs. on projection. There were 50 bulls in this group. Their original projection was -2.31 lbs. milk and their progeny data indicated them to be -8.36 lbs. for Milk. 46 of these bulls were below 0 lbs. and 4 were above 0 lbs. 92% of this group were minus and 8% were plus for Milk.

The next and last group were the bulls that projected EPD for Milk was -5 lbs. or greater. This group averaged -7.70 lbs. projected and their progeny data was -14.10 lbs. All of these bulls or 100% were below 0 lbs. for Milk. The following table summarizes the above data.

Group	No. Bulls	Projected EPD	Actual EPD	% Above 0	% Below 0
+10 or higher	13	+13.30	+11.98	100%	0%
+5 to +9.9	53	+7.06	+6.67	87%	13%
0 to +4.99	110	+2.16	+ .05	47%	53%
0 to -4.9%	50	-2.31	-8.36	8%	92%
-5.0 or lower	27	-7.70	-14.10	0%	100%

Summarizing the EPD data concerning milk, I think one realizes that the EPD projection on young bulls was very accurate. If we are going to sample young bulls it would be wise to utilize young sires with EPD's for milk of +5 lbs. or greater if we want to stack the deck in our favor. The closer the EPD approaches 0 lbs., there is a great change of a sire becoming minus for milk.

In the beef cattle industry in the future, if we are going to make maximum genetic improvement, breeders must utilize sire summaries. We must start to breed cattle utilizing the high EPD bulls for the particular traits we are interested in. With sire summary information on bulls now possible to take much of the guess work out of breeding cattle. The result will be high performing, high milking offspring.

GROWTH

110 TOTAL BULLS

88 + FROM PROJECTION
22 - FROM PROJECTION

86 ± 0 → 1 ST. ERROR 78%
23 ± 1 → 2 ST. ERROR 20.9%
1 ± 2 → 3 ST. ERROR .9%

0 → +10 EPD PROJECTION FOR GROWTH (16 BULLS)

5.74 LBS. PROJECTION
10.45 LBS. PROGENY

PROGENY RESULTS

0 → - 10 = 3 BULLS
0 → + 10 = 3 BULLS
+10 → + 20 = 8 BULLS
+20 → + 30 = 2 BULLS

+10 → +20 LBS. EPD PROJECTION FOR GROWTH (22 BULLS)

+13.99 LBS. PROJECTION
+19.08 LBS. PROGENY

PROGENY RESULTS

-10 → 0 = 1 BULL
0 → +10 = 1 BULL
+10 → +20 = 9 BULLS
+20 → +30 = 8 BULLS
+30 → +40 = 2 BULLS

+20 → +30 LBS. EPD FOR GROWTH (32 BULLS)

AVG. PROJECTION +24.63
AVG. PROGENY +32.34

PROGENY RESULTS

+10 → +20 = 4 BULLS
+20 → +30 = 12 BULLS
+30 → +40 = 8 BULLS
+40 → +50 = 6 BULLS
+50 → = 2 BULLS

+30 → +40 LBS. EPD PROJECTION FOR GROWTH (22 BULLS)

AVG. PROJECTION +33.90
AVG. PROGENY +39.85

PROGENY RESULTS

0 → +10 = 1 BULL
+10 → +20 = 0 BULLS
+20 → +30 = 2 BULLS
+30 → +40 = 7 BULLS
+40 → +50 = 11 BULLS
+50 → +60 = 0 BULLS
+60 → +70 = 1 BULL

+40 → +50 LBS. EPD PROJECTION FOR GROWTH (14 BULLS)

+43.68 PROJECTION

+55.7 PROGENY

PROGENY RESULTS

+30 → +40 = 1 BULL

+40 → +50 = 3 BULLS

+50 → +60 = 6 BULLS

+60 → +70 = 2 BULLS

+70 → +80 = 2 BULLS

GROUP	NO.	AVG. PROJECTION	AVG. PROGENY
0 → +10	16	+ 5.74	+10.45
+10 → +20	22	+13.99	+19.08
+20 → +30	32	+24.63	+32.34
+30 → +40	22	+33.90	+39.85
+40 → +50	14	+43.68	+55.7

To EPD Or Not To EPD. That Is The Question.
(The Answer: To Be, Or Not To Be)

Henry Gardiner
Gardiner Angus Ranch
Ashland, Kansas

When Oklahoma State University has a cattle conference it is always impressive. There are about 43 speakers at this conference. There are more speakers here than I usually have in the audience of most of the groups that I talk to.

When you analyze this meeting it becomes apparent that it is not unlike an old fashion camp meeting with a number of performance preachers such as Reverend Wallace and myself preaching the performance gospel to you. It is always interesting to hear from a few reformed sinners at such a revival. That group has been well represented here by the members of the packing industry who spoke to you earlier. I am really impressed by the fact that one of the Bishops of the Movement is here. I am referring to Bishop Benyshek who has been so effective in his work to give we laymen accurate EPD data on which we can build sound breeding programs. But frankly I have to admit that it blows my mind that this conference even brought you the Pope to speak in the person of Dr. Bill Pope this morning.

Not only did OSU put together a lot of good talent for this conference, but Dr. Bob Kropp challenged each speaker to do his best when he got here. The challenge that Reverend Roy and I received contained an interesting observation of where the industry is now in its acceptance of EPD's. Since my talk will attempt to answer some of the questions that this letter raises, I would first like to quote two paragraphs from this challenge. I am quoting now from this letter from Dr. Kropp:

"I seriously believe that this portion of the program holds the future direction of the industry in the palm of its hand. If we can get a sound message across on how to utilize EPDs for herd and breed improvement, then we will have helped the industry. If we fail, then the promoters will do enough barn talking to beat down association efforts to document more performance. There is really a lot of confusion, frustration and misconception in the industry regarding performance and EPDs. Breeders do not believe the data. They think some bulls are over, as well as under evaluated and really believe a lot of money is being spent on worthless information.

"The message is simple--how we get it across is very hard. The utilization of EPDs to build a solid, functional set of cattle with industry merit doesn't seem hard until one tries to convince breeders to do it. They do not feel they can sell the kind of cattle they have strong EPDs. They feel we are going backward rather than forward. The utmost thought in everyone's mind is, "Can I sell them?", not whether or not they are the "right kind". If we can convince breeders that the "right kind" is the "right kind", then there will be a market for the "right kind". Most breeders perceive the "right kind" as what brought the most money last week!"

To be told that you hold the future of the industry in the palm of your hand is really a pretty heavy load to carry even with Roy's help. Today I wear two hats--one as your friend and one as your competitor. As your friend I am glad to share with you what our experience has been in using EPDs as the only way to choose our sires for the last eight years. However, if you are trying to produce good bulls I am also your competitor. The use of EPDs has dramatically increased the performance on our ranch of our commercial as well as our registered cattle. The cattle we are selling from our registered herd now are bringing three times what they did 10 years ago. As your competitor I hope you never use EPDs.

I would like to begin this EPD discussion quoting an editorial written on the front page of the April 25, 1988 edition of the Western Livestock Journal by the editor, Fred Wortham Jr.

> "The day when a producer simply set out down the road to find that "good doing" bull is gone...apparently forever. No longer can you depend on commercial men to eyeball that "bugger" and decide he would fit the cow herd and the environment...and, by the way, he's no longer content to simply hunt for a bargain bull...in fact in many cases he shuns that bargain-buy chance."
>
> "These things were brought forcefully to the forefront a week ago when more than 2,000 bulls found new owners through a series of auctions in the state of Montana."
>
> "Today's bull buyer--the commercial man in particular--is as hard to please as some of our ultimate customers, Mrs. American Housewife and her peers. He knows what he wants, and more importantly he knows what he doesn't want. If you are going to sell him a bull, you not only had best have all the growth traits listed for your production, you had better have the data (expected progeny differences) on his dam, and granddam, and for that matter on his sire and grandsire. The further back into the pedigree you can go with data, the better chance you'll have to sell him the bull and with that chance comes a better chance for a higher price than you might otherwise expect."
>
> "One very successful firm in Oklahoma recently made the point that commercial producers want EPDs--the full compliment, please--while there are still seedstock people who don't know what EPDs are and worse, can't read them or interpret them.. Those who don't know EPD's now had better take a crash course, a point brought home time and time again in Montana a week ago. "
>
> "Bulls offered which did not carry very desirable maternal traits in their EPDs or those which had little or no EPD information sold at prices as much as $1,500 to $2,000 less than those that carried a "full report card."

"The days when weight per day of age, when average daily gain and weaning and yearling weights were enough, no longer exist. Most of the people we talk to during this trip in the seedstock sector acknowledge this for the most part, though some of them still accept the fact with some qualification or reservation."

"Pedigrees are still important to the bull buyers, but breed families with the desirable maternal traits, including ease of calving and lower birth weights, are in highest demand right now."

"In most instances the difference between $1,000 bulls and $3,000 bulls in the Montana sales were more desirable maternal trait EPDs."

"The roles of the seedstock producer, our interviews in Montana revealed, is due to change somewhat, and the changes seem to be drawing closer at a more rapid pace than previously thought."

"Specification beef for the super market counter is not the only specification of the future. Specification genetics, specification bulls, to fit specific herds with the seedstock producer and the commercial producer working in partnership with feedlot operators and even packers as members of the "firm" is not such far-fetched pipedream as the industry attempts to move toward the product in high demand."

"Indicators which point to this kind of an industry adjustment were in evidence in conversations carried out at Treasure Test Center in Great Falls, at Midland Test Center and at the Leachman Cattle Co. sale, the latter two in the Billings area."

"The cattle industry of the late 1980's and early 1990's will be exciting times...the excitement is here already and evolution is all around us."

I have heard it said EPDs are just a fad that will not be around very long. I firmly believe EPDs are by far the best genetic selection tool that has <u>ever</u> been available to beef cattle producers. This "fad" will be with us until it is replaced by something better. I would like to share with you how we have used them and what they have done for us at our ranch.

Beginning in the fall of 1980 we have used only EPDs to select our sires. Most of the bulls we use as sires we have never seen. However, they are bulls that are listed in the sire summary so they are progeny proven bulls. Most of our females are settled by A.I. We have not used a clean-up bull on our replacement heifers since 1964 or on our registered cows since 1979. Our registered cows are bred in a 70 day season, commercial cows 60 days, registered heifers 50 days and commercial heifers have a 30-day breeding season. Open females are sold.

At the beginning of our fall breeding season in 1987 we had 980 females, including replacement heifers, to breed. Only 80 head of those had clean-up bulls turned with them. We should have only about 10 to 15 naturally sired calves in the fall of 1988. This will be the highest percentage of A.I. calves we have had, but for several years 85 to 90 percent of our total calf crop has been A.I. calves.

We use three EPD scores to select our A.I. sires. Those EPDs are birth weight, pure milk, and yearling weight. Sires used on first-calf heifers have around 0 lbs. EPDs for birth and as high on EPD as we can find on milk and yearling weight. On cows we have used bulls with as high as +8 lbs. EPDs for birth weight. EPDs this high have given us high birth weights and dead calves at birth from mature cows when those cows have a lot of growth in their own pedigree. This 8 lbs. birth weight EPD gave us very little birth weight problem on cows whose pedigrees were not stacked for growth. I would say as we continue to stack pedigrees for growth in our cow herd we will use EPD's of 6 lbs. or less for a maximum for mature cows. May I caution you that these are Angus figures. EPDs across breed are not comparable but genetic principals apply to all breeds.

We are not sure how much milk our environment will support but we want more milk in our cow herd than we have now. Until the pure milk figures came out about three years ago we were not able to measure milk production very accurately. The present system does a good job of measuring milk production.

Thus the bulls that have acceptable birth weights and milk and also high yearling weights are the sires that we use. The system is not very complicated. What has it done for us?

We have owned some of our steers through to slaughter since 1970. We have also been buying feeder cattle and putting them into the feedlot since 1972. The feeder cattle have been purchased by the same order buyer at the same locations. There has been about 2000 steers purchased each year and about 60 to 100 home raised steers fed. Over the last 10 years the purchased cattle have not changed their performance very much. During the same time our home raised steers changed their feedlot performance considerably. All steers purchased and raised have been fed at the same commercial feedlot during this time.

Steers	Pounds of feedlot gain per day	Days on Feed	New weight @ slaughter
Purchased			
(1978-80 avg.)	2.87 lbs.	142	1099 lbs.
(1986,87 avg.)	3.09 lbs.	133	1145 lbs.
	+.22 lbs.day	- 9 days	+46 lbs.
Home Raised			
(1978-80 avg.)	2.81 lbs.	154	980 lbs.
(1986,87 avg.)	3.63 lbs.	108	1172 lbs.
	+.82 lbs/day	- 46 days	+192 lbs.

Another interesting demonstration of EPD effect on our cattle production is a before and after comparison on our weaning weights. The average weaning weights of our steer calves from 1964 to 1973 was 523 pounds. From 1974 to 1979 we creep fed our steers and also weaned them at earlier dates so our weights were not comparable. Then in 1980 we returned to a comparable management of our steer calves. Those calves weighed 526 pounds. No change from the 1964-73 steer weights.

In the fall of 1980 the first field data sire evaluation report was published. This was the first time that all the widely used A.I. bulls of the breed were evaluated with EPD scores. That 1980 report listed 23 Angus bulls that we had used by A.I. over a 12 year period. When we averaged their EPDs their composite values were as follows:

Avg. birth weight = +.1 lbs.
Avg. weaning weight = +3 lbs.
Avg. yearling weight = +9 lbs.
Avg. maternal breeding value = 99.5

If these EPD scores were correct we would obviously get very little change in our weights. As I have already told you from 1964 to 1980 our weights were stuck on about 525 pounds. Our cattle in 1980 were a little taller but not heavier. You might correctly say we did a poor job of selecting bulls. But other purebred herds at that time were not doing much better. One of the leading Angus herds in the 1970's had a sale that 5 bulls brought from $21,000 to $53,000. Guess what their herd bulls averaged on their EPDs?

Avg. birth weight EPD = +.17 lbs.
Avg. milk EPD = -1.6 lbs.
Avg. yearling weight EPD = +4.8 lbs.

In 1981 we started using only progeny proven A.I. sires with acceptable EPD values. Our steer weights from 1980 through 1987 are as follows:

	Weight off cow	Date Weaned
1980	526 lbs.	Aug. 6
1981	661 lbs.	July 22
1982	723 lbs.	July 22
1983	706 lbs.	July 18
1984	736 lbs.	July 16
1985	705 lbs.	July 15
1986	786 lbs.	July 18
1987	774 lbs.	July 13

Using proven bulls with acceptable EPD's for birth, milk, and yearling has added over 250 lbs. to the weights of our steers. For the last two years we have been using only daughters of A.I. sires for our commercial replacement heifers. In another 5 years most of our commercial cow herd will be daughters of some of the top bulls in the breed. We will continue to see improvement in the performance of our herd.

Dr. Kropp said in his letter that breeders do not believe the EPD data. Roy Wallace's analysis of 257 progeny-proven sires with 50 or more daughters with weaning ratios on their calves indicates that pedigree projected data alone will be within 7 pounds, on the milk EPD, 75 percent of the time after those sires have progeny data to actually prove their milk EPD's. Both sire and dam had to have a milk EPD for the 257 bulls to be included in the analysis.

We have never ever had such an accurate predictor of production before. Can the "eye of the master" equal or even come close to that? No! Do we have any other system of gene selection that can even come close to the EPD system? No! why don't breeders use EPDs? As your competitor I vigorously support your EPD opposition!

Some breeders get very upset when they see EPDs change very much. One of the few tools that an animal breeder has is genetic change. The more genetic variation there is in a population the faster the genetic improvement can be made if you will identify the change that is going toward your goals. Without genetic variation genetic improvement can not be made. If we as seedstock breeders can not offer genetic improvement then all we have to sell are cow fresheners.

Though 75 percent of the time the change in Roy's milk EPD study was less then 7 pounds, there were 14 of the 257 sires or 5 percent that their milk EPD change fell in the less than 3 standard error range or up to a change of $\pm$21 pounds. Change of that magnitude is genetic opportunity not genetic disaster because part of those sires may give you rapid genetic improvement. Identify them and go with them. Without them we have genetic stagnation or change at a snail's pace.

Dr. Kropp indicated breeders think they cannot sell cattle that have strong EPDs. We had a sale at our ranch this last April. Our catalog talked about and had EPDs in it from cover to cover. We sold 91 bulls for a $3,050 average, the top bull bringing $7,000. There were 51 bulls that brought $3,000 or more. Only five of the 91 bulls were purchased by registered breeders. Just as the editorial in the Western Livestock Journal said happened in Montana, the demand for light birth weight EPDs was high. The 23 bulls with EPDs of less than +2.0 pounds birth weight averaged $3,525.

On the other side of the coin 10 bulls sired by the bull with the most frame and also the heaviest EPD for birth weight averaged $800 less than the light birth weight bulls. Times are changing rapidly. You <u>can</u> sell cattle with EPDs. Will you be able to sell cattle for much longer without EPDs?

Two years ago at the Beef Improvement Federation annual meeting in Lexington, Kentucky the group went to the race track for an evening's entertainment. After the races on the bus on the way back to our hotel an interesting observation was made by my seat mate. He said some of the people who have told him that a sire evaluation report was too complicated to understand had figured out the much more complex and detailed racing form in five minutes. It made them more successful at the race track. Expected progeny differences will make you more successful with breeding cattle.

To EPD or not to EPD? That is the question. The answer is to be or not to be.

Back to the Basics-Emphasizing the Economically Important Traits

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Introduction

The Overview for this 1988 National Beef Cattle Conference printed on the advertised program clearly identified the questions needing an answer:

1. Has recent emphasis on frame and single trait selection resulted in purebred cattle that are genetically not the kind of cattle needed in the commercial beef industry?

2. What are the important issues and economically important traits to emphasize in selection of seedstock and how should breeders change selection emphasis to produce more profitable cattle?

Traits to Emphasize

Selection decisions in breeding purebred cattle are still largely subjective even though we use objective measurements more in making selection decisions. The herd owner is the authority who establishes priority among the traits and actually culls cattle to create genetic change. Normally, breeders produce what they feel can be easily and effectively sold. Commercial cattlemen frequently state that purebred breeders breed for breed "standards" and do not reflect upon and consider the commercial cattleman. In fact, most purebred cattlemen are believed to have a rather limited exposure to the commercial industry and may not understand nor fully appreciate the real economic impact that the genetics of their breed is making in the beef industry. We all talk commercial beef production but few truly live and work in full appreciation of the problems. We tend to be breed oriented and totally committed to breed promotion. All breeds should not be the same and purebred breeders must be aware of where and how their breed and the genetics in their herd fits into the commercial industry. There should be a common breed utility and production objectives for purebred and commercial cattlemen or the breed(s) will not remain viable and be used commercially. There are sufficient breeds to allow for selection among similar breeds for use in the commercial industry. Breeds not acceptable or accountable will not be used nor remain a significant factor in the national breeding herd.

On a national basis we have seen emphasis on frame score (growth rate) that has been consistently stressed in nearly all of the beef breeds. Since beef production encompasses use of a mammal supported mainly on native forages in widely variable environments, there are several important aspects (traits) that become critical to profitable performance that may be specific to the environmental conditions. This cannot and must not be overlooked by cattlemen as they design and manage beef cattle enterprises. Taylor (1980) prepared an excellent summary table to identify traits of importance within the various segments of the beef industry.

Table 1. Identification of traits important to various segments in the beef industry.

SEGMENT	CHARACTERISTICS OF BEEF THAT AFFECT NET RETURN OR DESIRABILITY
Purebred breeder	All the characteristics listed for the other segments (must meet the needs of entire industry).
Commercial cow-calf producer	Reproductive efficiency Weaning weight Weaning conformation
Feeder	Rate of gain Feed efficiency Live or carcass grade
Packer	Carcass grade Carcass weight Carcass cutability
Retailer	Carcass grade Carcass cutability Product appeal and shelf life
Consumer	Lean-fat ratio Lean-bone ratio Tenderness, flavor, and juiciness Consistency of product

Adapted from Taylor (1980)

Secondly, Taylor (1980) identified the goals of purebred beef breeders in terms of the needed performance levels for some of the important traits (Table 2).

Table 2. Desired levels of productivity for the economically important traits of beef cattle raised under intensive management systems.

Trait	Desired level of Productivity
Calf-crop percentage (weaned)	95 percent and higher
Seven-month weaning weight	225 kg (500lb) and higher
Yearling weight (after going directly into feed-lot at weaning)	455 kg (1000lb) and higher
Feed: gain ratio	6:1 and lower
Carcass quality grade	Minimum, low choice
Yield or cutability grade	YG 2 (50 percent of the carcass weight in closely trimmed, boneless, retail cuts from the round, loin, rib and chuck)

Adapted from Taylor (1980)

Koch (1980) identified the important traits into classes as:

1. Reproductive performance
2. Preweaning growth
3. Postweaning growth
4. Efficiency of gain
5. Carcass merit
6. Conformation
7. Longevity
8. Disease resistance or defects in function.

Pollak (1980) presented an interesting methodology to determine the relative importance of beef production traits by citing earlier work of Lindholm and Stonaker (1957). He compared the correlation of net return to a single trait and squared the correlation coefficient to obtain the coefficient of determination or a percentage expression. By multiplying this value times the heritability of the trait he arrived at an index of importance of a beef trait based on the association to net return and the amount of genetic variation (heritability). This is identified as the index of importance in table 4. Heritability is important because it identifies those traits that will respond to selection or lets breeders know which traits can be controlled better with genetic methods. Weaning weight is one trait that is associated with net return and under good genetic control. Percent calf crop is extremely important but because of its low heritability, selection change will be slow. Selection of cow breeds and crossbred females offers a much faster and effective means of improvement rather than selection within a breed. Size of dam, average daily gain (growth rate) and days to finish are similar in the index of importance. Lastly, carcass cut-out value is also comparable. While this presents an early attempt to classify the more important traits, it does not correctly reflect on all aspects.

Table 4. Estimated ranking of importance of single traits to the breeder based on economic worth and heritability. (From Lindholm and Stonaker, 1957)

Traits	Relative Economic Worth (r^2)[a]	Heritability (h^2)	Index of Importance ($r^2 \times h^2$)
Weaning weight	0.64	0.30	0.19
Size of dam	0.10	0.70	0.07
Daily gain	0.14	0.45	0.06
Days to finish	0.21	0.25	0.05
Percent of calf crop	0.64	0.07	0.04[b]
Feed per pound of gain	0.04	0.39	0.01
Carcass cut-out value	0.08[b]	0.25 - 0.50	0.02 - 0.04[b]
Slaughter grade	0.21	0.00	0.00

squared correlation coefficient between trait and net income.
[b]Estimated.

Pollack (1980)

All of these references were used to provide a concept of needed traits. The relative value determination is generally left to the breeders. Simply stated, acceptable performance must be realized for all traits or a breed or herd will not survive as an economic unit. Breed roles are becoming more important because we are not just evaluating on a general purpose basis. Terminal sire breeds and maternal breeds are now common terminology and have a defined role in the commercial beef industry with the observed advantages of beef cattle crossbreeding. Stated differently, some breeds have a utility in crossbreeding that is not related to their performance as a straightbred. The Brahman breed is an example in that the purebred animal is a relatively poor beef animal based on performance traits but is uniquely identified and appreciated by some as an outstanding breed for crossbreeding. It has a niche that is founded upon the documented question that they can be too large and demand more nutritionally than the natural environment can provide. Fitness is immediately reduced. Frame has been overemphasized because it is easily measured and new, uniformed purebred breeders feel comfortable with it because they can see animal differences. Evidence from feedlot performance of yearling steers cited by Neumann and Lusby (1986) showed yearlings steers above 51 inches in height were not as profitable as steers of more moderate frame. Larger framed steers gained more but did not grade as well which resulted in lower profit or return.

The importance of carcass traits is now being stressed because they reflect unit value for the weight of beef produced. No one can deny the importance of USDA Choice grade as the standard value reference. Cundiff (1987) expressed concern over the antagonism between marbling and muscling (retail product yield) and the different approaches required to address the problem between the purebred breeder and the commercial cattlemen. General purpose beef breeds will be changed by breeders only to the extent that they can locate and select individuals within the breed to qualify as a complete beef animal. Commercial breeders using crossbreeding have a more accurate and effective means of meeting performance goals. Breeds selected for use in crossbreeding programs can stress those traits that lead to the merits of the crossbred progeny. These breeds may well be out of balance genetically as a straightbred beef animal.

Recently the emphasis to improve lean yield and reduce fat has moved from trimming the retail cuts to the possibility of hot fat trimming on the kill floor. The question now being asked is: Why not do this genetically? High lean yield (minimum fat thickness or content) and high eating quality (marbling) are going to be difficult to obtain in a single animal based on the observed genetic antagonism but it is not an impossible assignment. The promotion of beef to strengthen demand is stressing a healthful, low fat product that is flavorful, juicy and tender. Carcass traits are highly heritable and will respond to selection. The problem is that they are difficult and expensive to measure. The industry is moving to collect the necessary data and provide an opportunity for breeders to utilize carcass traits in their selection. However, we must realize that we can and should manage cattle of various genetic potentials to best utilize their capabilities. Overfattening to produce USDA Choice quality grade is not the answer and the current concern introduced by Excel simply reflects an effort to identify what is wanted by our packing and retail industry. They cannot assume to dictate the genetics required in the national cow herd, but hopefully give breeders an opinion of the carcass aspects desired.

Berg and Walters (1983) in a review paper addressing the changes and challenges concerning our meat animals also reflected that maturity in meat animals results in a decrease in the portion of muscles in the high priced regions and an increase of those muscles in the less valued regions. Cundiff (1987) cited results of sensory panel evaluations on various breed crossbreds fed and managed alike to slaughter at 14 to 16 months of age. Taste panel differences were small and a minimum of fat content of 3 percent in rib and loin steaks was identified as acceptable. This equated to a degree of marbling similar to USDA Select performance of the crossbred cow with Brahman inheritance. Research results generated from the Germ Plasm project at the Roman L. Hruska Meat Animal Research Center, Clay Center, Nebraska published by Cundiff et al. (1983) and Cundiff et al. (1987a,b) have clearly established that we are limited in our ability to make our breeds the sam genetically and we should follow breeding policies and selection goals to create breeds and cattle within breeds that will effectively match the natural environment. Breed differences are important but breeders must carefully identify the selection goals within a herd. Commercial cattlemen need to be able to purchase predictable genetics (breeding value) both among and within the breed genetics he chooses to use. Mr. Burke Healey probably prepared one of the better articles referencing these points and the use of frame scores in breeding purebred cattle (Healey, 1987). Frame scores were cited as a tool but not the total or final answer. In fact, he reflected that "They're about to lead many breeders from the pinnacle of success right on over the cliff into oblivion and ruin. Always bigger can't continue to be always better." So what are the answers need today?

Discussion

The national cow herd must be one that reflects high fertility or fitness for the environment under consideration. Maternal ability must include calving ease, survival of newborn calves, milking ability that supports calf growth and allows the cow to rebreed to continue calving on a yearly basis. Cow size and body condition scores are measures that are descriptive of how the cows are responding to the level of management and natural environment. The use of a herd index measure is recommended that measures the pounds of calf weaned per cow exposed to breeding. It is calf crop percentage weaned times the average weaning weight. Herd owners should use this statistic to describe herd production to prospective buyers. It is not a statistic that can be measured on a single animal. Selection for weaning weight should relate to selection for better milking cows and for genetic growth potential that is transmitted by both the cow and the bull. This is why we need direct genetic and maternal or milk EPD values calculated in our sire summaries.

Weaning weight is an important performance trait that requires selection attention along with fitness (reproductive performance). Calves with heavy weaning weights are important in that they attain more weight early in life and this affords the opportunity to shorten the time from birth to slaughter (length of the food chain). Gains made early in life are more efficient. Postweaning growth rate is positively correlated with mature size and frame score used here is a good indicator of expected growth and estimated slaughter weight. Large scale breeds are favored for efficient gains and lean tissue yield but they lack he ability to grade (marble) at comparable slaughter weights to smaller mature size breeds that fatten earlier. The need is to define a weight and composition of slaughter animal to balance the need for yield of retail lean and marbling for eating quality. We can answer the original question concerning frame score by noting that increased mature size in our breeding cattle has lead to increased birth weights and calving problems. As more large cows are studies there is not quality grade (slight degree of marbling). However, Berg and Walters (1983) felt the quality of beef (meat) would be more dependent upon technology (pre and post - slaughter) in the future and less dependent on production factors. The role of the beef producer was stated as increasingly one of producing lean meat as efficiently as possible. Technology was felt to assume a greater role in assuring consumer acceptance of the final product.

Smith (1987) considered the available "target" markets for beef and identified that not all beef markets require high quality or marbling.

It seems logical to assume that breeders need to take time to review their breeding programs and clearly define selection and performance goals that are realistic and profitable. All breeds will not be placed into a single category and evaluated solely on carcass aspects. In fact, the priority rank of traits should be:

1. Reproduction
2. Maternal
3. Growth (weaning weight)
4. Carcass (optimum size and fatness)
    - Retail yield
    - Marbling

The first three areas are capable of change genetically via selection and crossbreeding (heterosis) and must be evaluated relative to a defined production environment. Carcass traits are moderate to highly heritable and should respond to selection. It will be difficult and expensive to collect carcass data but general purpose breeds will need to do so to make the correct selection decisions. Specialty breeds will not be required to do this but they must clearly identify the crossbred types that will work.

How to Change

Single trait selection has never been advocated as the "best" method. Multiple trait selection methods have consistently been taught and advocated. Such procedures are not easily employed. With the use of computers, we are increasingly obtaining a more effective approach. I believe the use of independent culling levels represent the easiest approach to managing multiple trait selection. This simply says cull the herd as the traits are expressed and keep the number of traits under selection to a minimum number.

Young heifers should be selected on weaning weight and reproduction (palpated pregnant to calve at two-years of age for a general purpose beef breed). Cows should be culled for calf survival and nursing problems related to the cow, poor milking ability and failure to reproduce as required. Herd bulls should come from cows with established maternal performance.

Selection of bulls should include emphasis on weaning weight, postweaning growth, early puberty and carcass traits. Scrotal circumference is a measure that should be used. A knowledge of fat thickness may have merit but this should best be determined by carcass evaluation of progeny or predicted EPD carcass values.

Summary

Breeding purebred cattle is not an easy task. The extremes of size, large and small, will not be the answer. What really will be true is that several breeds, crosses and body types will find advantage according to the natural environment. Breeders must recognize the utility of their breed and clearly define how it is best used commercially. The answer is simply to stress those traits in selection that are basic to commercial productivity. All cattle must be reproductively fit, cows must provide a maternal environment beneficial to their calves and genetically transmit growth and carcass potential. Breeding bulls should come from proven productive cows and selection for growth, milk and carcass traits is recommended in general purpose breeds. Specialty breeds will not have to contend with all the traits identified but must be reproductively sound and selected for merit as measured in their hybrid progeny. Sire breeds will represent only a small segment of the beef cattle herd. Maternal breeds will be those in greatest numbers. Crossbreeding will remain the most effective breeding policy for the commercial producer and this will create a need and demand for sound, productive purebred cattle.

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Where Do We Go From Here?

Dr. Harlan Ritchie
Michigan State University

My first impression of the conference was if I am planning a meeting, I am going to hold it at Oklahoma State. I have never seen a place in my life that could get a crowd like OSU can. I have been around several conferences held at OSU. They are always well attended and properly conducted.

In addition, practically everyone that I respect in the beef cattle industry was either on the program or sitting in the audience. I truly mean that. I respect all of you and I am humbled by the fact that I have been given this assignment.

As Bob Totusek mentioned yesterday when he launched the conference, he asked the question "Why are we here?" The answer is to seek the truth. There are three basic reasons why we are here: 1) to determine what the industry needs and wants, 2) how can we make the necessary adjustments to produce what the industry needs and wants, and 3) if we make these necessary adjustments will it make our industry more competitive in the future? We have been given some tools to help us answer those questions.

I tell students that they should have heroes. Some of mine are here. Everyone here is someone that I respect, but there are four that I wanted to mention in particular. When I started out in university work, my heroes were guys like Bob Totusek, Bill Pope, Bob Long, and Don Good. Don is not here, the other three are and they have been on the program. They deliver just as well today as they did when I was just a cub professor coming on to the scene and I wanted to acknowledge them.

Where do we go from here? My analysis of the industry is that we are presently in pretty good shape. Sure, we can complain a bit but we've got alot to be thankful for. The beef referendum apparently passed. Prices are good. The attitude of breeders and producers is the best that I can ever remember as far as wanting to progress and move ahead in the industry.

It hasn't always been that way. Jack Allen, a beef distribution specialist, has said, "Prior to 1986 beef marketing could be characterized as 25 years of tradition unhampered by progress." In the production sector, we have seen that as well.

It is exciting that there has been more change in the product and in its image in the past 24 months than in the previous 30 years. Before I came here I tried to put together some things that I thought would come out of the conference and then adjust them as the conference went along, and I will try to present those at this time.

A little bit of where we've been before we get into the future. Larry Cundiff alluded yesterday to a very interesting study. He did not have the data yesterday, but he talked about a project that MARC had started a couple of years ago. They used original Hereford and Angus sires, born prior to 1969, and current Hereford and Angus sires, born since 1982, on MARC owned cows to see what change may have been made since 1969. The study showed some rather dramatic changes in growth; however, at weaning and at slaughter there really hasn't been any change in carcass characteristics. Percent grading choice is about the same, 77% versus 78%; fat thickness about the same; ribeye area about the same; yield grade the same; tenderness, shear force, about the same. We have changed growth rate and size, but we really haven't changed the product. So, since 1969, in 19 years, we have changed the growth of our cattle considerably, but the carcass, the product, really, is about the same as it was.

The Mission.

1. First of all, I think we agree from this conference, we need to stabilize frame size to fit market needs as well as to fit the environment.

2. We need continued improvement in early growth within an acceptable frame size range, but beware of unacceptable increases in birth weight and calving difficulty.

3. We need some increase in muscle thickness without reducing overall productivity. Ribeyes too large for acceptable portion size, reduced quality grade, larger cow size and higher maintenance costs, later sexual maturity, longer gestation period and lower birth rates are the risks in selecting for extreme muscling.

4. Some reduction in external fat without jeopardizing reproduction or marbling is necessary. Reduced quality grade, later sexual maturity, harder doing cows, lower fertility, and increased calving difficulty may be risks associated with selection toward excessive leanness.

5. We absolutely need to eliminate cattle with problems, fertility problems, structural problems, disposition problems. We are moving fast. We can't stand problem cattle. This can easily be taken care of through culling.

Now the Mechanics:

1. We need to use performance. In this case the EPDs to select for early growth, calving ease and maternal ability. We heard a very dramatic presentation from Larry Benyshek, Roy Wallace and Henry Gardiner on the theory and the effective use of EPDs. EPDs are effective if we have accurate and an adequate amount of data. Hopefully in the future, we could add carcass traits and perhaps even reproductive traits.

2. Cull against functional unsoundness. The breeding soundness exam which includes scrotal circumference, is an excellent tool. Simple visual observation for structural problems and poor disposition would also be effective.

3. Selection for carcass merit within a breed. We have three main avenues for selection for carcass merit:

   (a) Visual Appraisal: Cattle are still bought on a visual basis. That may change some, but the eyeball will always play a major role.
   (b) Instrumentation: The possibility of ultra sound in evaluating carcass merit in breeding animals could be a very, very important breakthrough.
   (c) Carcass EPDs as more sires are evaluated.

So much for within the breed. There are several avenues for altering carcass composition in the population of cattle.

1. Reduced time on feed. Avoid overfeeding cattle in feedlots We've seen the dramatic impact of trimming excess fat and the impact that has had on the demand for our product. About 87% of the beef at the retail level now is trimmed.

2. Breed complimentary - by crossing breeds and thereby, changing carcass composition.

3. Recombinant DNA technology, commonly referred to as genetic engineering. As Martin Jorgenson said so well, "purebred breeders must be prepared to harness the possible advantages of genetic engineering when it does come."

4. Repartitioning agents. Primarily growth hormone and a family of compounds known as Beta Antagonist. Millions of dollars are being spent on research by private industry on these products. If they are approved by FDA they could have some interesting and very dramatic implications for the meat industry. Repartitioning agents are compounds that will repartition nutrients from fat production into lean production and thereby increase the lean deposition in the carcass.

   The cow/calf industry could keep moderate sized, easy fleshing cow herds, having reasonable maintenance requirements and high fertility. By using repartitioning agents on their progeny, the feedlot industry could enhance growth rate and feed efficiency, reduce fat deposition, and produce more muscular carcasses within a desirable weight range.

   A potential problem may be maintaining palatability while simultaneously reducing fat and increasing muscle. Research out of Ireland, using repartitioning agents, has demonstrated a 30% increase in average daily gain, 31% improvement in feed efficiency, a 38% decline in separable carcass fat, a 17%

increase in total carcass lean and a 41% increase in ribeye area by feeding repartitioning agents to Fresian steers for a short 13 week period. Dramatic results!

We don't know if they will be approved yet but it could impact the red meat industry quite dramatically.

On the subject of carcass, Rex Butterfield made this statement in 1973, 15 years ago, at a Polled Hereford Conference at Kansas State University, and I quote, "The ideal carcass is one which yields a maximum percentage of muscle, a minimum percentage of bone, and enough fat to meet the minimum quality requirements of the marketplace. It must be produced economically within the limits of functionally efficient cattle." I think this says a whole lot. It said a whole lot then, I think it says a whole lot today.

The following steer represents the ideal end product as well as any steer shown during the conference. The steer weighs 1272, stands 54 3/4" tall, has an ultrasonic fat thickness of .35 in., ribeye area is 16 square inches. If we assume a 2% kidney, heart and pelvic fat, his yield grade would be 1.8. Visually, he appears likely to grade U.S.D.A. Choice. If he dressed 63%, he would produce an 800 lb. carcass which might be a little on the heavy side according to the specs that were drawn out for us yesterday. I would like to stretch those specs to accommodate an 800 lb. carcass because frankly, a 600-800 lb. carcass range should be satisfactory to the industry as a whole.

Grand Champion Steer 1988 National Western Stock Show on foot and on the rail. Live weight 1272 lbs. Hip height 54.5 inches. 0.3 inch fat. 16.4 square inch LEA. Average Choice. Yield grade 1.9.

This steer meets those specs and I think he is visually appealing enough that we can we can live with that kind. One thing we might change on him is his age (18 months). We would like to see him weigh 1270 at a younger age. We want to get cattle killed younger. In fact, Charles Mostek, our representative from IBP, indicated that he wished we could kill cattle at a younger age and if there were some way to document it, to validate it, IBP would like to move in that direction.

We can agree, we don't want extra large frame, light muscled, hard doing bulls that sire feeder and slaughter cattle that produce light muscled carcasses that will not grade Choice. We don't need the fat toad either. We've been down that road. Many of you have, I sure have. Shocking that we got them that small, but we did. We don't need cattle approaching double muscling either. We know the risks and penalties of extreme muscling.

We are talking about practical, useful cattle with capacity and volume, durability and natural thickness. Cattle, that when slaughtered will produce a consumer acceptable product with adequate quality, but minimal fat trim. If cattle have enough finish to grade Choice, enough muscle to get into the Yield Grade 2 category and are of an acceptable carcass weight for the industry, who cares what their frame size is! We have the genetics available today to produce these kind of cattle. The Champion Steer at Denver is a good example; a magnificent steer. The steer weighted 1272 lbs, which might be a little heavy for the industry, stood 54 1/2 inches tall at the hips, graded average Choice with a 16 sq. in. ribeye and yield graded 2.0. A super steer, structurally correct, practical looking and represents what we have been talking about today.

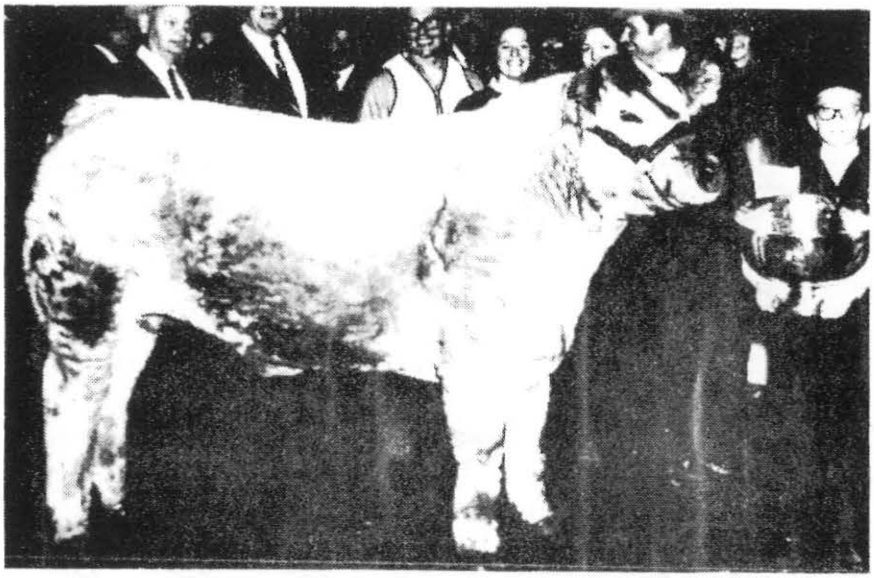
To generate these kind of cattle, we need to put more natural muscling into our breeding cattle. That has been alluded to in the conference. Remember the statement this morning, "flat, smooth muscle pattern is an excuse for using cattle that don't have any muscle?" Maybe we need bulls that have more muscle expression in them and have it validated with ultra sound measurements.

Our national cow herd still needs to be allowed to vary and be somewhat diverse. We've heard of the tremendous diversity in resources and environment that we have all over this continent and I simply can't see how we can tighten our national cow herd into one mold and make them all like they were out of a cookie cutter. There has got to be room for diversity in our national cow herd to accommodate the environment and differences in market requirements.

Again, turning back the clock, I think the following steer is still a pretty good model for today. That was Don Good's Champion Steer at the 1969 International. He weighed a little over 1200, graded Choice, & had a yield grade 2 carcass. He was a great meat animal, I think he would be a great meat animal today.

I would like to read something to you. It was written recently and I think is important for you to hear and I quote,

> "The methods and practices of the past have accomplished a great deal, giving us the superior lines of livestock that we have



CONOCO - 1969 International Grand Champion Steer. This Charolais Angus crossbred weighed 1250 lbs. and graded Choice, yield grade 2. Dr. Don Good helped to change the direction of the industry when he selected this outstanding steer - the first crossbred to win a major show.

today, but these methods and practices have taken us about as far as they can. The most that we can expect to do if we continue to follow them is to hold the gains that have been made. Breeding in these classes of livestock, or meat animals, in other words, is likely to become a frozen and static art. This is in marked contrast with the situation in plant breeding. There are indications, however, that livestock breeding may be at a turning point in its long history. He would be a wise man who would say exactly what direction it will take. But there is a growing feeling that something is basically wrong in the present situation. If a blueprint for future progress cannot be made at present, there is no question about the need for a fresh appraisal and analysis. All of which it should be possible to develop the main outlines of a program for further improvement."

I was teasing you a little bit. That statement was actually written in 1936 in the Yearbook of Agriculture.

We've talked alot about the past as well as the present. We need to think about the future. I would like to think about the future, the way Thomas Jefferson did and I quote, "I prefer the dreams of the future to the history of the past."

Another one that I dearly love "Our real task is not to foresee the future, but to enable it." Let's enable it.

Thank you very much.

National Beef Cattle Conference Summary

Dr. Harlan Ritchie
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The paragraphs that follow represent an attempt to summarize the major issues that were brought forth at the National Beef Cattle Conference. Because of the scope of the conference, it is not possible to cover all of the points that were discussed.

Pricing System:
Jim Eller, Chairman of NCA's Purebred Council, launched the conference with a convincing argument for a beef pricing system that would adequately and fairly recognize true value differences in slaughter cattle. He pointed out that if this is to come about, it must start with an accurate "price discovery" system. This would benefit all segments of the beef industry.

Carcass Size:
Although they are currently purchasing cattle that produce carcasses weighing from 550 to 950 lb (the heavier carcasses going to H.R.I.), the representatives of two major meat packing firms, IBP and Excel, indicated that a range of 650 to 750 lb would be much more ideal. In fact, retailers tend to prefer carcasses in the 650 to 700 lb range. Realistically, however, the packers suggested that a range of 600 to 800 lb would be highly acceptable. Depending upon dressing percent, this translates into a live weight range of approximately 1000 to 1300 lb. A carcass weight range of 650 to 750 lb represents live weight spread of about 1075 to 1225 lb.

Frame Size:
There is a need to stabilize frame size in order to meet the requirements of the market place and to satisfy environmental constraints in certain regions of the country. The national cow herd appears to average somewhere around 4.5 in frame size. In order for the population of slaughter cattle (steers and heifers) to fit an acceptable carcass weight range of 600 to 800 lb, frame size of these terminal cattle should fall in the range of approximately 4 to 6. This implies that the average size of the national cow herd can still increase somewhat without jeopardizing total beef production efficiency. Nevertheless, we are getting close to the limit. There was a general consensus among conference participants that bulls produced for use in commercial cow herds should lie in the range of 5 to 8 and that the upper limit for sires used in purebred herds should be no more than 8 to 9.

Early Growth:
Significant improvements in early growth (weaning and yearling weight) have been made during the past 15 years. Because it is related to total efficiency of beef production, there should be continued selection for early growth within an acceptable frame size range. However, care must be taken to avoid unacceptable increases in birth weight and calving difficulty.

External Fat:

During the past 30 months, the industry has benefited greatly from the fact that external fat is being trimmed off before the product goes into the retail case. For the future, however, it will be important that excessive amounts of fat not be added at any point in the food chain. This means there needs to be some reduction in external fat from current average levels (0.5-0.6 in.). Nonetheless, the industry must avoid going to extremes because research has shown there are some risks in selecting for extremely lean cattle; namely, later puberty, lower conception rate, increased calving difficulty, and reduced quality grade (marbling). Commercial cow herds need enough fat (fleshing ability) to enable them to condition score 5 to 6 so they can breed back on schedule.

Consensus of conference participants was that 0.2 and 0.5 in represents a reasonable minimum and maximum, respectively, for external fat. However, it was pointed out that 0.4 in. maximum should be our goal, because 0.5 in. is still a relatively fat carcass.

It was emphasized that the industry will not feel the impact of reduce fat in the pricing system until retailers understand the "new math" of trimmed beef and realize that they can make as much or more profit from this approach as they did on traditional methods of processing and merchandising beef.

Seam Fat:

A rapidly emerging issue is: "How do we efficiently, cleanly remove seam fat?" There is actually more seam fat than external fat in the average carcass. Furthermore, seam fat is the primary contributor to plate waste. Developing genetics and/or management systems to deal with seam fat will be a real challenge for the future.

Muscle:

It was generally agreed that today's U.S. beef population can benefit from some increase in muscle thickness. However, like other traits, there is always the temptation to carry selection programs to the extreme. Intense selection pressure for heavily muscled cattle could increase the frequency of the gene that leads to double muscling. Research has shown that extremes in muscling may increase the risk of lowered fertility, increased calving difficulty, lowered milk production, and reduced levels of marbling. Furthermore, extreme muscling can lead to over-sized retail cuts. For example, the industry currently recognizes the acceptable range for rib eye and to be from 12 to 15 square inches

Refinements in ultrasound technology will enable the industry to accurately evaluate yearling breeding cattle for rib eye area (REA). Before these data can be utilized in breed and herd improvement programs, we must develop adjustments for some or all of the following environmental factors: weight, age, sex, plane of nutrition, etc.

Quality Grade (Marbling):

As long as the current pricing system continues to discount Select carcasses, the quality grade target for retail beef will continue to be

Low Choice. For the "gourmet" or high quality restaurant trade, the target will be average Choice or higher. It was shown that marbling is an "insurance policy" in that higher levels tend to reduce the variation in tenderness in today's beef population and keeps most steaks in the "acceptable" category. However, there was considerable sentiment among conference participants, including packers, that the industry should somehow reduce the emphasis on marbling and place more emphasis on producing "young" beef. Research has shown that youth and tenderness are closely related. It was pointed out that we have the tools to produce 12-to-18-month old cattle grading high Select that will fit the box and be lean and tender. The present pricing system encourages us to produce older and fatter cattle (20 to 28 months) that can rather consistently achieve a Choice level of marbling. In order to change, the big problem is: "How do we validate age and time on feed?"

Achieving Optimum Carcass Merit:
Optimum yield grade (YG) is determined by optimum combinations of fat and muscle. Conference participants agreed that today's standard of YG3 will shift to YG2 in the future. As mentioned above, the reduction of fat and the increase of muscle is associated with some risks. Matching breeds that are high in lean growth with breeds having marbling and maternal ability offers great potential for optimizing carcass merit. In a rotational crossbreeding system, however, this approach can result in rather wide fluctuations in cow size and milk production. Furthermore, terminal sire systems have the inherent problem of generating replacement females.

A family of compounds known as beta agonists may help make the job easier because their mode of action is to repartition nutrients from fat to muscle. For example, the cow-calf industry could conceivably keep moderate-size, easy-fleshing cow herds having reasonable maintenance requirements and high fertility. By feeding repartitioning agents to the progeny of these herds, the feedlot industry may be able to enhance growth rate and feed efficiency, reduce fat deposition, and produce more muscular carcasses within a desirable weight range. However, maintaining palatability while simultaneously reducing fat and increasing muscle could be a potential problem. Beta agonists are not yet cleared for use in animals, but they are being intensely researched by several pharmaceutical companies. Even if these compounds are not cleared for use, recombinent DNA technology (genetic engineering) may eventually enable us to achieve comparable results.

Milk Production:
Milk production should be adjusted to fit a given environment. Furthermore, milk produced in excess of the growth needs of the calf is not an efficient use of resources. Some breeds and herds may need to improve their average milk production, but there is danger in selecting for extremely high milk levels because it could reduce fitness (reproductive performance) for the environment.

Functional Traits:
A routine breeding soundness exam (BSE) can help eliminate bulls with problems that reduce function. Scrotal circumference is a highly heritable trait that is related to early puberty in half-sisters and

daughters. Structural problems as well as disposition are heritable traits and should be particularly discriminated against in maternal and general purpose breeds where daughters will be kept for replacements.

Using EPD's:

The emergence of the "reduced animal model" (RAM) in 1984-85 was a major breakthrough for genetic improvement programs. RAM is an extremely robust statistical model that incorporates progeny, pedigree, and individual performance data into expected progeny differences (EPD's). Recent research has shown that EPD's are accurate in theory and in practice when the data base is adequate. In the future, EPD's will be heavily relied upon to improve early growth, calving ease, and maternal traits. Carcass and reproduction traits will eventually be added to National Cattle Evaluation (NCE) programs.

Number and Role of Breeds:

Reducing the number of breeds that play a major roll in beef production systems was advanced as a means of increasing uniformity and consistency in the U.S. beef supply. However, when one considers the extremely diverse environmental conditions under which beef cattle are raised in the U.S., it appears there is a legitimate need for a significant number of the breed types that are available today. Nevertheless, there may be justification for heavier utilization of a fewer number of breeds within a use classification (terminal, maternal, general purpose, etc.). One speaker suggested that the number of breeds playing a major role may eventually boil down to 8 to or 10 out of a total of 70. The burning question is: "Which ones will they be?" Opening its herd book could dramatically alter a breed's competitive position in the industry. The emergence of "composite" breeds further clouds our vision of the future as far as breeds are concerned.

There seemed to be agreements that, regardless of its use classification, no breed could survive without <u>acceptable</u> performance in all economically important traits. As Dr. Dave Buchanan stated, "It is probably in the best interest of each breed to emphasize a balance of traits while ensuring that nothing is done to damage their primary utility. Historically, those breeds of livestock that cannot serve broad segments of the commercial industry have become novelties."

Kinds of Purebred Breeders:

In his analysis of the future role of the purebred industry, Dr. Bill Pope suggested there would be five kinds of seedstock producers in the future.

1. Large breeders who follow the latest research and pay little or no attention to the show ring.
2. Small to medium size breeders who will sell bulls locally, will use A.I., but will find the competition tough. To survive, small breeders may have to go together or align themselves with a large breeder.
3. Breeders producing seedstock for specific commercial crossbreeding programs, such as F^1 heifers, etc.

4. "Brand X" breeders who have outside funding and will develop "composite" populations. They will not be a part of a breed association.
5. "Hi-tech" breeders who have outside funding. They will stay within a breed. They will be constantly searching for a competitive edge and will use every tool available for genetic improvement.

Planning Ahead:

In planning ahead, the following summary points seem appropriate:

- Look for the industry to "stabilize" somewhat around the current specifications after two decades of dramatic change.

- Identify emerging trends early, but be certain they are well-founded. Use caution and moderation. Avoid the temptation of going for "extremes".

- Be aware of trends and changes in other industries (swine, poultry, dairy, and even crops). We are all in the "protein business".

- We are a highly segmented industry. Our competition is either integrated or moving rapidly in that direction. For that reason, we need to keep talking to each other.

National Beef Cattle Conference
Blueprint for the Right Kind
Results of the Opinion Survey

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All members of the audience were asked, at the beginning of the conference, to answer a series of questions pertaining to the evaluation of beef cattle and procedures for beef cattle shows. There were 402 respondents comprising several segments of the beef cattle industry (Table 1). The results of the survey, catagorized by type of respondent, are presented in the tables that follow. There were generally fewer responses than the total for any particular question because various respondents chose not to answer all the survey questions.

While there are aspects of the results that seemed inconsistent, we feel it is better for the reader to evaluate the results and come to his/her own conclusions. It is of some interest to compare the results of this survey to the similar survey conducted at the National Steer Symposium in 1982. Questions pertaining to the steer or steer shows were also asked at the Steer Symposium while those associated with breeding cattle were not.

There were more respondents in the current survey than in the previous one (402 vs 145). The current respondents included larger representation from purebred and commercial producers, but fewer show officials or club calf producers. In describing the optimum steer, the respondents at this conference indicated less fat thickness and smaller rib eyes but the descriptions of optimum weight, height and quality grade were generally similar. More of the current respondents felt that steer show classes should be split by breed and weight than was previously the case. Approximately the same proportion of the respondents thought that steer show judges should be provided with data, but the amount of information to be provided was much greater with the current group. Members of the audience at both symposia felt overwhelmingly that a Grand Champion should fit the beef cattle industry.

Different categories of respondents did not generally differ a large amount in how questions were answered. Of course, most groups were represented with small enough numbers that comparisons between groups were not very meaningful. However, college personnel, breed association representatives, purebred producers and commercial producers each comprised more than 10 % of the respondents. Those four groups did not have large differences in how responses to various questions were given except in the case of the sources of information which were appropriate for the judging of breeding cattle classes (Table 18). College personnel and breed association representatives generally felt that EPD values would more useful than simple performance information, while purebred and commercial producers requested EPD values and simple performance information in roughly equal frequencies.

Table 1. What is your commitment to the beef cattle industry that generated your interest in this conference?

Judge	5
Show official	10
College personnel	103
Breed association	45
Club calf producer	18
Purebred producer	162
Packer	1
Commercial producer	42
Feedlot operator	8

Table 2. What range includes the optimum weight (lb) for an industry steer?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
901 - 1000	0	0	1	0	0	2	0	0	0
1001 - 1100	1	0	13	4	0	19	0	9	1
1101 - 1200	3	7	72	27	4	92	1	25	7
1201 - 1300	3	7	16	14	12	49	0	8	0
1301 - 1400	0	0	0	0	1	0	0	0	0
more than 1400	0	0	1	0	1	0	0		

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 3. What is the optimum height (in) for an industry steer?

	J	SO	COL	BA	CCP	PP	P	CP	FO
52 or less	0	0	2	1	0	4	0	0	0
52.1 - 53	0	1	10	3	0	20	0	4	2
53.1 - 54	1	1	17	11	2	46	0	8	1
54.1 - 55	1	4	47	9	4	45	0	12	2
55.1 - 56	2	4	20	15	6	31	0	12	3
56.1 - 57	1	0	2	4	5	10	1	2	0
57.1 - 58	0	0	0	0	1	3	0	0	0
more than 58	0	0	1	0	0	0	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 4. What is the optimum fat thickness (in) for an industry steer?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
.1 or less	0	0	1	0	2	3	0	0	0
.11 - .2	1	2	4	8	0	29	0	8	0
.21 - .3	1	7	48	21	11	78	1	24	3
.31 - .4	3	1	45	12	3	45	0	6	4
.41 - .5	0	0	5	3	2	6	0	2	0
.51 - .6	0	0	0	1	0	1	0	1	0
more than .6	0	0	0	0	0	0	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 5. What is the optimum rib eye area (sq in) for an industry steer?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
10 or less	0	0	0	0	0	1	0	0	0
10.1 - 11	0	0	1	1	0	1	0	0	0
11.1 - 12	0	1	4	5	0	7	0	2	0
12.1 - 13	1	4	26	7	0	31	1	8	3
13.1 - 14	2	3	39	15	4	54	0	14	3
14.1 - 15	2	2	24	14	9	43	0	14	1
15.1 - 16	0	0	6	2	3	17	0	2	1
16.1 - 17	0	0	0	0	1	4	0	0	0
more than 17	0	0	3	0	0	3	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 6. What quality grade is optimum for an industry steer?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
Standard	0	0	0	0	0	0	0	0	0
Select minus	0	0	1	0	0	0	0	1	0
Select plus	0	0	20	9	4	31	0	7	0
Choice minus	5	4	67	28	7	66	1	20	0
Choice average	0	5	11	7	4	58	0	10	3
Choice plus	0	1	1	0	1	5	0	3	0
Prime	0	0	1	0	1	2	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 7. What is the average frame size of the national cow herd?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
2	0	0	0	0	0	2	0	0	0
3	0	0	4	2	1	10	0	3	1
4	2	1	45	20	6	77	0	12	3
5	3	3	28	14	4	42	1	13	2
6	0	2	18	8	4	22	0	7	2
7	0	3	6	1	2	5	0	2	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10 or higher	0	0	0	0	0	0	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 8. What frame size bull is necessary to mate with the national cow herd to produce optimum sized market steers and heifers?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	2	0	0	1	0	0	1
5	0	1	8	1	0	9	0	2	0
6	0	1	36	15	1	55	0	12	2
7	3	4	34	24	8	62	1	16	5
8	2	3	17	3	6	25	0	6	0
9	0	0	1	1	1	7	0	2	0
10 or higher	0	0	1	0	1	1	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 9. What is the minimum frame score that a purebred breeder should produce?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
	0	0	0	0	0	1	0	1	0
3	0	0	2	1	0	1	0	1	0
4	1	1	25	4	0	8	0	3	1
5	1	5	37	24	4	64	0	8	1
6	2	1	22	14	9	55	1	16	4
7	1	2	12	1	2	21	0	6	2
8	0	0	1	1	1	6	0	0	0
9	0	0	0	0	0	1	0	2	0
10 or higher	0	0	1	0	1	0	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 10. What is the maximum frame size that a purebred breeder should produce?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
2	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	1	0	0	0
4	0	0	2	0	0	0	0	0	0
5	0	0	0	1	0	2	0	1	0
6	1	0	5	2	1	8	0	2	1
7	0	3	28	12	1	46	0	13	2
8	2	6	38	22	7	55	1	12	3
9	1	0	21	7	3	32	0	5	0
10 or higher	1	0	5	1	5	13	0	4	2

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 11. If a judge has an individual that falls outside of your range for minimum frame score or maximum frame size, what then should be done with that animal when placing the class?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
disregard frame	0	0	2	3	0	4	0	2	0
place last or near bottom of the class	2	1	13	5	2	18	0	6	3
place some emphasis on frame, but greater emphasis on other attributes	3	8	81	34	15	127	1	28	3
none of the above	0	1	4	2	1	9	0	4	1

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 12. Should steer shows require a minimum daily gain (for a specified time period or weight range)?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
yes	4	7	86	34	11	131	1	36	7
no	1	3	17	10	7	29	0	4	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 13. If you feel steer shows should require a minimum daily gain, what should that daily gain be?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
1.01 - 1.5	0	0	3	1	0	0	0	0	1
1.51 - 2.0	0	1	6	1	2	8	0	1	0
2.01 - 2.5	2	6	31	10	6	36	0	8	1
2.51 - 3.0	2	0	27	13	2	51	1	18	5
3.01 - 3.5	0	0	15	8	1	31	0	6	1
3.51 - 4.0	0	0	3	1	0	5	0	3	0
more than 4.0	0	0	2	0	0	2	0	0	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 14. How should steer show classes be divided?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
weight	1	3	23	6	2	14	1	5	1
height	0	0	11	5	3	7	0	1	0
breed & weight	3	5	39	24	9	111	0	24	6
breed & height	1	2	20	9	3	20	0	5	1
breed & weight & height	0	0	0	0	0	0	0	0	0
none of the above	0	0	9	2	1	10	0	3	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 15. Should a steer show judge be provided with performance data?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
yes	4	6	79	40	9	112	1	31	7
no	1	4	24	6	9	50	0	8	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 16. If you feel a steer show judge should be provided with performance data, what pieces of data are appropriate?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
weight	3	5	55	27	4	68	0	17	6
height	3	3	31	12	1	25	0	9	3
average daily gain	4	4	71	32	7	87	1	29	7
fat thickness	2	3	38	28	2	52	0	17	3
rib eye area	2	3	35	22	2	45	0	16	2
age	3	3	42	24	4	52	0	18	5

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 17. Should a judge of breeding cattle classes be provided with performance data?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
yes	4	7	94	40	15	132	1	34	8
no	1	3	9	6	3	30	0	6	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 18. If you feel a judge of breeding cattle classes should be provided with performance data, what pieces of data are appropriate?

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
birth weight	1	4	36	13	3	46	0	20	5
birth weight EPD	2	2	52	23	5	40	0	12	5
weaning weight	2	1	33	16	5	49	0	18	5
weaning weight EPD	1	3	55	21	7	47	0	13	4
yearling weight	1	1	36	15	6	51	0	18	5
yearling weight EPD	2	2	56	21	7	53	0	14	5
milk EPD	1	1	34	17	5	25	0	11	1
milk + growth (maternal) EPD	2	1	42	19	3	37	0	17	2
scrotal circumference	3	3	54	30	4	79	0	13	4
frame score	1	3	41	20	6	47	0	14	4
weight per day of age	2	6	54	31	11	91	1	25	4

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 19. Please rank the following traits for consideration when phenotypically evaluating breeding bulls.[b]

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
height	4.8	5.7	5.2	6.0	5.6	5.5	-	5.3	4.8
muscling	3.0	3.0	2.6	2.7	2.6	3.0	-	3.0	2.9
volume	3.8	4.3	4.1	4.1	4.4	4.6	-	3.9	4.1
structural correctness	1.2	2.2	2.3	1.9	1.7	1.9	-	2.4	2.1
breed character	6.6	4.8	6.1	5.0	5.6	5.0	-	5.2	5.4
length	5.6	4.8	5.2	5.1	5.2	4.5	-	5.1	5.6
growth rate	3.0	3.2	2.4	3.0	2.6	3.3	-	2.9	3.1

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

[b]These numbers are the average rank.

Table 20. When purchasing a commercial breeding bull, rank the following characteristics in order of importance for the selection process.[b]

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
performance information	2.6	2.7	2.1	2.6	2.1	2.2	3.0	2.0	2.0
conformation & appearance	2.4	2.2	3.0	2.7	1.9	2.7	2.0	2.6	3.1
breed	3.8	3.9	3.8	3.5	4.0	3.6	1.0	3.4	2.6
breeder	4.4	4.0	4.4	3.9	5.2	4.2	4.0	4.4	5.1
pedigree	5.4	5.2	5.2	5.5	4.9	5.0	6.0	5.1	5.0
EPD values	2.4	3.0	2.3	2.8	2.9	3.0	5.0	2.9	3.1

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

[b]These numbers are the average rank.

Table 21. The showring has an effect on the type of commercial cattle that are produced.

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
strongly agree	1	1	13	2	5	26	0	4	0
agree	2	5	47	30	9	89	0	23	6
disagree	2	4	36	12	4	42	1	10	1
strongly disagree	0	0	7	1	0	5	0	3	1

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 22. The Grand Champion steer should fit the industry.

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
strongly agree	3	3	50	26	10	85	0	23	7
agree	1	7	50	17	7	72	1	15	1
disagree	1	0	2	2	1	4	0	2	0
strongly disagree	0	0	1	0	0	1	0	1	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

Table 23. The Grand Champion in a breeding cattle show should fit the industry.

	J[a]	SO	COL	BA	CCP	PP	P	CP	FO
strongly agree	3	5	44	24	8	85	0	21	6
agree	1	5	52	17	5	66	1	19	2
disagree	1	0	5	4	4	9	0	0	0
strongly disagree	0	0	2	0	1	2	0	1	0

[a]J=judge, SO=show official, COL=college personnel, BA=breed association, CCP=club calf producer, PP=purebred producer, P=packer, CP=commercial producer, FO=feedlot operator.

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