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PROCEEDINGS

BEEF IMPROVEMENT FEDERATION

RESEARCH SYMPOSIUM & ANNUAL MEETING

BEEF IMPROVEMENT FEDERATION

21ST MEETING

MAY 11-13, 1989

B I F

NASHVILLE, TN

1989
Beef Improvement Federation
Annual Convention
May 11-13, 1989

Hyatt Regency Nashville
Nashville, Tennessee

PROGRAM

THURSDAY, MAY 11 -

11:00 a.m. -2:00 p.m. Board meeting
11:00 a.m. Registration
1:00 p.m. - 9:30 p.m. Tour of Jack Daniels' Brewery and Barbecue dinner

FRIDAY, MAY 12 -

8:00 a.m. Registration (until 5:00 p.m.)
Symposium - New Technologies for Live Animal Evaluation, John Crouch, Moderator

8:30 a.m *Advances in ultra-sound procedures for determining carcass merit in live cattle*, Russell Cross, Texas A&M University

9:15 a.m *Electronic identification of cattle for evaluation and marketing*, Gary Weber, USDA, Federal Extension Service

10:00 a.m. Coffee Break

10:15 a.m. *Electronic livestock identification in Canada. . . . how it works*, Herb Marshall, Anitech Identificattion Systems, Inc.

11:00 a.m. *Utilizing pelvic measurements to reduce calving difficulty*, Gene Deutscher, University of Nebraska

11:45 a.m. Questions

12:00 noon Awards Luncheon

2:30-5:00 p.m. BIF Committee Meetings (Attend the meeting of your choice)

Live Animal and Carcass Evaluation Committee, John Crouch, chairman

Guidelines for gathering and analyzing ultra-sound measurements for determining carcass merit, Bill Turner, Texas A&M University

Update on the ultra-sound training and certification process held at Texas A&M University, Jim Stouffer, Cornell University, and Lorna Pelton, Texas A&M University

Central Bull Test Committee, Ron Bolze, chairman

Expected progeny differences for group tested bulls in Ontario, James Wilton, Sue Armstong, Paola De-Rose, University of Guelph, Ontario

Identifying, qualifying and merchandising calving ease sires in central test stations, Keith Vander Velde, American Breeders Service; Dave Kirkpatrick, University of Tennessee; Wayne Wagner, West Virginia University

Educational Materials Committee, Daryl Strohbehn, chairman

5:10 p.m. Caucus for Election of Directors

6:00 p.m Social Hour

7:00 p.m. Awards Banquet - Presiding, Bob Dickinson, BIF President

Speaker - The Honorable L. H. (Cotton) Ivy, Tennessee Commissioner of Agriculture, *Animal Agriculture, Tennessee Style*

Awards - John Crouch, chairman of Awards Committee

SATURDAY, MAY 13 -

7:00 a.m. Board of Directors Meeting

7:30 a.m. Breakfast - Brian Pogue, *Preview of 1990 Convention in Canada*
Bob Dickinson, *President's Remarks*

Symposium - New Technology for Genetic Evaluations, Larry Cundiff, Moderator

9:15 a.m. *Expected progeny differences (EPD's) for use within breeds*, John Pollak, Cornell University

9:45 a.m. *EPD's for use across breeds*, David Notter, VPI&SU

10:15 a.m. *Genotype-enviornment interaction within and across breeds*, Larry Cundiff, USMARC, ARS-USDA

10:40 a.m. Coffee Break

11:00 a.m. *EPD's for carcass traits*, Keith Bertrand, University of Georgia

11:30 a.m. *A national focus on carcass evaluation*, Darrell Wilkes, National Cattlemen's Association

12:00 noon All speaker panel discussion, Larry Cundiff, moderator

12:45 p.m. Lunch on your own

2:15 p.m. BIF Committee Meetings (Attend the meeting of your choice)

Genetic Prediction Committee, Larry Cundiff, chairman

Guidelines revision, R L. Willham, Iowa StateUniv.

Genetic prediction of reproduction, Merlyn Nielsen, University of Nebraska; Jim Brinks, Colorado State Univ.

Genetic prediction of body composition, Keith Bertrand, University of Georgia

Genetic prediction of mature size and composition, Doyle Wilson, Iowa State University

EPD's across and within breeds, David Notter, VPI&SU

Genetic grouping-direct and maternal effects, Dale Van Vleck, U.S. Meat Animal Research Center

Floor Discussion

Growth Committee, Henry Gardiner, chairman

Reproduction Committee, Keith Vander Velde, chairman

Proceedings of Beef Improvement Federation

1989 Annual Convention

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ADVANCES IN ULTRASOUND PROCEDURES FOR DETERMINING CARCASS MERIT IN CATTLE

H. Russell Cross
Professor
E. M. Rosenthal Chair
Department of Animal Science
Texas A&M University

The meat industry in the United States has had an interest in instrument grading for the past 15 years. There was a flurry of activity in the late 1970s, but efforts to date have not been very well concentrated or organized. Because of very rapid changes in the meat industry over the past four years, the interest in instrument grading has intensified. The U.S. beef industry has seen more change in the past 4 years than it has in the past 20. When the results of the National Consumer Retail Beef Study (Cross et al., 1986) were released in 1986, the U.S. beef industry learned that consumers felt that their product was excessively fat. Prior to 1986, the typical external fat trim for beef retail cuts was in excess of 1/2 in. When the results of the National Consumer Retail Beef Study were released, the retailers quickly changed their trim specifications to no more than 1/2 in. of external fat. The changes did not stop at 1/4 in. The results of the recently released National Beef Market Basket Survey (Savell et al., 1988) revealed that the average fat thickness is now less than 1/8 in. In that study, over 42% of the retail cuts had no external fat. Thus, the retailers in the U.S. are now placing at least 27% less fat in the meat case in 1989 than 1986.

The U.S. beef industry is rapidly shifting from a commodity oriented to a consumer or food oriented industry. With this shift the need for a value based marketing system will increase dramatically. As the retailers trim more fat from their retail cuts, they will begin to send a strong signal to the packer to trim the primal cuts more closely. As the packer receives this signal he will be forced to send a similar signal to the cattle feeder and so on to the seed-stock producer. For these reasons, the U.S. beef industry has listed the objective measurement of value as a very high priority.

THE U.S. EXPERIENCE. Since grading began in 1927, its application has been primarily subjective, particularly with respect to the USDA quality grades. The USDA beef carcass yield grades can be determined somewhat objectively, but Cross et al. (1980) reported that in actual application, error was greater for yield grades than for quality grades. Over the past 12 years, the USDA has been actively seeking more objective means of determining grades. With this intent, the USDA, in cooperation with the National Aeronautics and Space Administration (NASA) and the Jet Propulsion Laboratory, began a project in 1978 to develop an instrument for objective evaluation of beef carcass quality and yield grade traits. Video image analysis (VIA) was identified by NASA as having the greatest potential for that purpose and USDA solicited proposals to develop such an instrument. In 1980, a contract was awarded to Kansas State University for that purpose.

Following the evaluation of the VIA system, the U.S. beef industry held two key meetings that had a significant impact on the future of instrument grading in the U.S. On February 7, 1984, USDA and 12 industry representatives met in Washington DC to discuss the future of instrument grading. The industry representatives were unanimous in expressing the need for an objective measurement of value. They felt that prediction of composition was a higher priority than prediction of quality. They also recommended that the instrument be designed so that it could be used to measure composition on unchilled and unribbed beef carcasses. They felt that an instrument that required a chilled, ribbed carcass (such as the VIA) would prevent the industry from using innovative new technology such as hot processing. They preferred an instrument that functioned on the slaughter floor prior to hide removal or chilling. This recommendation effectively stopped further research on the VIA.

USDA sponsored a second meeting with the meat industry in Beltsville, MD on June 13, 1984. The objective of this meeting was to identify the state of the art of technology that might be used for instrument grading. Four types of instrumentation were discussed: (1) nuclear magnetic resonance; (2) near infra-red reflectance; (3) real time ultrasound and (4) video image analysis. Based on input from those technical experts at the meeting and predicted costs, the group made the decision to move in the direction of ultrasound for grading beef.

Following the meeting, the National Cattlemen's association, the American Meat Institute and the National Live Stock and Meat Board funded research at Texas A&M University and Cornell University to investigate the potential of ultrasound to predict composition (Texas A&M) and marbling (Cornell).

ULTRASOUND-STATE OF THE ART. Ultrasound measurements have been used as an objective method for measuring characteristics which are in turn used to estimate quality and conformation of several different meat animal types such as beef, swine and sheep. This technology provides an adequate method for measuring subcutaneous fat thickness. It is also useful for measuring the area of the longissimus dorsi (ribeye) although not quite as accurately. Ribeye area is somewhat difficult to measure using the current technology because of degradation in the reflected energy at the muscle tips as well as the attenuation of power as the depth increases. The sensors that are normally used to measure fat thickness and muscle area are off-the-shelf sensors that have been designed to suit human medical diagnostics requirements. In order to take advantage of ultrasound as a noninvasive, objective grading instrument for livestock, research must be dedicated to redesigning the ultrasound sensor.

Most of the sensors currently in use operate at between 1.0 and 5.0 MHz. The sensors are normally fixed within this range. A lower frequency such as 1 MHz tends to provide better penetration per unit of power, but lower resolution (Anselmo et al., 1980). In other words, it is unable to predict the location of a fat/meat interface as accurately as a higher frequency. In addition it is not as sensitive to small interfaces such as intramuscular fat depositions. On the other hand, a higher frequency such as 5 MHz may provide higher resolution, but is unable to penetrate as far as a lower frequency (Anselmo et al., 1980). Research has been initiated at Texas A&M University to design a multi-frequency ultrasonic imaging transducer for live animal and carcass grading. This sensor will be capable of optimizing the frequency in order to locate the interfaces of interest most accurately.

Sound wave velocity may be used as another source of information for determining yield and quality grade (Kanis et al., 1986, Busk, 1984). There is a difference in the speed at which a sound wave travels through fat and through muscle. By measuring the time that it takes the sound to travel through the animal, an estimate may be made of the percent of fat and meat that that wave travelled through. The measurement is extremely sensitive to the distance between transmitter and receiver (Busk, 1984).

In addition to sensor redesign, objective data analysis methods must be developed. Currently, data from ultrasound images is extracted by a human operator. This operator must determine the fat thickness and the muscle area by measuring it from a video image or a photograph. These two measurements provide enough information to predict body conformation rather accurately if they are measured accurately and consistently. Research is underway to automate the evaluation of these images using a combination of image analysis and artificial intelligence techniques.

In addition to using ultrasound measurements to objectively grade an animal or carcass for yield, they may also be potential for determining intramuscular fat content (marbling). The current sensors that are used to determine backfat thickness and muscle area have been used to show that a relationship exists between marbling percentage and ultrasonic image texture (Haumschild et al., 1983, Anselmo et al., 1980); however, the accuracy has been too low to permit their use as a grading tool. Research is underway at Texas A&M University to determine an optimum ultrasound sensor design for the objective measurement of marbling.

POLITICAL CLIMATE FOR INSTRUMENT GRADING. Instrument grading research in the U.S. is very fragmented and moving at a slow pace. The list below summarizes most of the work in progress at the various institutions:

Institution	Scientist	Approach	Specie
Texas A&M	Cross/Savell/Hale/ Whittaker/Pelton	Ultra/NMR	beef/pork
Cornell	Stouffer	Ultra	beef/pork
Purdue	Forrest	Ultra/TOBEC	beef/pork
Miss. State	Rogers	Fat Probe	pork
USDA	Chen	Expert Sys.	beef

Most of the above research is underfinanced and is not being supported by private industry. Past emphasis on instrument grading has come from the live animal sector of the U.S. meat industry. This sector has always had more interest in a value based marketing system than the U.S. packing industry. The National Cattlemen's Association has listed instrument grading as a priority for the last 10 years. Other than informing USDA that instrument grading is a priority, the U.S. beef industry has made no major moves to fund research in this area. With the beef checkoff programs in place and with the move towards a value based consumer oriented industry, **this should change.** At a recent meeting in Denver, the National Cattlemen's Association Grading Committee listed instrument grading as being among their top priorities and urged their association to move forward quickly. The question is **how?** Who should provide the dollars--USDA, the private sector or both? The industry or government will likely have to pay the research and development costs since there may be a limited market for these instruments.

INTERNATIONAL COOPERATION. If we are not very careful, a great deal of time and money will be wasted. There is no question that objective grading to determine value is a priority in many countries throughout the world. We run a great risk of serious duplication if we are not organized. Since our objectives are similar, perhaps we should entertain the possibility of **working together** to reach our common goals. We could perhaps share technology and dollars to reach our goals much more quickly. To accomplish this, the industry must:

1. Identify the value traits that you wish to measure.

2. Establish parameters for precision and accuracy for the instrument.

3. Identify conditions under which the instrument would have to operate--speed, temperature, humidity, physical abuse, etc.

4. Identify technologies that are available or are likely to be available to meet these needs. Perhaps various institutions or countries can try different approaches with different technologies. Rather than concentrating all of our efforts on one approach you could try at least two or three.

5. Identify project leader(s) for each country and potential sources of funding.

6. Establish goals or milestones that need to be met so that progress will be swift.

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Electronic Identification of Cattle for Evaluation and Marketing

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The need to develop a means of identifying livestock began with the first efforts to domesticate wild animals. The very earliest identification systems were likely based upon recognizable phenotypic and behavioral characteristics. Ancient herdsmen effectively utilized their skills to identify and select animals. These early efforts established the foundation for the domestic livestock industry as we know it today.

Presumably not long after the domestication of cattle, civilizations developed to the point where identification of cattle to support the concept of individual ownership became an issue. Ancient Egyptian tombs contain artwork depicting the branding of cattle to provide a simple means of proving individual ownership.

The basic need to identify cattle has not changed since the time of the pharoahs. However there has been, and will continue to be, advancements in identification technology as well as how these identification systems contribute to the effectiveness of management systems.

The purpose of this report is to surface, define and discuss recent developments in electronic identification technologies which can enhance the efficiency of production, evaluation and marketing of cattle.

Determining the Ideal Identification System

Designing an ideal identification system requires that we define our goals and objectives. The primary identification needs for the cattle producer include systems which will provide proof of ownership and individual animal identification. One might argue that there are production situations where the need for animal identification ranges from none to sophisticated. Regardless of the production situation, we must review our goals and ask ourselves if achieving them can be enhanced by utilizing some form of animal identification.

Goals Determine the Identification System

If a livestock producer is to produce livestock without concern for production efficiency, other than that controlled by mother nature, then a simple identification system to denote ownership is probably sufficient. For this situation there is perhaps no better identification system than branding.

Cattle branding, either by freezing, hot iron or chemical means, is a fast, economical, permanent identification system. Branding is difficult to alter, and as such, helps eliminate the potential for theft. However, branding does reduce the value of cattle hides and so it presents a hidden cost to the industry. In addition, branding is not an efficient means of individual animal identification due to inherent limitations in the number of unique identification sequences which can realistically be utilized.

Individual Animal Identification Systems

Genetic selection, breed registry requirements, herd health programs, control and eradication of contagious diseases, and strictly controlled feeding and production record systems all require, or can be enhanced by, an individual animal identification system of one form or another.

Individual identification systems such as tatooing, metal and plastic eartags, ear notches, neck chains, and other systems, each have their strengths and weaknesses.

The optimal individual identification system would have the following characteristics: 1) low cost, 2) easy to read at a reasonable distance, 3) essentially permanent and tamper resistant, 4) large number of unique identification sequences consistent with criteria for an international, multiple species, livestock identification system, 5) capable of providing measures of animal activity, temperature etc., 6) capable of directly interacting with feeding and management equipment.

There may never be one identification system which meets all requirements of the optimal identification system. The current solution is to utilize a combination of identification systems. Mixing identification systems such as a tatoo or brand and an ear tag system is more the norm than the exception on todays farms and ranches. Recent advances in electronic identification systems make it possible to utilize this new technology as a component of a livestock management system.

Electronic Identification Systems

The development of electronic animal identification systems in the United States dates from the early 1970's when the U.S. Department of Agriculture - Animal and Plant Health Inspection Service (USDA-APHIS) began supporting the development of a National Electronic Identification System for livestock. The first major electronic identification research was conducted at the Los Alamos, New Mexico, Scientific Laboratory in the mid 1970's (Holm, 1981). Funding for this project was provided by USDA-APHIS and the Energy Research and Development Administration.

The first unit developed at Los Alamos was designed to be implanted, utilized passive (no battery) radio frequency (RF) operated componentry, and had the ability to measure animal temperature. Puckett et al. (1982), reported on extensive tests conducted with this first electronic identification system. The electronic identification technology developed at Los Alamos was not commercialized.

Leaders in the livestock industry visualized the potential for electronic animal identification. They also identified the need to establish uniform standards which would enhance the use of the same basic systems across livestock species. In an effort to accomplish this standardization the Livestock Conservation Institute established the

National Livestock Identification Board in 1977.

There are a number of electronic identification systems now on the market which utilize RF technology operating in the 420 to 915 MHz range. These units are very similar to those developed at Los Alamos although miniaturization of components has advanced significantly. Buckley and Robinson (1987) reported on an analysis of five commercially available electronic identification systems of various types. Spahr (1986) has also reported on various electronic identification systems which are available to the livestock industry. Karamchandani (1986) has provided a review of electronic identification systems and their potential benefits to the livestock industry. These systems utilize technology referred to as passive (responders) as well as battery powered (transponders) units. Although not reported in these papers, there are also systems which utilize infrared technology and bar code scanning devices. Watson (1986) has reported on the use of a bar code identification system for livestock.

Enhancing Livestock Management Systems

Various forms of individual animal identification systems can be utilized to control sophisticated individual feeding systems. The dairy industry has utilized individual identification systems coupled to sophisticated computer feeding and milk production monitoring systems for many years. These systems utilize several technologies including infrared tag scanning, passive (responders) as well as active (transponders) RF transmission. These systems can provide financial returns to producers as a direct result of mechanization of routine feeding regimes which enhance control over individual animal feed intake as well as reducing labor inputs.

Spahr et al. (1985) has reported on efforts to develop a system to interface electronic identification with other components in dairy production systems. Systems patterned after those developed for the dairy industry are also being marketed for swine operations. Olsson et al. (1987) has reported on systems to individually feed sows at various stages of production. These systems have received an excellent response in Europe where individual confinement of sows is not allowed, yet the need to individually feed is very important for efficient swine production.

Research has been conducted in West Germany to develop computerized individual feeding of forages to cattle (Schon and Meiering, 1987). Research in this area is an important component in the search for systems capable of individually feeding cattle during various stages of production where forages are the primary feed ingredients.

Gabel et al. (1988) has reported on the potential for a permanent electronic identification systems for horses. The research indicates electronic identification implants, when correctly implanted, will not migrate nor irritate tissues. The passive electronic implant used in this study is of such a small size that it is reported to require approximately two hours of surgery to successfully find and remove the implant.

Therefore, these implants are essentially permanent. Reports indicate that these implants have the memory capacity sufficient to register all the animals in the world, yet are so small that they have been used to identify salmon fingerlings used in migration studies.

Potential Uses of Electronic Identification of Beef Cattle

Electronic identification of beef cattle holds great potential for the industry in areas of animal health, feeding systems, and permanent identification of high value animals for evaluation and marketing.

Animal Health

An important component of any animal health or disease eradication program is individual animal identification. Electronic identification systems, coupled with computer technology, could enhance the speed and efficiency of data recording. The use of programmable, temperature sensing implants, in cattle pulled due to illness, could provide feedlot operators the ability to monitor temperature, store previous medication codes, and the date the livestock can be marketed based upon drug withdrawal times. Interface with computer systems could actually automate these processes and produce recommended treatment regimes based upon previous treatment, animal temperature, days sick, etc.

Electronic systems could also provide an essentially permanent identification means for eradication of diseases such as brucellosis. Computer assisted identification scanning and recording could reduce error rates and accelerate disease control activities.

Animal Production

Electronic identification systems have already been incorporated into dairy production systems in the United States. These systems have been designed to utilize individual animal identification to control feeding regimes, monitor production levels, and alert managers of off-feed or off-production situations.

Systems similar to those developed for dairy producers are becoming common on swine farms in Europe and are now being advertised in the United States.

Systems of this type could be utilized for beef cow-calf operations where managing cows based on body condition scores or feeding heifers would require more control over the levels of feed provided. Individual feeding of feedlot cattle would not seem efficient due to the technology cost and the production benefits of competitive behavior at the feedbunk. However, there is potential for individual feeding of bulls during testing programs. Individual bull feeding has potential to enhance our selection of superior sires, as well as serve as a marketing tool for the seedstock producer.

Evaluation and Marketing

One of the most interesting applications of electronic identification of cattle and utilization of associated computer technology is in the area of evaluation and marketing.

The beef cattle industry is rapidly approaching the point where we will have EPD's for carcass traits and carcass specifications or targets. Electronic identification technology provides us with a useful tool to take full advantage of our selection processes.

It is reported that feed costs represent 60 to 70 percent of the cost of producing beef. Data also indicate that more than 70 percent of the total feed required to produce a pound of beef is required to maintain the animals responsible for it's production. We also are aware that there are differences in feed efficiency between animals and that feed efficiency is highly heritable with estimates ranging from 40 to 50 percent.

Therefore, the individual electronic identification of growing bulls and subsequent utilization of computer controlled individual feeding systems can provide a measure of the efficiency of gain. Since feed efficiency is so critical to the profitability and competitiveness of the beef industry these data could play a significant role in bull selection.

Feed efficiency data could have a significant effect on the marketing strategies of specification seedstock producers as well as upon the selection programs of cow-calf producers. Specification seedstock producers possessing a complete set of performance data would have a marketing edge over their competition.

Selection for carcass traits as well as for efficiency of production would greatly enhance the ability of the beef industry to make significant selection progress toward specification cattle that are also feed efficient.

Electronic identification systems could also be utilized to follow progeny to market and serve as means of acquiring data on bulls to more rapidly establish accurate EPD's for carcass traits.

Conclusions

Electronic identification and associated technology is not a panacea and it is not necessary for all production situations. As with any new technology there are opportunities and problems associated with it's implementation. Recent developments in electronic technology, including reductions in cost, and miniaturization of components, indicate the technology has great potential to provide an improved means of animal identification and enhance the efficiency of some phases of beef cattle production.

However, before there is extensive use of some specific electronic identification devices, there are issues which must be resolved. The efficient utilization of electronic identification will require continued efforts to standardize identification sequences and scanning technology across livestock species. Minimum standards for scanning distances should also be established. Experts in the field suggest a minimum standard of 15 inches, and an optimal distance of 36 inches, should be one of the system design criteria. Another factor requiring resolution is the issue regarding the use of implanted devices and their potential to enter into the food and byproduct system. Research and dialog now underway may provide some insight into methods of dealing with these and other issues pertaining to the use of electronic identification systems.

It would appear that electronic identification systems have evolved to a point where they can play an important role in livestock production systems. One can expect the development of these systems to accelerate and to provide some very significant opportunities for future gains in the efficiency of livestock production, evaluation, and marketing.

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Beef Improvement Federation Annual Convention
May 11-13th, 1989

Symposium: New Technologies For Live Animal Evaluation

Topic: Electronic Livestock Identification in Canada.... how it works.

Presented By: Herb Marshall, President of Anitech Identification Systems Inc.

The need for a positive, secure and tamper resistant means of animal identification has been an obvious requirement of the meat industry for centuries. In the beef and pork industry alone in Canada these animals have an asset value at the time of slaughter of 9 billion annually. Naturally the determination of ownership and the assignment of proper payment at the time of transfer or slaughter to the rightful producer is paramount.

Human ingenuity responded to this need to identify by creating at the time the most practical of the alternatives available. Basically these alternatives included marking an animal with a brand or tattoo, configuring some area of the animal such as an ear by removing a piece or notching it; attaching a tag to the animal or attempting to identify it by capturing its likeness in "a drawing". Whereas the primary advantages of these schemes are cost and traditional acceptance, the drawbacks are numerous. The variety of methods alone causes problems in recognition or interpretation of identity, uniformity and ease of information recording and I.D. transferring. It should be of no surprise that the search for better identification alternatives has captured the attention and financial commitments of Governments worldwide.

Other major obstacles to the identification equation have been the inability of the present systems to provide feedback to those who control and shape the genetic evolution of the product which makes up the meat industry. Present methods of identification do not facilitate the passing of kill floor performance data on individual animals back to the serious farmers and breeders. Now animals at the time of slaughter are identified largely by lot and not individually, thus the feedback of herd health data, the verification of Records of Performance, feed management and genetic breeding programs are costly and time consuming and therefore not practical. Lastly, concern has been shown throughout North America around the problem of tracing back the presence of drug residues in animals at slaughter. While tattoo/branding systems in Canada serve to identify "farms of origin", electronic identification would offer a convenience advantage where the marketing of animals is likely to involve their transfer, both inter-provincially and through multiple levels of handlers.

As a result of the limitation of the present forms of identification, much interest and concern has been shown worldwide in the concept of electronic animal identification (Transponder Technology). Electronic identification is becoming an essential tool for the livestock industry which should lead to the improvement of performance efficiency, breed improvement and product quality. Implant or visible ear transponders will be a key link in the computerization of record keeping, including weight and feed data, sorting systems, identification of pathological and abnormal conditions, transfers of information and the retrieval of carcass and meat quality data. The information obtained on individuality electronically identified animals will be used to help select genetically superior animals so breeding programs can be established. This will produce more efficient, healthier animals which results in a higher quality meat product.

On-farm systems will allow the recording of feed conversions, weight gain, and management practices to enable producers to identify the best producing animals. The identification of individual animals will be maintained through slaughtering, inspection procedures, grading, and maybe even cutting so information can be sent back to the producer for use in identifying both superior animals and problems associated with the herd. The meat industry will be in a much better position to evaluate abnormal conditions as they relate to individual animals so improvements can be made in eliminating these problems.

Many of the large abattoirs in North America have begun to do away with manual "ticket" systems for collecting weight and grade information and for identifying and tracking carcasses through the slaughtering facility. Anitech for the past 3 years has been instrumental in automating plants with its introduction of "Automatic Data Capture". The company utilizes its transponder technology in conjunction with electronic terminals to automatically identify and weigh carcasses, collect kill floor performance data and report the data on a daily basis.

With improvements in individual animal identification, data collection and record utilization, progress can be made in genetic selection which will be perhaps even greater than that from the use of growth hormones and other feed additives. The key to making this happen is the use of electronics in the identification of individual animals and the integration of this with on-farm and slaughter plant data capture systems. The net impact on the industry will be to improve production efficiencies and product quality so red meat can remain competitive in the market place.

TRANSPONDER TECHNOLOGY

There are essentially two components to the technology - the implant or ear tag transponder and a reader/interrogator. The implant is a micro electronic circuit measuring less than the size of a grain of rice (.40 inches in length and .08 inches in diameter). It contains a coil antenna and a microchip sealed in a surgical glass envelope. Utilizing passive low frequency technology it operates without batteries. The Electronic Ear Tag operates in the same manner as the implant. It is circular in shape, 1 1/4 inches in diameter and has a hole through its middle.

Both the implantable transponder and ear tag are activated by a low frequency signal transmitted by the reader interrogator. For example, by simply holding the reader's electronic wand close to the animal, the transponder is excited via its coil antenna, causing it to transmit its unique identification code back to the reader. The reader then converts the signal into a number which is shown on the reader's display. A full range of operational functions are provided by the reader. Able to be used in the barn, field and laboratory, its batteries are rechargeable. The unit contains memory storage and it easily interfaces with a computer.

The transponder implant is inserted into the animal using a syringe which is spring loaded and equipped with a 12 gauge retractable needle providing safe, sterile implantation. The ear tag is attached with any standard ear tag applicator and utilizes a Y-Tek male pin inserted through the circular transponder's centre.

Figure 1. A General Model For Introducing Electronic Livestock Identification

DEMONSTRATE:

Feasibility
Practicality
Durability
Longevity

SELL INFLUENCE GROUPS:

Governments
Associations
Marketing Boards/Agencies

DEFINE PRODUCT OFFERING:

DEVELOP FARM DATA CAPTURE/HERD MANAGEMENT PROGRAMS INTEGRATE WITH EXISTING PROGRAMS.

SET UP RETRIEVAL SYSTEM IN PLANTS:

Automatic Data Capture

1st LEVEL SELLING

Purebreds

2nd LEVEL SELLING

Commercial Operation

3rd LEVEL SELLING

General Livestock-National

Figure 1: describes the approach Anitech has taken to gain acceptance for electronic identification in Canada. Certain truths must be established about electronic identification technology.

We must demonstrate that it makes economic sense, that the technology or equipment can easily be used, that the equipment stands up over time and that the technology will not be quickly surpassed by "something better or cheaper". Many of our field studies demonstrate that our technology is practical and durable. Efforts now must be spent: in confirming through economic analysis that transponders offer a beneficial alternative to current identification techniques; in clearly stating the rationale as to why this technology deserves to be considered the technology of choice; and in instilling comfort in the "influencers" that it is unlikely that the technology will become outdated.

Various interest groups directly connected with the livestock segment must be contacted, sold on the above mentioned issues and their commitment obtained. For every market segment application requirements should be defined and , if required, modifications may be made in order to insure that each animal group has the equipment it requires to use the technology in a practical way.

As the transponder technology for identification gains acceptance, it is anticipated that a need for computer based application software packages will be developed for different animal species and those programs currently available on the market will be modified to accommodate the transponder's 10 digit identifier.

There are several reasons which cost justify adopting electronic identification. These are: convience; herd management; herd health; and herd registration/identification. In order to satisfy the purposes of herd management (genetic improvement) and herd health, kill floor performance data on the individual animals must be made available to the producer. The provision or availability of this data greatly adds in justifying the cost of identifying animals individually. By selling Canadian abattoirs on automatic data capture for their kill floors, they are supplied with the ability to provide valuable data to producers and to act as a retrieval mechanism for the transponders.

<u>1st Level Selling</u> refers to Anitech's belief that organizations which provide registration services for various purebred organizations have the most to gain immediately from electronic identification. These groups are in need of an identification method which provides for a high level of security as a protection against the possibility of manipulating animal identities. They are also extremely interested in retrieving kill floor performance data for the purpose of updating the genetic records of their breeding stock.

2nd Level Selling has Anitech approaching large commercial farm operations who would have specific benefits from utilizing electronic animal identification. Again, slaughter house feedback is a necessary requirement. Many of these operations are what are termed "finishing" operations in that they purchase young livestock for the purpose of fattening the animals and sending them to market. This target group has interest in determining the quality of their sources of supply and would benefit from the automatic reading, weighing and sorting functions the company's technology would provide. The great majority of these commercial operations are already heavily computerized.

Finally, 3rd Level Selling involves the wholesale adoption of electronic identification of livestock as a legitimate alternative to traditional methods. It will occur as a natural progression from the successes experienced by the purebred groups and large commercial operations. It can also occur as a result of individual provinces and animal groups individually switching to electronic identification. For beef cattle the advantages of electronic identification will have to be sold to the cow-calf operator ie. less stress/weight loss when not branding and he/she receives a premium for electronically identifying his/her cattle in the sales barn from the new purchaser. Slaughter houses will benefit significantly with the reduction in branding and on average will receive $7.50 premium on every hide not branded. A challenge for the company then will be to find a method of channelling this premium down through the system to the cow-calf operator. Another challenge will be the financing of the large scale use of electronic identification. One thing we can say for sure is that each livestock group will likely support electronic I.D. if some other group pays for it.

THE ISSUE OF THE FEASIBILITY OF ELECTRONIC I.D.

The introduction of electronic identification to the Canadian Livestock Industry involves substantial change in the present systems of identification within the nation. Dissonents to the concept frequently state a common response; that workable methods and systems for identifying livestock are already in place and "if they work why fix them"? A rationale for changing the status quo is required to point out in economic terms that the financial advantages of electronic identification makes major contributions in the areas of registration, herd health, genetic improvements and herd management and in convenience or ease of use.

Models are required to determine the financial feasibility of introducing electronic identification for:

a) Purebred Beef and Dairy Cattle
b) Purebred Swine
c) General Market Cattle
d) General Market Swine

D. Karamchandani in her 1986 publication Food Market Commentary, "Electronic Identification for the Livestock Industry" Agriculture Canada (8, 2:32-38) discussed the need for an economic rationale for the implementation of electronic I.D. for general market cattle and swine.

Karamchandani examined the costs and benefits of electronic I.D. when considering each participating group in the entire meat production system. In her model she assigned non-financial costs and the corresponding benefits at each stage:

The Farm
In Transportation
At The Stockyard
At The Abattoir
and
Marketing Agencies

As a final conclusion in Karamchandani's report she stated that, "although there were too many unknowns to allow for a quantitative estimate of the cost - benefit ratio, ... there is little doubt that systems for the identification of animals compatible with high technology would present considerable advantages."

In a later telephone conversation, Karamchandani reported that one of the bigger obstacles in her being able to assign costs and benefits to her model was her belief at the time that a mechanism or technology for tracking carcasses through slaughter did not exist. Therefore if slaughter house results could not be fed back on an individual carcass basis, much of the advantage of electronic I.D. would be lost with respect to herd health and genetic improvement information. It is important to note that Anitech has, since 1986, developed a nationally accepted method for feeding back individual carcass kill floor performance results through its Automatic Data Capture program.

A PRACTICAL DURABLE ENDURING TECHNOLOGY

The need for a positive form of animal identification within the meat and livestock industry has captured the attention and financial commitment of the Canadian Government since 1979. Canada made its first investment in a passive transponder research company which ended with disappointing results. In 1984 the Canadian Government held a national work planning meeting on electronic I.D. of beef and dairy animals. About 70 government, industry and academic personnel met to discuss "state of the art" electronic identification techniques for the purposes of ensuring that participants were at the same level of awareness; to ascertain the level of desire for a national system of livestock I.D.; and to establish a mechanism by which a national electronic livestock I.D. system could become a reality.

In the summer of 1985 a national technical advisory committee on electronic identification of livestock was created. This committee and the Engineering and Statistical Research Centre for Agriculture Canada conducted research with all of the commercially available I.D. technology companies (5). All systems were tested for their ability to withstand high temperatures, thermal shock, thermatic sealing, vibration, strength of attachment mechanism, puncture resistance, electronic isolation, chemical resistance, operating life, code capacity, visual marking, veterinary appraisal and flexibility at low temperatures. The results of the study concluded that the Destron/IDI technology and one other warranted further testing. The other manufacturer selected utilized Surface Acoustical Wave Technology. Although this technology allows a 1 metre read distance it is: a more expensive technology; must have direct line of sight to read; does not come as an implant; and the reader or interrogator will not read animals electronically ear tagged in close proximity to one another.

Since the fall of 1987, Anitech has conducted further tests with the Destron/IDI transponder technology. Tests were conducted with beef cattle in the Provinces of Saskatchewan and Ontario and swine in Prince Edward Island and Ontario. Anitech also installed industrial slug transponders in trolleys in four different swine slaughtering facilities. It is anticipated that four beef plants will purchase Anitech's Data Capture System utilizing transponders over the next 12 months. As we are satisfied that the ways and means are available now to track livestock electronically from birth through slaughter, Anitech has committed to proceeding with the Destron/IDI technology.

However, we are frequently asked - will the technology endure? Will not another company come along with a more attractive technology. Our answer is this. The livestock industry has been searching and waiting for the "ideal" since the mid 1970's. There are those who feel the ideal electronic identification device should cost less than $1.00, operate without batteries, be implantable and read from 20 feet away. Personally, I am one of those individuals, but I do not know of any principles in physics today which would allow for the existence of such a device.

Anitech in Canada has taken the position that the need for electronically tracking livestock exists. The ideal technology for fulfilling that need exists in parts. Every bit as critical as finding a technology of choice is the constructing of a support system, network or framework in which the technology fulfills its promise. There is no reason today not to begin to construct the system to make use of existing proven technologies. Anitech believes that the cost/benefit ratio has begun to favour the user of electronics. Why else has the livestock industry in Canada begun to purchase our products. That ratio can only dramatically improve with engineering, manufacturing advancements and of course volume usage.

Pelvic Measurements of Heifers and Bulls for Reducing Dystocia[1]

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Introduction

Dystocia (calving difficulty) is one of the more important production problems of the beef cattle industry. It represents major economic loss, because it increases calf losses, decreases conception rates and increases labor costs. Dystocia has become a greater problem for beef producers due to increased emphasis on rapid growth rates and improving production efficiency. As producers select for more growth, larger calves can be expected at birth and more calving difficulty.

In Nebraska studies, average calf losses of 4% within 24 hours of birth were reported for those born unassisted versus 16% for those born during dystocia (Laster and Gregory, 1973). Also, the subsequent pregnancy rate was lower (69% versus 85%) in cows requiring assistance at calving than those calving unassisted (Laster et al., 1973). Montana research indicated 57% of all calf losses were due to dystocia (Bellows et al., 1971).

Many factors are associated with calving difficulty including: small, young cow; large fetus; male fetus; small pelvic size dam; long gestation; large-breed sire; dam body condition and abnormal fetal presentation. Several of these factors are interrelated, which complicates research and methods of reducing the problem. This paper will primarily address the influence of pelvic size of heifers and calf birth weight on calving difficulty and the genetic implications of pelvic size of bulls on future offspring.

Does pelvic size of dam influence calving difficulty ?

Many research studies have investigated this question? Rice and Wiltbank (1972) conducted early studies and found that calf birth weight was the most important variable influencing dystocia with pelvic size of heifer second. Together they accounted for 38% of the variation in dystocia. However, heifers (3 mos before calving) with pelvic sizes less than 200 cm^2 had 69% incidence of dystocia while heifers greater than 200 cm^2 had 28%. At the US MARC at Clay Center, NE, a study on about 600 heifers of 14 different breed crosses and 5 sire breeds producing the calves was reported by Laster, 1974. These results showed that calf birth weight was the most important factor but breed of sire, sex of calf and pelvic area of cow influenced calving difficulty. Traits known before calving accounted for 26% of the variation in dystocia and traits known after calving increased the percentage to 39%. Calf

[1]Presented at 1989 Beef Improvement Federation Annual Convention, Nashville, TN.

shape measurements, independent of birth weight, were not related to dystocia. Cow weight and breed significantly influenced pelvic area. Larger cows had larger pelvic size but also had heavier birth weight calves; therefore, it was concluded that selecting for pelvic size would not reduce dystocia. Later research by other workers using more uniform groups of heifers disagreed with this conclusion. Laster's study used many different dam and sire breeds which may have inflated the variation in the data and influenced the results.

Price and Wiltbank (1978a) concluded from a literature review of over 80 studies that (1) occurrence of dystocia in two-year-old heifers was primarily a function of size of calf and pelvic area of dam; (2) statistical analyses indicate that these two variables account for less than half of the variation in dystocia but other identified sources account for little or no variation; and (3) a combination of culling heifers with small pelvic areas and using bulls which sire calves with small birth weights may significantly reduce dystocia. In a study on 940 heifers, Price and Wiltbank (1978b) reported results which supported the above conclusions. In addition, they found that when calf size was combined with pelvic area, both were equally important in contributing to dystocia variation. Pelvic area growth in heifers from 15 to 23 mos. of age was .25 to .27 cm^2/day for the breeds studied. They concluded that a low level of dystocia can be maintained only if pelvic area increases in proportion to calf size. Pelvic measurements at breeding can be used as an aid in reducing dystocia; but to accurately predict dystocia, calf size needs to be predictable prior to calving.

Short et al. (1979) and Belcher and Frahm (1979) reported studies on 600 and 900 heifers, respectively, and plotted graphs showing the effects of both calf birth weight and dam pelvic size on dystocia. Heifers that calved unassisted had 7.4 cm^2 larger pelvic areas (at 15 mos. of age) than heifers requiring assistance (Belcher and Frahm, 1979).

In other studies, Axelsen et al. (1981) found that heifers with dystocia had calves 5 lbs heavier and pelvic areas 14 cm^2 smaller than those calving unassisted. Dufour et al. (1981) reported cows with difficult first and second calvings had a low ratio of pelvic size to body weight indicating a lack of pelvic size development. They suggested using a ratio of pelvic size to body weight at first breeding to predict calving ease.

In more recent studies, Ruttle et al. (1982), Deutscher and Zerfoss (1983), Bolze (1985), Brethour (1987) and Johnson et al. (1988) reported that calf birth weight and dam pelvic size were the most important variables influencing dystocia. Morrison et al. (1985) used discriminant analysis with cow age and precalving pelvic height to correctly predict 87% of dystocias. From the numerous studies previously cited it appears to this author that, in fact, pelvic size of dam does significantly influence dystocia.

Relationship of Dam Pelvic Area to Calf Birth Weight

Gregory (1984) stated that dystocia seems to be a result of disproportionality in skeletal dimensions of calf and associated skeletal dimensions of dam; and differences in skeletal anatomy are highly heritable. Therefore, if the skeletal anatomy can be measured with precision and variation exists in dimensions of cows and calves, then this can be used as a partial solution to dystocia.

Although Laster (1974) reported a high relationship between dam pelvic size, dam weight and calf birth weight using many different crossbred dams and calf sires, other workers have reported low correlations between dam pelvic size and calf birth weight. Deutscher and Zerfoss (1983) found a .07 correlation between heifer precalving pelvic area and calf birth weight of 244 Hereford x Angus heifers all producing calves sired by one Red Angus bull. Price and Wiltbank (1978b) reported a .16 correlation and Bolze (1985) reported .05 to .08 correlations between heifer pelvic area and calf birth weight of two dam breeds. Correlations of dam weight with pelvic size and with calf birth weight were similar and fairly low (.22 to .34) in studies by Deutscher and Zerfoss (1983) and Bolze (1985). These results would indicate that pelvic size and calf birth weight have a low relationship. Therefore, selecting heifers with larger pelvic size should not increase calf birth weight.

Since heifer weight is not a good indicator of pelvic size, heifers of similar weight can have considerable different pelvic areas. In a group of replacement heifers of similar weight and breeding, pelvic size may vary by 50 to 60 cm^2. External dimensions such as width of hooks and length of rump are not good indicators of pelvic area or calving difficulty (Johnson et al., 1988). Therefore, internal pelvic measurements need to be taken.

Concern has been expressed on the accuracy and repeatability of pelvic measurements. Dr. Bob Short at Miles City, MT, (personal communications) indicates from their research the repeatability of pelvic measurements are about .85 to .90 between experienced technicians which compares to .8 to .85 for scrotal circumference. Repeatabilities within technicians were reported to be high (.91 to .90) by Holzer and Schlote (1984). The author's experience would support these findings. However, knowledgeable and experienced people need to obtain the measurements at the proper locations for accurate and repeatable results.

Neville et al. (1978) obtained pelvic measurements on heifers about every three months from 9 to 22 mos. of age and found a linear growth pattern in heifers calving as 2-year-olds. Johnson et al. (1988) and other workers have reported high correlations (.70 to .75) between yearling and 2-year-old pelvic areas. Therefore, prebreeding pelvic area could be used as an indicator of precalving pelvic area.

Nebraska Research

Research in Nebraska was conducted to investigate the relationship of dam pelvic area and calf birth weight. A ratio of dam pelvic area to calf birth weight was developed by dividing the dam pelvic area by the subsequent calf birth weight delivered. Since both traits have been found to influence dystocia independently, but really work in combination, a ratio of the two may give a better value to use in evaluating dystocia. Table 1 shows the relationship of pelvic area, calf birth weight and the pelvic area/calf birth weight (PA/BWT) ratio to calving difficulty score in about 400 Hereford x Angus 2-year-old heifers bred to Angus bulls.

Table 1. Variables Influencing Calving Difficulty

	Calving difficulty score[a]			
Variable	1	2	3	4 & 5
No. heifers	312	42	33	8
Precalving wt (lb)	822	819	833	812
Precalving pelvic area (cm^2)	231[c]	224[d]	228[cd]	222[d]
Calf birth wt (lb)	63[c]	71[d]	76[e]	81[e]
PA/BWT ratio[b] (cm^2/lb)	3.7[c]	3.2[d]	3.0[de]	2.8[e]

Deutscher and Zerfoss (1983).
[a]Scores were 1 = no assistance to 5 = Caesarean.
[b]Precalving pelvic area divided by calf birth wt.
[c,d,e]($P < .05$).

These results showed calf birth weight, dam pelvic area and PA/BWT ratio all significantly influenced degree of dystocia. The PA/BWT ratio had a linear relationship to calving difficulty score as did calf birth weight. Pelvic area was not linear because heifers in difficulty score 3 had large pelvic areas but larger calves and required assistance with a puller. This concerned many people. However, from experience and logic, we know that some large heifers (8% in this study) have very large calves and the calf is just too large to go through the pelvic area (the peg is too large for the hole). This extreme disproportion is explained by the PA/BWT ratio as shown in Table 1. This ratio appears to fit well with calving difficulty score. As previously discussed, other researchers have reported that calf size in relation to pelvic size determines amount of dystocia. Therefore, if we could accurately measure pelvic size and calf size, we could predict dystocia. Since determining calf size before birth is impossible at this time, we can only take the next best approach and estimate the calf birth weight.

Since the best time to identify heifers with small pelvic areas (or high potential for dystocia) is before breeding as yearlings, so breeding and management decisions can be made, further studies in this area were conducted. A yearling pelvic area and calf birth weight ratio was investigated and found to be significantly related to calving difficulty score (Johnson et al., 1988). A prebreeding PA/BWT ratio of 4.7 cm^2/kg or 2.1 cm^2/lb was found to be the pivotal point between calving assistance needed and no assistance. Heifers with ratios of 2.1 or greater in general had no difficulty while heifers with ratios of 1.9 or less had major difficulty (1.7 ratio = a caesarean). Therefore, these ratios may be beneficial in the selection of replacement heifers. Pelvic measurements can be obtained on a heifer before breeding and the pelvic area divided by a ratio (factor) to estimate the calf birth weight the heifer can deliver as a 2-year-old without substantial difficulty. For example, a 600 lb yearling heifer with a pelvic area of 140 cm^2 should be able to deliver, as a 2-year-old, a 67 lb calf without difficulty ($140 \div 2.1 = 67$). This ratio changes according to weight and age of heifer as shown in the tables in attached NebGuide (Nebraska Extension fact sheet) "Pelvic measurements for reducing calving difficulty". This NebGuide also discusses the management practices for using pelvic measurements and the instruments and for proper procedures obtaining the measurements. Therefore, these subjects will not be covered in this paper.

These ratios have been used on ranches in western Nebraska and monitored for usefulness and accuracy. On one large ranch with 900 heifers over a three-year period, the amount of calving difficulty was reduced in half by breeding the small pelvic size heifers (25%) to Longhorn bulls for small calves, while the adequate size heifers (75%) were bred to Angus bulls (Deutscher and Zerfoss, 1983). The relationship of PA/BWT ratio to calving difficulty score was as follows.

Calving Difficulty Score	PA/BWT Ratio
1 - no assistance	2.2
2 - hand pull	2.1
3 - puller needed	1.9
4 - hard pull with puller	1.8
5 - Caesarean	1.6

These ratios closely support the research results of Johnson et al. (1988) and the tables in the NebGuide. The accuracy of using these ratios have been generally between 75 and 80%.

Genetics of Pelvic Size Trait

Little research has been reported on the genetics of pelvic size until recent years. The heritability of pelvic size has been estimated by several workers and is summarized in Table 2.

Table 2. Summary of Pelvic Size Heritability

Researchers	Method/Animals	h^2 Est. ± SE
Benyshek and Little (1982)	Pat HS[a] Simmental hfrs	.53 ± .14
Holzer and Schlote (1984)	Pat HS Simmental cows	.36
Bolze (1985)	Pat HS Sim., Angus hfrs	.51 ± .22 .71 ± .31
Morrison et al. (1986)	Pat HS Angus, Here. cows	.68 ± .15
Nelsen et al. (1986)	Pat HS Hereford bulls	.68 ± .16
Green et al. (1988)	Pat HS Ang., Brah., Here., Sim. cows	.92 ± .16 .99 ± .24
	Average	.61

[a]Pat HS is paternal half sibs method of estimating heritability.

The range in estimates was .36 to .99 with an average of .61 which is quite high. This value is higher than the heritability estimate of .45 for calf birth weight and similar to the .58 for yearling weight. This means pelvic size should be transmitted readily from sire and dam to resulting progeny. Selection of sires for pelvic size should result in increased pelvic size of daughter offspring.

Nelson et al. (1986) pelvic measured 256 Hereford son-sire pairs and estimated heritability at .40 ± .13. Bolze (1985) studied 164 Simmental heifers from 12 sires which had been pelvic measured and reported h^2 = .37 ± .21. Daughter's pelvic area increased .19 cm^2 for each cm^2 increase in sires pelvic area. Neville et al. (1978) reported results on 202 daughter-dam comparisons in Angus, Hereford and Simmental herds and found h^2 = .24 ± .12.

Green et al. (1986) studied 900 heifer, cow and bull measurements and found the genetic correlation between male and female pelvic area was .60. They concluded that selection for increased male pelvic size should result in increased pelvic size of female progeny.

Beef producers have become very interested in the pelvic size trait but have concerns about what other traits are correlated with it. Nelsen et al. (1986) using 427 Hereford bulls reported genetic correlations of pelvic area to birth weight (-.29 ± .30), to hip height (.61 $\pm$ .24) and to scrotal circumference (-.17 $\pm$ .27). These results indicate near zero correlations except with hip height.

Nebraska research on 800 yearling bulls showed the phenotypic correlation of pelvic area to birth weight was low (.07), while correlations to yearling weight (.35), age (.28) and scrotal circumference (.26) were moderately positive (Johnson and Deutscher, 1986). These results would indicate that pelvic size and birth weight have little relationship so selecting for one should not give a corresponding response in the other. However, age, weight and frame score are positively correlated with pelvic size in bulls similarly to the data in heifers.

A total of 1600 bulls in test stations from four states was summarized by Missouri to calculate age and weight adjustment coefficients for pelvic area to allow for comparison of genetic potential of bulls (Siemens et al., 1989). Bulls were primarily Angus, Polled Hereford and Simmental and averaged about 385 days of age (300-450), 1140 lbs (700-1430) and 172 cm^2 pelvic area, with little difference in averages between breeds. However, much variation existed between bulls within a given breed (from 70 to 80 cm^2) indicating adequate opportunity for selection. The pooled across breed adjustment coefficient for age was .25 cm^2/day and for weight was .09 cm^2/lb. These values can be used to adjust a set of bulls to a given standard, but <u>both</u> age and weight adjustments should not be used on the same bull. For example, the formula for adjusted 365 day pelvic area = actual pelvic area, cm^2 + .25 (365 - actual age).

In summary, the following information has been reported on bull pelvic size.

(1) The heritability of pelvic size appears high so the trait should be transmitted readily to daughter offspring.

(2) No great average pelvic size differences have been found between British and Continental sire breeds of similar weight and age.

(3) Considerable variation in pelvic size exists within a breed so selection can be effective.

(4) Weight, age and frame score are positively correlated with pelvic size and adjustment factors for age and weight are available.

(5) Birth weight appears to have a low correlation with pelvic size so traits can be selected independently and both will respond to selection.

(6) Average pelvic size of yearling bulls weighing 1000-1200 lbs is in the range of 160 to 180 cm^2.

Conclusions

Brinks (1987) in a symposium paper stated the following conclusions on calving ease and pelvic measurements which agree closely with the previous literature review.

(1) Calving ease is an important economic trait and the heritability of pelvic area may be higher than calf birth weight.

(2) Taking pelvic measurements of heifers instead of relying solely on weight and skeletal size may be justified.

(3) Most genetic progress is made through sire selection. Selection for increased male pelvic area should result in correlated increases in pelvic size of female offspring.

(4) If female pelvic areas are increased and calf birth weights are held constant, it is logical to expect improvement in maternal calving ease.

(5) Pelvic measurements of yearling bulls and replacement heifers appear to be promising to increase pelvic area and enhance calving ease.

In the future, research is needed on culling thresholds for minimum pelvic height and width measurements; on refinement of pelvic size/calf birth weight ratios for various weights and ages of heifers; and on methods to more accurately predict calf birth weight. Research is also needed on the relationship between sire's pelvic area and the subsequent effect on his daughter's first calf calving ease. Pelvic measurements will be used more widely in the future because producers must have a practical method of reducing dystocia.

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COLLECTION, ADJUSTMENT METHODS AND USE OF LIVE ANIMAL ULTRASOUND DATA

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Introduction

In April, 1988, Texas A&M University initiated a beef cattle industry service program administered by the Texas Agricultural Extension Service. The Live Animal and Carcass Evaluation Program (LACES) is designed to collect ultrasound data on ribeye area and fat thickness on live cattle and carcass and beef product measures on slaughtered cattle using both objective and subjective taste panel evaluations. The purpose of this paper is to document the data collection, adjustment procedures and projected uses of ultrasound data by cattlemen. A database has been established with a cooperative contract with the American Hereford Association being the major source of live animal data.

Methods and Data Collection

The LACES program supports two fulltime ultrasound technicians that schedule on-the-farm visits to measure and record live animal data. Both technicians are experienced operators that use an Aloka 210 DXII real time linear array ultrasound unit equipped with a 3.0 MH_z probe. Fat thickness is directly measured during data collection while ribeye area is measured by use of audio visual tape that records the ultrasound ribeye image (split screen) that is later traced and converted to an actual measure. In addition to ultrasound measures the following data are also required on each animal:

1. Date of data collection
2. Animal identification - Breed - Herd
3. Sire identification (optional)
4. Weight of animal
5. Birthdate
6. Sex

Based upon an expected use of live animal ultrasound data for selection in yearling cattle, age should be between 330 days to 450 days. This is recommended for standardization to 365-days of age. Also, Mendel (1980) cited work from Hammond (1932) and Berg and Butterfield (1976) which defined protein development (muscle growth) as being linear up to about 350 kg of empty bodyweight. This relative weight is comparable to yearling bodyweight. Muscle growth does continue but at a decreasing rate as the animal matures. In addition Mendel (1980) stated that nutrition has little effect on the development of muscle as long as nutrition restriction is not prolonged and severe (i.e., for six months or longer).

There are evaluation problems with absolute measures of fat thickness, ribeye area and weight. Comparisons among individuals are influenced by age and weight development. Therefore, ribeye area data should be adjusted for known effects of age and weight. Fat thickness measures are not as easily evaluated since fat thickness can vary due to nutrition at various ages and weights.

The primary problem to consider in adjusting ribeye area for age and weight is based upon the fact that each animal has only a single ultrasound measure at a corresponding age and weight. There is no opportunity to consider an individual adjustment for age comparable to weaning or yearling weights since two weights or measures are required to calculate an individual slope. By using the contemporary records of several animals a regression of the response variable on age can be calculated and used to predict values at 365-days of age and at the actual age of an individual animal. By taking a ratio of the predicted values (estimated Y at 365 days / estimated Y at the actual age) a multiplicative adjustment factor is calculated that can be used on the actual record to yield the age-adjusted value. It is also possible to consider regression models or regression responses that are non-linear (quadratic) to adjust for more than one independent variable. This methodology was initially used on sample data sets to develop age-adjusted variables and to determine what variables might be used by cattlemen.

Variables

The initial data collected were classified by breed, ranch and sex with observed variables of birth date, age, weight (WT), ultrasound fat (FAT) and ultrasound ribeye area (REA). Additional input also included scrotal circumference, hip height and sire identification at the discretion of the cattleman. Original data were recorded in an individual file and ribeye area per hundred weight of live weight was calculated (REACWT = REA/WT*100).

Software for a personal computer was developed that calculated the linear regression of weight (WT) on age and a 365-day age-adjusted weight (AWT). Secondly, REA was regressed on age (linear) and a 365-day age-adjusted REA calculated as AREA. The variable, REACWT, was next adjusted for age by quadratic regression on age and the 365-day age-adjusted variable, AREACWT, calculated. Lastly, the AREACWT variable was observed to be negatively correlated with weight and fat so a third ribeye area variable, SREACWT, was calculated based upon the regression of AREACWT on AWT, FAT and the interaction, AWT*FAT. The SREACWT is a standardized ribeye area per hundredweight that reflects a 365-day age, AWT and FAT equal to the average values of the contemporary group. This measure is felt to reflect a more accurate measure of muscling relative to weight and also helps avoid the use of absolute values of AREA that are strongly correlated with weight.

The program was also designed to calculate the sire group means for the variables AWT, AREA, FAT and SREACWT.

Ultrasonic fat thickness was not adjusted for age since most data sets did not reveal any strong association. Certainly cattle on superior diets would be expected to have an association of fat thickness with age. Growing and development diets do not reflect this association in young cattle, especially bulls.

Results

An analysis of 469 yearling Hereford bull records provided by B and B Cattle Company, Connell, Washington, in cooperation with the American Hereford Association was used to validate the adjustment methods (Turner et al., 1989). Table 1 contains the descriptive statistics for the data set. It is noteworthy to point out that the relative variation, measured by the coefficient of variation, C.V., was relatively large for fat thickness. These bulls were developed on a grain based diet and were well conditioned at the time ultrasound measurements were made. There is evidence that the relative variation in REA is smaller than that observed for performance traits. However, there appears to be sufficient variation for effective selection response. Absolute measures of ribeye size, REA and AREA, had standard deviations of 1.19 and 1.16 (sq.in.) which would relate to roughly 6 square inches of difference in ribeye size in the yearling bulls. Koch (1980) reported the estimated heritability of loin-eye area as 50% which is an average of several reported studies. Field data have normally yielded lower heritability estimates than experimental herd data sets. However, current information would indicate that selection for ultrasound ribeye area would be effective with both a relatively high degree of heritability and phenotypic variation.

Table 2 contains the observed phenotypic correlation coefficients for the observed and calculated variables. Correlation coefficients among actual variables revealed REA was positively related to WT (r=.57) and REACWT (r=.24). There was no correlation of REA with FAT (r=.00). The correlation of WT and FAT was .33. The ratio variable, REA/WT x 100, was negatively correlated with WT (r=-.65) and FAT (r=-.39) and positively correlated with REA (r=.24). Therefore, using REACWT as a selection variable would favor lighter weight cattle of younger age. Calculation of the SREACWT variable showed it was positively associated with REA (r=.78), REACWT (r=.70), AREA (r=.81) and AREACWT (r=.76). The observed correlation coefficients of SREACWT with WT (r=.03), SREAWT with FAT (r=.07), SREACWT with AWT (r=.01) and SREAWT with AGE (r=.03) indicate that the adjustments were appropriate.

Figure 1 contains the linear and quadratic responses to WT regressed on age. Figure 2 illustrates the regression of REA on age. In both cases the linear models were biologically more correct. Considering the possibility of large uncontrolled age variation in other data sets, the quadratic models are recommended with wide age ranges. However, linear models appear best recommended in the age-controlled data sets.

Figure 3 illustrates the curvilinear response of REACWT in a quadratic model regressed on age. This variable is easily understood by cattlemen but biologically is difficult to use since it automatically favors lighter and younger cattle with higher ratio values. It was felt necessary to develop the SREACWT for comparison purposes. One important question is whether cattlemen will use this type of measure. Also, it is possible to adjust to a standard weight and fat thickness; however, initial efforts were to restrict comparisons to only the contemporary group so the adjustments were made to the average AWT and FAT values of the group. It is suggested that an acceptable range of SREACWT values be recommended to avoid selection for extreme muscling. A tentative range of 1.2 to 1.4 is considered applicable. The use of REA or AREA could easily lead to muscling emphasis to the extreme. More thought is surely needed. The LACES cover letter returned to cattlemen stresses the need for multiple trait selection. We have urged selection for growth performance first then attention to SREACWT.

Lastly, there are questions of the accuracy of ultrasound and whether visual estimation is comparable or equally applicable. Turner et al. (1989) reported on the accuracy of ultrasound with very positive results. However, evidence of technician skill was referenced. The simple consideration of an objective measure versus a subjective visual evaluation is of first importance. With further development of electronic equipment the use of ultrasound should increase. At present it seems advantageous to consider this application in order to select young cattle for muscling and to correctly assess fat content. It would be far less costly than progeny tests for carcass traits. However, research must continue to verify the utility and application of ultrasound data. It is also important to consider the advantages and disadvantages of selection for muscling in both sexes. It appears conservative to recommend use of ultrasound in bulls with limited consideration in heifers.

Summary

The use of ultrasound to estimate ribeye area and fat thickness simultaneously with known age and weight is recommended in young bulls between 330-450 days of age. Linear regressions of weight and ribeye area on age are recommended to adjust to a 365-day standard using multiplicative factors. Ribeye area per hundred weight of live weight is considered as a muscling variable and adjusted for age and to the mean weight and fat thickness of the contemporary group. This standardized measure is recommended for selection after consideration of growth performance. There are questions concerning ultrasound accuracy and the amount of emphasis to place on muscling in selection and if selection should be recommended in females. However, it is an objective technology that should be considered because it affords live animal evaluation at a young age and should be less costly in expense and time than progeny testing.

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TABLE I. DESCRIPTIVE STATISTICS

TRAIT	MEAN	S.D.	C.V. %
REA[a]	13.28	1.19	9.0
WT[b]	960.4	110.7	11.6
FAT[c]	.247	.062	25.6
REACWT[d]	1.39	.14	10.1
AREA[a]	13.49	1.16	8.6
AWT[b]	995.6	98.3	9.9
AREACWT[d]	1.36	.126	9.3
AGE[e]	350.8	25.7	7.0
SREACWT[d]	1.36	.100	7.4

[a]square inches
[b]pounds
[c]inches
[d]square inches per hundred weight
[e]days

TABLE 2. CORRELATION COEFFICIENTS BETWEEN ACTUAL AND 365 DAY AGE-ADJUSTED TRAITS*

Trait	WT	FAT	REACWT	AREA	AREACWT	AWT	AGE	SREACWT
REA	.57	.00	.24	.96	.35	.50	.27	.78
WT		.33	-.65	.44	-.51	.85	.52	.03
FAT			-.39	-.03	-.38	.32	.11	.07
REACWT				.36	.94	-.54	-.36	.70
AREA					.37	.52	-.02	.81
AREACWT						-.59	-.00	.76
AWT							-.01	.01
AGE								.03

* r values > .12 (P<.01)

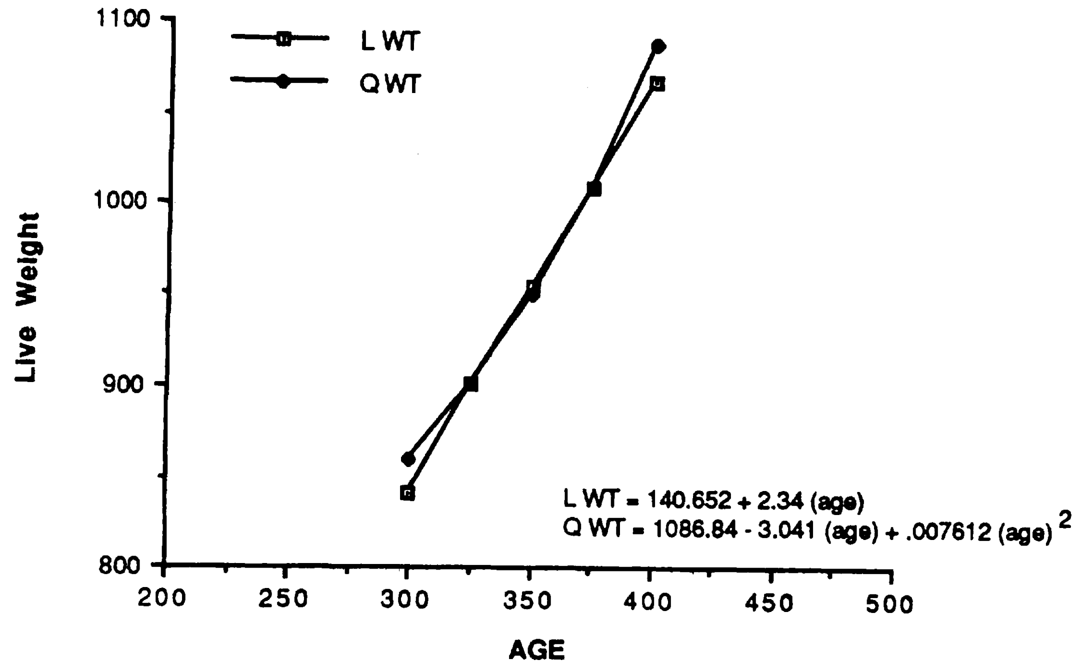

Figure 1. Regression Response of Weight on Age

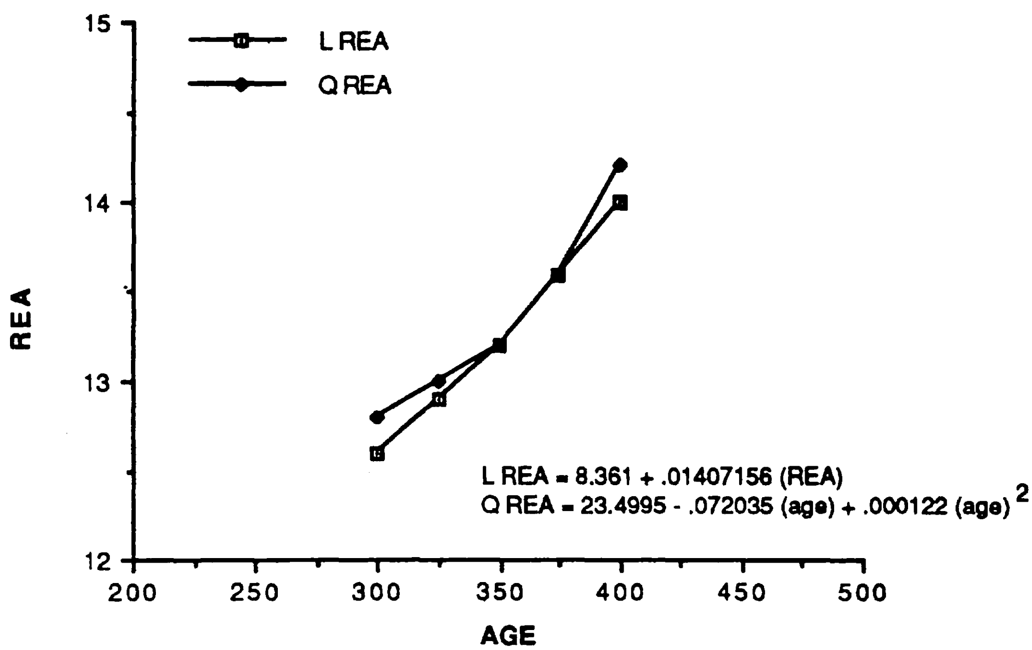

Figure 2. Regression Response of Ribeye Area on Age

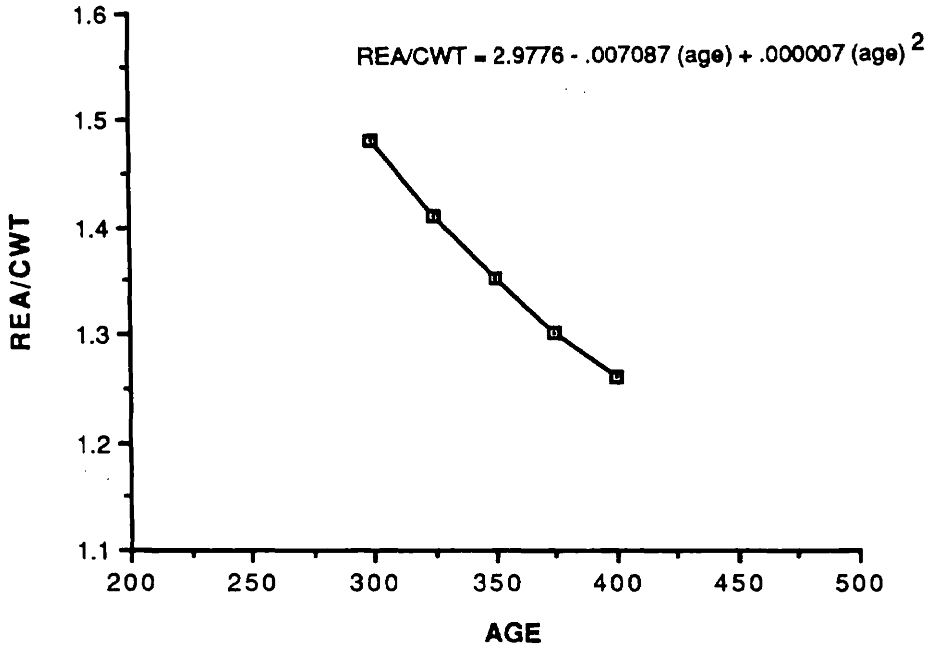

Figure 3. Regression Response of Ribeye Area Per Hundred Weight on Age

Ultrasonic training and proficiency- Update.

J. R. Stouffer
Professor Emeritus
Cornell University

Immediately after the 1988 BIF Meeting in Albuquerque the ad hoc committee on "Ultrasonic guidelines and recommendation" met and started aprogram on education and training. The committee consisted of Patsy Houghton, Kansas State University, Lorna Pelton, Texas A & M University and J. R. Stouffer, Cornell University.

An ultrasonic workshop was scheduled in July, 1988 at Cornell University just prior to the American Society of Animal Science Meetings at Rutgers University where a symposium, Animal Ultrasound Update, was conducted. A training session was held at Texas A&M University in October and the Ultrasonic Technician Proficiency Evaluation was held at Texas A&M University on January 21, 1989.

I would like to take the opportunity to emphasize a few points about the use of ultrasound for live cattle evaluation while I have an opportunity. Although we routinely get detailed carcass fat thickness, ribeye area and marbling information, we need to be reminded that this information can be greatly affected by workmanship even though we assume that it is very accurate. If the live ultrasonic measurements don't agree exactly with the carcass values we start to question the ultrasonic technique rather than question the accuracy of the carcass data.

In order for an individual to carry out a complete and accurate ultrasonic evaluation a number of items need to be considered. First, they must have a thorough knowledge of the animals anatomy in order to correctly place the ultrasonic probe as well as subsequently make the correct interpretation of the image. Another important item that is frequently overlooked is the careful and thorough preparation of the animals haircoat. Excess hair and dirt must be combed out to insure efficient transmission of the sound waves into and back form the underlying tissues.

Individuals need to have a thorough understanding about ultrasound, such as principles, how to produce a good image and how to make the proper interpretation and measurements. The individual needs to be accurate and repeatable which means that a standardised procedure must be followed at all times. After an individual has developed a rigorous standardised procedure there are three very important items which are: EXPERIENCE, EXPERIENCE and EXPERIENCE.

This includes many times following and learning form the experience of scanning live steers and following them through the cooler with detailed measurements and then scanning some more cattle and observing and tracing the ribeyes in the cooler.

With these guidelines firmly established I am confident that we will see ultrasound benefitting all segments of the beef industry in the future.

BIF ULTRASOUND TECHNICIAN PROFICIENCY GUIDELINES

Presented by Lorna Pelton, Texas A&M University

Recommendations by: Implementation Committee
John Crouch, Jim Wise, Dan Hale, Lee Haygood,
Jim Gibb, Dr. Larry Benyshek, Dr. Bill Turner

1. It is recommended that another ultrasound proficiency test be conducted in the fall, 1989. Any institution wishing to host a proficiency test may submit a proposal to BIF.

2. The recommended format will consist of
   a. a written exam
   b. live cattle measurement
      1. repeatability
      2. accuracy and correlation coefficient

3. The cattle will have large variation with respect to weight, frame, age, muscle and fat.

4. Until future demand warrants, only one BIF proficiency test will be held per year.

5. The following recommendations are made for the use of actual carcass data gathered for comparison.
   a. One qualified meat inspector and one meat scientist will take independent measurements on each animal and each side.
   b. The official measurement will be the average of both sides per grader, then the average of both graders' score for REA and fat thickness.

6. The statisticians involved have the option to look at variables, such as rank correlations, average error, standard error, variation and simple correlation.

7. Those technicians meeting BIF standards have demonstrated proficiency; however, it is recommended that they be retested every two years.

8. It is recommended that breed associations only accept data from technicians who have passed BIF testing procedures, effective January 1, 1990.

BEEF IMPROVEMENT FEDERATION
ULTRASOUND TECHNICIAN PROFICIENCY GUIDELINES
FOR DETERMINING FAT THICKNESS AND RIBEYE AREA
IN BEEF CATTLE

The BIF Proficiency Guidelines Implementation Committee:

Member of the BIF Live Animal and Carcass Evaluation Committee - John Crouch
Member of USDA Standardization Branch - Jim Wise
Member of Host University - Dan Hale
Breed Association Representatives - Lee Haygood, Jim Gibb
Statisticians - Dr. Larry Benyshek (University of Georgia), Dr. Bill Turner (Texas A&M University)

Advisory Committee:

Jim Stouffer, Patsy Houghton, Lorna Pelton

Who Should Attend and What is Required?

All individuals who wish to demonstrate proficiency in measuring ribeye area and fat thickness using ultrasound should attend.

A. General Knowledge Exam

Twenty-five multiple choice questions at four points each will be asked of each participant.

A study guide will be furnished to prospective technicians prior to the proficiency program.

A score of 80 percent or greater must be achieved in order for a participant to continue with the process.

The exam will be given by a proficiency implementation committee member.

B. Proficiency - Accuracy and Repeatability

1. Speed of Data Collection

Each participant will have twenty minutes to collect REA and fat thickness ultrasound data on five head. There will be a timer at each station checking in-time and out-time on each head for each person at each station. Measurements taken during this phase will be used in the next two parts.

2. Repeatability

Approximately thirty beef cattle differing in weight, frame, age, (cows, steers, heifers, and bulls), muscling and fat thickness will be used in this phase to determine repeatability with ultrasound.

Approximately twenty-five carcasses will be used in determining the final results.

The USDA member of the proficiency implementation committee will review each carcass in the cooler and on the slaughter floor and delete those considered to be improperly dressed and ribbed.

Each operator will measure each animal twice in one day.

The measurements between two sessions will be compared and a simple correlation coefficient of .85 or greater will be required.

3. Accuracy

The ultrasound images taken by each participant will be used to evaluate each participant's ability to get accurate measurements.

Accuracy will be determined by comparing ultrasound measurements with carcass measurements in all cases.

Two copies of each participant's video tape will be copied and held for future reference by two members of the committee. The host university will provide the video tapes for these two copies only.

Participants will take their tapes home to measure REA and fat thickness and will send their ultrasound measurements to the statisticians for repeatability and accuracy determination. Each participant then must send their ultrasound ribeye and fat thickness measurements to the two statisticians postmarked within one week after the proficiency exam.

Participants must bring their own equipment and video tapes or use equipment that they use routinely, but someone else owns. No equipment will be provided by the host university. For those participants who wish to measure their ultrasound images at the host university, a room will be provided for that purpose.

The mean difference between ultrasound ribeye measurement and actual ribeye measurement cannot be greater than 1.5 square inches.

The mean difference between ultrasound 12th rib fat measurement and carcass 12th rib fat measurement cannot be greater than .12 inch.

The correlation coefficient between actual measurements and ultrasound measurements must be .78 or greater.

CARCASE EVALUATION IN AUSTRALIA

ADDRESS TO BEEF IMPROVEMENT FEDERATION ANNUAL CONVENTION MAY 11-13, 1989

By
Alex McDonald, Coordinator
National Carcase Evaluation Project
Animal Genetics and Breeding Unit
University of New England
Armidale NSW 2350
Australia

This is my first visit to the USA and I have only been here four days. I want to say how much we Australians have appreciated your friendliness and willingness to share information and experiences.

I must say I came here to look and to listen and to ask questions. I had the good fortune to be talking to (visiting with) Dr. Cross' group from Texas A&M last night to listen and ask some more questions. About 11:00 p.m. Dan Hale turned to me and said "Now that you have asked so many questions, how about you tell us a little about what is happening in Australia -- in 5 minutes!"

So here I am and I'll do my best. I haven't had much time to prepare the excellent slides that have been used by the previous speakers and I hope you have listened to Paul Hogan enough to be able to interpret my Australian accent.

Firstly a little background on the Australian beef industry. As well as kangaroos, koalas and a few crocodiles we have 22 million cattle. We export about 620,000 tonnes of beef per year, or about 60 per cent of our production. The major importers of Australian beef are the USA, Japan and Canada. We also import a considerable amount of genetic material from the USA and Canada.

We have a National Beef Recording Scheme (NBRS) which is basically a self funding body. The NBRS provides the pedigree recording service for 25 of our beef breed associations. It also provides the only genetic analysis system in Australia using BLUP technology similar to that used in the USA to produce your sire summaries. There are about 900 purebred herds of many breeds using this service.

We currently analyze growth and growth-related traits and in the near future will be introducing both male and female fertility traits. Our breeders are also very keen to have carcase traits introduced to the system as soon as possible.

The National Carcase Evaluation Project was commenced in early 1989 and is funded to a level of about half a million dollars over the next two and one-half years. This funding comes from producer levies which are matched on a one-for-one basis by the Government.

The major objective of the project is to produce EPDs for carcase traits.

The major challenge is to get enough accurate, unbiased data to allow this to happen and it is my job to make sure it happens.

We have two problems. Firstly, it is difficult to get individual animal carcase data back from the packer. Secondly, our bull breeders, like yours, only want to slaughter their cull animals which can produce very biased evaluations of sires and dams.

We therefore have two options. We can use designed progeny tests, and we have some of them underway, especially to find some sires that will give us the sort of marbling levels we require to supply the Japanese market. We can also use live animal measurements using ultrasound technology which allows us to collect data on the whole drop of progeny without the need to slaughter. We plan to use this technology extensively.

What progress have we made?

In February we were fortunate to have Lorna Pelton in Australia for a week to help us run an intensive training course for potential contract scanners. In April we ran our first accreditation or proficiency clinic. We now have some accredited contract scanners collecting cacase data from some of the 900 herds using our performance system.

We are as concerned as you are about the need to maintain high standards of scanning accuracy for the following reasons:

a) Phenotypic data will be used in sale catalogues either as raw data or preferably as an index as proposed by Dr. Turner, and it should be as accurate as possible.

b) The data used for genetic analysis also needs to be accurate.

c) It is very important that the credibility of ultrasonic scanning technology is not damaged by careless operators.

We have cloned our accreditation system from that used at the Texas A&M proficiency test and we are very grateful to them for allowing us to learn from their experiences. We are serious about accreditation as demonstrated by the fact that we have accredited only three people of the seven who undertook the first clinic. Our goal is to obtain enough good data to allow us to calculate the parameters required to produce the first EPDs for carcass traits in Australia by early 1990.

To do this we aim to have accurate scan data on 5000 animals by October this year. To ensure that we get unbiased data we are offering in the short term a per head dollar incentive to those breeders who use accredited scanners to scan at least 90 per cent of their 1988 born calves or at least 90 per cent of one sex (male or female).

I believe we will achieve our goals.

One thing before I finish. We Australians have a little competitive spirit. You would have noticed that we have won the odd boat race. There is a small group of Australians here at the conference and I was wondering what sport we might challenge you to. I first thought of gridiron football but we don't understand the rules and it looks a little rough. Then I thought of basketball. Our "Aussies" went pretty well in the Olympics and Australia's Andrew Gaze almost won the final of the college competition for Seaton Hall. Then I looked at our average height and decided that we were a bit short. I have watched a few games of baseball on television and that little white ball goes a bit too fast for us. So it looks like cricket. Now I know you don't play much cricket here, so I'll just outline the basics. You normally need 11 players but we can negotiate on that. Don't worry about the rules; we will explain those as we go along. However, I should warn you that if you are any good at the game we may have to play for five days before we decide there is no winner! On behalf of the Aussies I hereby challenge you to a game of cricket at the BIF Conference.

Finally, I want to tell you that we are holding the first national conference of the Beef Improvement Association of Australia in September this year. (Our BIA is a similar organization to your BIF). I invite you to come to the conference in Australia and allow us to return some of the wonderful hospitality you have provided for us.

Thank you.

EPDs FOR GROUP-TESTED BULLS IN ONTARIO

J.W.Wilton, E.P. de Rose and S.L. Armstrong
Centre for Genetic Improvement of Livestock
University of Guelph, Ontario, Canada

Ontario Bull Test Program: The Ontario bull test program is a government sponsored program designed to promote the selection of genetically superior bulls as herdsires. Bulls must meet strict requirements for entry into test stations. All animals must be dehorned, weaned and started on concentrate at least three weeks prior to delivery to stations. Vaccines for IBR-PI3 and clostridia and treatments for lice and warbles, in season, must be administered. The first month in the station enables bulls to adjust to feeding and grouping procedures before beginning the official 140 day test. Average start of test age is 240 days, with animals within any one test group not exceeding a 90 day age range. Bulls are fed a variable, often pelleted ration of minimum 65% TDN. Table 1 contains numbers of groups and bulls in the program in 1988; Table 2 outlines breed representation.

Traits: Weight is measured at 28 day intervals during test, and gain on test is calculated using a regression of these repeated weights. Average daily gain has been reported as a phenotypic index, allowing comparisons across test groups and breeds. EPDs for absolute gain on test will be introduced in July, 1989. End of test measurements of ultrasonic backfat thickness, scrotal circumference and hip height are taken on all bulls. Although sample EPDs for these traits have been calculated, such EPDs will not be introduced for general use. While backfat is an important trait, reporting end-of-test or yearling backfat EPDs does not complement a constant finish endpoint system. Work is proceeding at the University of Guelph to obtain prediction equations for weight and days to Agriculture Canada A1 finish (4-9 mm backfat). EPDs will be introduced when reliable prediction equations are available. Scrotal circumference is an indicator of bull fertility at time of measurement, but research has not shown that selection for increased scrotal size is necessarily a desirable goal. Since publishing an EPD for scrotal circumference would encourage positive selection for scrotal size, such evaluations will not be produced. Rather, an adjusted value suitable for threshold culling will be provided. Hip height is a highly heritable trait which often receives undue selection pressure. EPDs for height will not be provided, for the authors believe that aiding such selection practices will not contribute positively to the industry.

Herd Test Program: The majority of bulls consigned to test stations originate from purebred herds. Upon completion of test, bulls return to both purebred and commercial herds as herdsires. Some bulls enter AI studs, and are used mostly on purebred cattle. Many Ontario herds, both purebred and commercial, are enrolled in a herd test program. Calving ease, birth weight, weaning gain, and heifer post-weaning gain are recorded. All weaning and post-weaning weights are supervised. Approximately 3,500 herds were enrolled in 1988, and over 120,000 weaning weights were taken. Data from the herd test program is available for the majority of tested bulls, and for the calves of tested bulls which become herdsires.

Importance of Central Testing and EPDs: Central bull test stations are considered an important part of the genetic improvement programs in Ontario. Traits measured in central stations are heritable, repeatable and economically important. Furthermore, comprehensive data collection, including backfat, feed intake and live animal measurements, can be most conveniently undertaken at central stations. Even with advanced genetic evaluation procedures, bull test stations will play an important role in beef improvement, for herds are too small and currently too poorly linked, genetically, to enable effective comparisons from on-farm testing. Advanced genetic evaluations can greatly enhance central testing programs. Because average genetic quality of bulls differs across test groups, an evaluation which simultaneously considers group effects is required to accurately compare bulls across groups. Use of information on relatives also enhances the accuracy of genetic evaluations. The use of a two trait evaluation, considering both gain to weaning and gain on test, allows for consideration of the selection of bulls entering test stations and for the effects of pre-test environment. Both these factors have been shown to affect the ranking of bulls based on post-weaning gain, despite the generous adjustment time allowed at start of test (de Rose et al., 1988). Thus bull test programs have much to contribute to genetic improvement in beef cattle and EPDs enhance that contribution.

Ontario Evaluations: Data collected from the herd and central test programs is sent to the University of Guelph by the provincial government. Breed Associations also contribute data directly to the University's database. EPDs are calculated at the University and sent to the Ministry for communication to producers. The target evaluation will involve a two-trait animal model with relationships considered. Breed, herd-year and test group will be included in the model. Different genetic parameters will be used for different breeds. EPDs will be calculated from a full run, involving the approximately 20,000 animals in the database, each time a group completes test.

EPDs will be reported as a deviation of absolute gain from breed average. A three year rolling base will be used. In addition, an ABC (Across Breed Comparison) will be reported. This value will be the deviation, in absolute gain, from overall across breed average. EPDs will be accompanied by accuracies and by information on the bull from the herd test program.

Analyses show correlations of .70 and .87 between single trait ABCs and absolute gain and phenotypic gain indices, respectively. Past analyses, involving sire-maternal grandsire models have shown a 5% decrease in correlations with the introduction of a two trait model. Thus considerable reranking will occur with the use of EPDs as a means of evaluating station tested bulls. With the accuracy of EPDs, appropriate timing of evaluations, and acceptable selection intensity, considerable genetic progress will result.

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Table 1. Numbers of groups and bulls in the Ontario bull test program in 1988, by station type.

Station Type	Groups	Bulls	Average Bulls/Group
Contract	27	2,442	90
Government	3	215	72
Private	36	1,000	28
	66	3,657	

Table 2. Breed representation in Ontario test stations in 1988.

Breed	Bulls
Aberdeen Angus	175
Blonde d'Aquitaine	37
Charolais	613
Hereford	912
Limousin	702
Maine Anjou	21
Red Angus	69
Salers	30
Shorthorn	108
Simmental	501
Other	489
Total	3,657

IDENTIFYING, QUALIFYING AND MERCHANDISING CALVING EASE SIRES AT CENTRAL TEST STATIONS

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Today in central test programs there is a lot of emphasis placed on growth rate. Bulls with high growth EPD's sire most of the bulls in many test stations. Due to the genetic relationship between growth and birth weight, it is becoming increasingly difficult to find bulls in tests that can be recommended for use on heifers. Therefore, some bull buyers are perplexed and are not coming to the bull test to purchase bulls. Some test stations have made an attempt to help bull buyers in identifying potential calving ease sires.

Since it is difficult for calving ease sires to compete with growth emphasis sires in average daily gain and yearling weight, test stations in West Virginia, Tennessee and Wisconsin have instituted new programs to insure that the test stations have a complete offering of both calving ease and growth sires at the central test sale. These programs have developed special groups of calving ease bulls that compete under different rules.

Birth weight EPD's were the major criteria used in identifying calving ease sires. One objective of these programs was to educate bull consignors and buyers on the use of EPD's. EPD's were used instead of actual birth weight since actual birth weights can be heavily influenced by environment and within herd methods of measurement. Since EPD's are based on contemporary group comparisons, they should do a better job of identifying low birth weight bulls.

In Tennessee and West Virginia, Angus bulls were accepted for the calving ease program if their birth EPD was less than +2.5. At the Tennessee test station at least 5 bulls were required to form a low birth group. To qualify for the sale a low birth weight bull had to ratio in the top 80% of the low birth group on ADG and 365-day weight or have a ratio of at least 90 when compared to all Angus bulls at the test.

At the Wisconsin test, maximum birth EPD's were +2.5 for Angus, 0.0 for Polled Hereford and 0.0 for Simmental. To qualify for sale low birth weight EPD bulls were required to have a combined index of at least 92. Other bulls in the test were required to have an index of at least 97 to sell.

In West Virginia, 31 of 112 Angus bulls in the test met the qualification for the calving ease program (Table 1.) In Tennessee, 6 Angus bulls of 35 qualified (Table 2.) In Wisconsin only 2 Angus bulls out of 57 met the standards for the low birth group. Eight of 35 Polled Herefords qualified with 5 making the sale. Six out of 68 Simmentals qualified with 4 meeting sale requirements.

Sale procedures varied with stations. In Wisconsin, low birth weight EPD bulls were the first bulls to sell within each breed. In Tennessee, low birth weight EPD bulls were sold after about 1/3 of the high indexing bulls. In West Virginia, bulls that met the standards were marked in the catalog with the words "Calving Ease" in bold print.

These programs were well received by buyers at the test stations. Stations that have tried these programs plan to continue them. Table 3 shows that fast gaining, large frame bulls continued to bring the best prices in West Virginia. However, bulls with low birth weight EPD's sold very well when compared to other bulls of the same frame size (Table 4).

It has been suggested that referring to these bulls as "heifer bulls" or "calving ease bulls" is not an accurate description, since there are breed differences and differences in the cows these bulls will service. Since the major criteria for qualification is a low birth weight EPD, referring to the bulls as "low birth EPD bulls" is probably the most accurate description. Comments were also made about considering other traits for special groups of bulls. These are certainly possible. Birth weight was singled out because it was perceived as the biggest single problem.

Table 1. General Description of Angus Bulls in the West Virginia Bull Test.

Item	< 2.5 lbs	> 2.5 lbs
No.	31	81
Percent in Sale	77.4	67.9
Av. Birth Wt. EPD	1.5	4.2
Av. ADG Ratio	100.8	99.4
Av. Yearling Weight Ratio	99.7	100.1

Table 2. Low Birth Weight EPD Angus Bulls Vs. Other Angus Bulls at the 1988-89 Senior Bull Test, University of Tennessee.

	Low EPD	Other
Number	6	29
Avg. Birth EPD	+1.6	+5.8
Avg. Sale Price	$1675	$1935
112 Day ADG	4.42	4.56
ADJ 365 Day Wt.	1118	1188
Frame Score	4.9	6.3

Table 3. A Comparison of Price and Various Performance Traits Between Frame Sizes in the West Virginia Bull Test.[a]

Trait	No	Price, $	Birth Weight EPD	Milk EPD	ADG Ratio
Frame:					
< 5.0	8	1388	2.4	5.0	102
5.0 - 5.4	14	1579	2.3	4.0	104
5.5 - 5.9	19	1796	3.3	4.2	105
6.0 - 6.4	19	1832	3.7	2.9	106
6.5 - 6.9	10	2283	4.3	2.6	104
7.0 +	6	2500	4.9	4.6	108

[a] Angus bulls sold in the 1989 Wardensville sale.

Table 4. A comparison of Price and Various Performance Traits Between Designated Calving Ease (CE) and Other Angus Bulls Within Frame Size at the West Virginia Test.

	Frame Size							
	< 5.0		5.0-5.4		5.5-5.9		6.0-6.4	
Trait	CE	Other	CE	Other	CE	Other	CE	Other
No.	5	3	9	5	5	14	4	15
Price, $	1440	1300	1553	1625	2320	1609	2219	1728
Birth Wt. EPD	1.2	3.2	1.6	3.3	1.7	4.6	1.2	4.3
Milk EPD	4.3	8.0	3.5	5.4	3.9	4.0	4.7	2.4
ADG Ratio	100	103	102	108	105	105	117	106

EXPECTED PROGENY DIFFERENCES
(WITHIN BREED COMPARISONS)

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Introduction

The purpose of a genetic evaluation program is to synthesize the often vast and varied information available on an individual into one number which can be used for ranking animals. In the beef industry, this number is called the expected progeny difference (EPD). The genetic theory used in the current systems is called best linear unbiased prediction (BLUP). Following BLUP theory provides the appropriate weights to be used for each of the sources of information, hence, not only is various information on an animal and its relatives used, it is used with the appropriate genetic weights to obtain the EPD's.

The purpose of this presentation is to describe EPD's for use in within-breed comparisons. Attention will be paid to 1) what EPD's predict biologically, 2) some of the features of the genetic evaluation systems used to obtain EPD's, 3) the accuracy of the EPD's, and 4) the genetic base.

What an EPD predicts

An EPD predicts the transmitting ability of an animal as a parent. Genetic material is transmitted from parent to offspring via that parent's gametes. The gametes are the sperm in males and the ova in females.

Bovine have 30 pairs of chromosomes which carry the genetic code for the animal's potential to perform. During the formation of gametes, one chromosome from each pair is randomly sampled. The gametes then carry one chromosome from each pair, 30 chromosomes in total. Each chromosome has a genetic value determined by the genetic material that it is carrying, and the progeny's performance reflects in part that value.

Because of the random process by which a chromosome from each pair is obtained by the gamete, different gametes from the same parents carry different genetic material. Hence, gametes differ in genetic value. The average genetic value of the gametes produced by a parent is that parent's transmitting ability. Remember, the EPD predicts the transmitting ability, hence, the EPD is a prediction of the average genetic value of the gametes produced by a parent.

The term EPD stands for expected progeny difference which suggests a comparison. That is exactly how expected progeny differences are intended to be used. Consider an example using weaning weight. Assume the EPD for bull 1 is +30 lb and the EPD for bull 2 is 10 lb. The difference between bull 1 and bull 2 is 20 lb at weaning. This means we expect the progeny of bull 1 to differ on average by 20 lb more at weaning than those from bull 2. The 20 lb reflects the difference in the average genetic value of the gametes produced by each bull.

Estimating EPD's

Expected progeny differences are obtained from genetic evaluation systems based on BLUP theory. There are many desirable features of the systems currently being used to obtain EPD's. These features include simultaneously estimating EPD's for direct and maternal traits where appropriate, incorporating all relationships among animals being evaluated and utilizing information from correlated traits in multiple trait evaluations.

Traits such as weaning weight are influence by two genotypes, that of the calf and that of the dam. Hence, it is appropriate to obtain both an EPD for direct growth as well as one for the maternal contribution. Direct growth EPD's estimate the value of the genes passed to the progeny which directly influence that progeny's ability to grow. Maternal evaluations estimate the value of genes in the dam which influence her ability to provide a maternal environment for the calf. All national sire summaries have evaluations for both direct and maternal contributions for weaning weight. Producers can determine not only the impact the bull will have on the current calf crop, but also the impact his daughters will have on future calf crops when they join the herd as replacement females.

All current systems incorporate relationships among the animals being evaluated. Related animals share genes in common. Performance in one animal provides information on the genes in that individual as well as information on all animals related to it. Incorporating relationships means EPD's reflect not only an animal's own performance but that of all his relatives as well.

The more closely related the animals are the more valuable their information is to the relative. For example, a parent and progeny share one-half of their genes in common. An individual and its grandprogeny share on average one-fourth of their genes in common. Records on progeny have more influence on an individual EPD than records on grandprogeny. The current genetic evaluation systems appropriately weight the information from the different relatives in estimating the EPD of the individual.

Several of the current systems are multiple trait systems. A multiple trait evaluation system is one in which estimates of EPD's are obtained simultaneously for more than one trait. If two traits are correlated, information on one is useful in predicting the EPD for the other trait. For example, there is a positive correlation between weaning weight and yearling weight. Information on an animal at weaning provides information on that same animal for yearling.

A genetic correlation occurs between two traits when the same genes influence both traits. This is easy to understand for the weaning weight/yearling weight example. Genes which influence an individual's ability to grow from birth to weaning probably continue to influence the individual's ability to grow from weaning to yearling. The expression of these genes for both traits causes the genetic correlation.

An additional feature of the genetic evaluation programs used for beef cattle is the ability to account for merit of mates. This means the evaluations obtained, for example, on a bull is adjusted for whether or not that bull was mated to a particularly good or poor set of females. Since many producers practice nonrandom mating of sires and dams, this adjustment is important.

Accuracy

Expected progeny differences are estimates of transmitting abilities that are based on varying information from one individual to the next. Hence, the accuracy with which each EPD is estimated also varies. For individuals with alot of information, which usually means many progeny, the accuracy of the EPD estimate is quite high. For individuals with limited information, the accuracy of the EPD may be low.

For each evaluation, an accuracy is obtained. These are published along with EPD's. The measure of accuracy most used in the beef industry is referred to as the BIF (Beef Improvement Federation) accuracy value. This value ranges from 0 to 1. The closer the value to 1, the better the accuracy. The interpretation of the BIF accuracy is quite simple. It is a measure of uncertainty removed in estimating an animal's EPD by the information available. An accuracy of .4, for example, means that 40% of the uncertainty or risk associated with that estimated merit has been removed by the information available. An accuracy of .8 means that 80% of the uncertainty has been removed.

The advantage of using the BIF accuracy is that the value means the same for each trait. That is, a .4 accuracy means that 40% of the uncertainty has been removed regardless of whether we are looking at birth weight, weaning weight, or yearling weight.

Although the accuracy values published with EPD's reflect the amount of information available, it is not intended to be a value upon which selection decisions are based. If an individual has an EPD in line with the goal of the producer's breeding program, that bull should be used regardless of his accuracy. That is, the selection decision is based on the EPD. The accuracy figure can be used, however, to determine the extent to which that bull might be used. A producer may wish to limit the use of a bull with a low accuracy, whereas a bull with the same EPD but higher accuracy may be used more extensively.

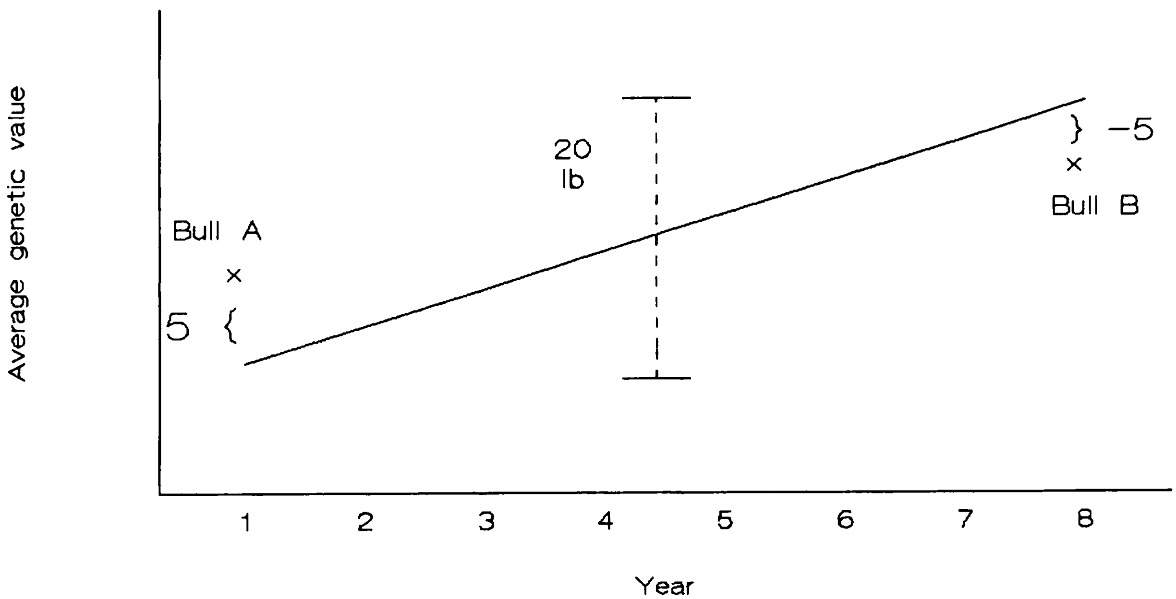
Genetic Base

It has already been pointed out that the proper use of EPD's is to compare them among animals within the same breed. Quite often, however, questions arise as to why the distribution of EPD's varies from one breed to the next. For example, for some breeds, almost all of the EPD's for a trait are positive while in another breed they may seem to be centered on zero with approximately as many negatives as positives. Likewise, the temptation exists (as evidenced by the symposium) to compare the EPD of an animal in one breed to that of an animal in another breed. To address these questions requires an understanding of the concept of a genetic base.

A genetic base can be defined as a group of animals whose EPD's average zero. This group of animals can be arbitrarily defined. For example, they can be animals born in or producing in the first year data were available, the last year data were available or for that matter any year data are available. The base can be defined by cows or bulls (or both) born in the year of choice. Although the choice of a base is arbitrary, once it is set, all EPD's are relative to that base.

The influence of a base on the distribution of EPD's will be shown by example in Figure 1.

Figure 1. Genetic trend in a population.



In this figure the average genetic value of the animals born each year is increasing due to selection. Bull A is an above-average bull born in year 1 (assume 5 lb better when compared to all bulls born that year), and Bull B is a below-average bull born in year 8 (assume 5 lb worse when compared to all bulls born that year). However, because of genetic trend, Bull B is superior to Bull A and we will assume this superiority is 10 lb since genetic progress has changed the population by 20 lb. If a base is set such that all animals born in year 1 average zero, the EPD of Bull A would be +5 and of Bull, +15. With this base, it is not hard to envision why most animals' EPD's would be positive. Now assuming year 8 was selected as the base year, the EPD's of A and B would be -15 and -5, respectively, and most EPD's would be negative. Quite a difference! Finally, a base chosen in the middle years would tend to give approximately equal proportions of positive and negative EPD's.

The actual values of Bull A and B's EPD's change dramatically with changes in the base. But remember, the bulls produce exactly the same gametes regardless of the base chosen. Their genes do not change! It is simply what gametes, chosen to represent the base, they are compared to. More importantly, however, the comparison of A with B is unaffected by the base as shown by the following table.

	EPD's		
Base year	Bull A	Bull B	Difference
1	5	15	10
8	-15	-5	10

The average difference in the gametes they produce is 10 lb regardless of the base.

Summary

The beef industry has undergone dramatic changes relative to the genetic evaluations. The current systems are based on best linear unbiased prediction theory. They synthesize the various information available on an individual and its relatives into one value which is relatively easy to use and understand. That value is called the expected progeny difference. The EPD estimates the average value of an individual's gametes. The difference between EPD's on two animals predicts the expected difference in the performance of those animals' progeny.

The current systems have several desirable features. They allow for the simultaneous estimation of EPD's for both direct and maternal effects where appropriate. They incorporate the use of all relationships among the individuals being evaluated. Some systems utilize information on correlated traits in multiple trait evaluations. All systems account for nonrandom mating.

Since animals being evaluated may have differing amounts of information, the estimate of their EPD varies in accuracy. Along with each published EPD is a value which ranges from 0 to 1 and indicates the level of accuracy associated with that EPD. Higher values indicated higher accuracy.

Al EPD's are calculated relative to a base. The choice of a base is arbitrary; however, once chosen, the distribution of EPD's is established. Although the magnitude (and perhaps even the sign) of an animal's EPD is influenced by the choice of a base. The difference between two EPD's does not change.

Understanding expected progeny differences is rapidly becoming a requisite for successful cattle breeding and merchandizing. The ability to predict the expected difference in performance of the progeny of two potential parents has helped to quantify the worth of potential breeding animals.

EPD'S FOR USE ACROSS BREEDS

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Introduction

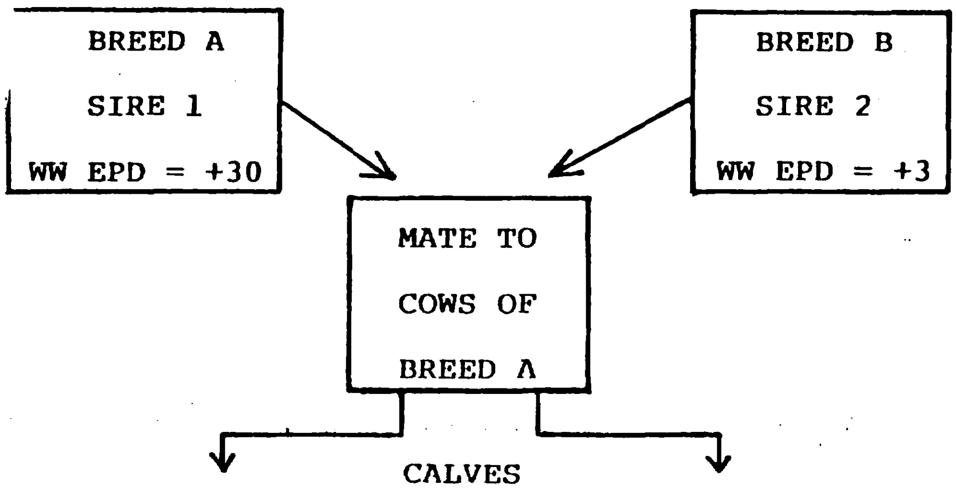
The widespread use of EPD's in selection programs represents one of the great success stories of beef cattle breeding. In most of the major breeds, we now have in place a system for comparative genetic evaluation of large numbers of animals for an array of production traits. Emphasis is still on selection of proven sires, but use of the animal model has also facilitated evaluation of cows and young bulls within the breeds.

A parallel important development in commercial beef cattle breeding has been the widespread implementation of designed crossbreeding programs. These programs allow commercial producers to utilize hybrid vigor in their herds, and, equally importantly, provide a means to combine genetic material from several breeds to meet the unique needs of specific production-marketing situations.

As commercial producers become more sophisticated in the design of crossing programs and in their knowledge of EPD's, progressively more interest has been generated in ways to combine these two technologies to more effectively design specification seedstock appropriate to different production environments. Most commercial producers recognize that differences do exist among existing breeds in mean levels of performance for different traits. They also recognize, however, that there is a great amount of variation within existing breeds, and that, over the past 10 to 15 yrs, uniformity of selection goals among breeds has probably tended to make our breeds more similar instead of accentuating their differences. Thus, confusion exists regarding the levels of performance that can be expected, for example, from high-growth-EPD British cattle compared to medium-to-low-growth-EPD Continental European breeds.

Due largely to the educational efforts of BIF, the state BCIA's and the breed associations, progressive commercial producers have begun to look to the EPD system for assistance in making between-breed as well as within-breed selection decisions. We have long emphasized that existing EPD's are directly applicable only within breeds, and that is unequivocally the case today. Use of within-breed EPD's to compare bulls of different breeds would, therefore, require additional information on mean breed differences in the environments of interest, on the reference base (zero EPD point) for the breeds, and on the expected effects of heterosis when the candidate bulls are used on available females. An example of the necessary calculations is shown in figure 1.

The purpose of this presentation is to discuss the possibility and advisability of attempting to formalize procedures to facilitate selection of sires from multiple breeds for use in crossbreeding. The remainder of



Breed constant	0	+20
Base adjustment	-10	0
EPD	+30	+ 3
Heterosis	0	+15
Total	+20	+38

Figure 1. Example of calculations required to predict progeny weaning weight for two bulls (sire 1 and 2) of two breeds (A and B).

the discussion will focus on procedures and complications associated with use of available data to make the kinds of calculations shown in figure 1.

Information Required for Between-Breed EPD's

Let us first list the information required for the calculations in figure 1 and then consider the availability of reliable estimates of the required parameters. These include: (1) breed constants appropriate to the breeds of interest and to the environments and mating systems being considered; (2) knowledge of the reference base (zero EPD point) for each breed; (3) sire EPD's appropriate for prediction of crossbred performance; and (4) heterosis adjustments which would potentially differ among crosses.

Prediction of heterosis effects. A substantial number of studies have estimated effects of heterosis for a variety of traits in cattle (Gregory et al., 1965, 1966, 1978a,c,d; Gaines et al., 1966, 1978a,b; Cundiff et al., 1974; Sagebiel et al., 1974; Peacock et al., 1978, 1981; Long et al., 1979a,b; McElhenney et al., 1986). For *Bos taurus* breeds, differences in level of heterosis have occasionally been observed for different crosses, but are generally not consistent, suggesting that for growth and maternal traits, reasonable average expected heterosis values could be derived and used to predict crossbred performance for these breeds. In contrast, crosses involving *Bos taurus* and *Bos indicus* (Zebu) breeds are known to result in more heterosis than that expressed in intraspecific crosses (Franke, 1980; Peacock et al., 1981; Comerford et al., 1987) and separate tables of heterosis values would be required for these crosses.

Use of Within-Breed EPD's in Crossbreeding. The main issue here is whether or not within-breed EPD's derived from purebred matings can be used to accurately rank sires for use in crossbreeding. Specifically, this issue relates to the importance of sire x breed of dam interactions.

Ruvuna and McDaniel (1983) clearly demonstrated that sire predicted differences for milk yield in dairy cattle were equally expressed in purebred or crossbred matings. In beef cattle, Benyshek (1979) investigated sire by breed of dam interactions for weaning weight in Limousin field data and reported that significant interactions did exist when Limousin sires were mated to Angus or Hereford dams. The repeatability of sire performance when sires were mated to the different dam breeds was approximately .60. In a somewhat different analysis, Massey and Benyshek (1981) reported genetic correlations of .81 for birth weight, .78 for weaning weight and .57 for yearling weight for Limousin sire performance when sires were mated to Angus or Hereford dams.

Mahrt et al. (1989) estimated the genetic correlation between Polled Hereford sire performance in the purebred herds used to generate sire summary EPD's and in crosses with Angus cows. Genetic correlations were .78 for birth weight, .61 for weaning weight and .93 for yearling weight. Thus, some reranking of sires in crossing may have occurred for the maternally influenced birth and weaning weights, whereas the genetic correlation for yearling weight was very close to one. All correlations were relatively large and positive, and changes in relative sire performance for preweaning traits may also have reflected environmental differences between the purebred herds and the experimental herd used in the crossbreeding study.

The uniformity of sire performance in matings with different dam breeds can be most easily interpreted when compared to results of similar studies on the consistency of sire EPD's among regions and herds within regions. Several such studies have been performed. In some cases, sire by region interactions have been observed (Buchanan and Nielsen, 1979; Bertrand et al., 1985); in others, sire x region interactions have been nonsignificant (Tess et al., 1979; Burfening et al., 1982; Bertrand et al., 1987). In cases where significant sire x region interactions were observed, genetic correlations between sire performance in different regions were generally still .60 or larger, although Buchanan et al. (1979) reported a between-region genetic correlation of .32 to .35 for birth and weaning weight in a Simmental data set specifically comparing Texas and Montana herds. These values for genetic correlations of sire performance across regions are thus generally similar to those reported across dam breeds.

Almost all the studies described in the preceding paragraph have observed significant sire x herd interactions within regions which are presumed to involve interactions with random herd effects rather than with fixed, identifiable regional differences. Thus, we usually view within-breed EPD's as average values calculated over a wide range of environmental conditions and correspondingly predictive of average progeny performance throughout the breed. Based on existing data, a similar view of within-breed EPD's for prediction of the relative performance of sires in crossing with available dam breeds appears reasonable. In general, fear of important sire x breed of dam interactions within crosses of *Bos taurus* beef breeds does not appear warranted, or at least is expected to be no more serious than existing regional interactions within breeds.

Data do not exist to confirm that similar uniformity of rank can be expected in crosses with *Bos indicus* breeds or dairy breeds. Certainly, the negative maternal effect on birth weight found in many *Bos indicus* breeds (Roberson et al., 1986) may reduce the magnitude (range) of sire differences, even if rankings are maintained. Conversely, crossing on dairy breeds may increase the range in sire progeny preweaning performance due to improved nutrition, but again will not necessarily change rankings of sires.

<u>Base Differences Among Breeds</u>. Before we can link the within-breed EPD's to reported breed mean differences, we must also specify the reference point used in definition of EPD's within each breed. For breed associations that use the animal model, this reference point is defined in terms of foundation animals used to build up the relationships of animals in the data set. Thus, for each breed, pedigrees are traced back to some arbitrary point, but no further. Relationships arising before this point are not used in calculating EPD's, and resulting EPD's are expressed relative to the foundation animals that begin the accumulation of pedigree relationships.

In British breeds, this base of foundation animals appears to involve animals born in the late 1950's or early 1960's. EPD's in these breeds would thus be relative to this base. In Continental European breeds and other imported breeds, this base would necessarily come in the early 1970's to coincide with the time of importation of these breeds to the U.S. If there have been consistent genetic trends in the breeds throughout this period (1960 to today), then the average EPD in 1989 for British breeds (relative to the breed base of 1960) is expected to be higher than the mean EPD of Continental European breeds (which is relative to 1970-born animals). Specifically, the difference in mean EPD would include 10 years (1960-1970) of genetic trend in the British breeds (which represents an arbitrary difference due to choice of the genetic base) plus any differences in cumulative genetic trend since 1970 (which represents a real genetic difference).

Let us now consider what impact the choice of genetic base may have on differences among breeds in mean EPD. Certainly, there have not been consistent genetic trends in growth traits for British breeds throughout the period 1960 to 1989. Nadarajah et al. (1987) evaluated genetic trends in Hereford and Angus weaning weights in Virginia herds from 1953 to 1983. Trends were clearly curvilinear with minimal net changes prior to 1971 and with consistent positive genetic trends only after that year (figure 2). Mean yearling weight EPD's for Angus, Hereford and Limousin animals born in 1970 (L. Benyshek, personal communication) were -2.2, -1.8 and -1.9 lb, respectively, suggesting nearly direct comparability in mean EPD's for these three breeds in that year. Differences in mean yearling weight EPD's for 1984-born animals of these breeds (19.9, 23.4 and -.5 lb, respectively) thus appear associated with differences in magnitude of genetic trends since 1970. These results suggest that for growth traits, differences in EPD's due to choice of genetic base may not be very important.

Estimation of Breed Constants. Ideally, breed constants would be estimated using data from either designed breed evaluation experiments or industry crossbreeding programs. Use of sires with accurate EPD's in such experiments is preferred, because such data can then be adjusted for sampling of sires within the breeds being compared. Also, crossbreeding data which includes within-breed EPD's of sires allows evaluation of the observed response to sire EPD differences in the crossing program. The expected regression of calf performance on sire EPD for weight traits is 1.0 lb/lb of EPD. If the observed response is significantly different from expectation, it indicates that the sire EPD's are not being expressed in the breeding system of choice, either due to reranking of sires (true sire x dam breed interaction) or due to scaling (sires rank the same, but EPD differences are not fully expressed). If the accuracy of the sire EPD's is high, the latter two situations can be differentiated by fitting sire effects in the model after adjustment for mean effects of sire EPD. If the sire EPD regression differs from 1.0 only because of scaling, residual sire effects are not expected to be significant. In contrast, significant sire effects after adjustment for the observed EPD relationship signifies reranking among sires. Thus, an analysis of this type allows adjustment for the sampling of sires used in the breed comparison and also allows evaluation of the magnitude and nature of rerankings among bulls used in the crossing program. A conceptually similar analysis using mixed model methodology was described by Elzo and Famula (1985).

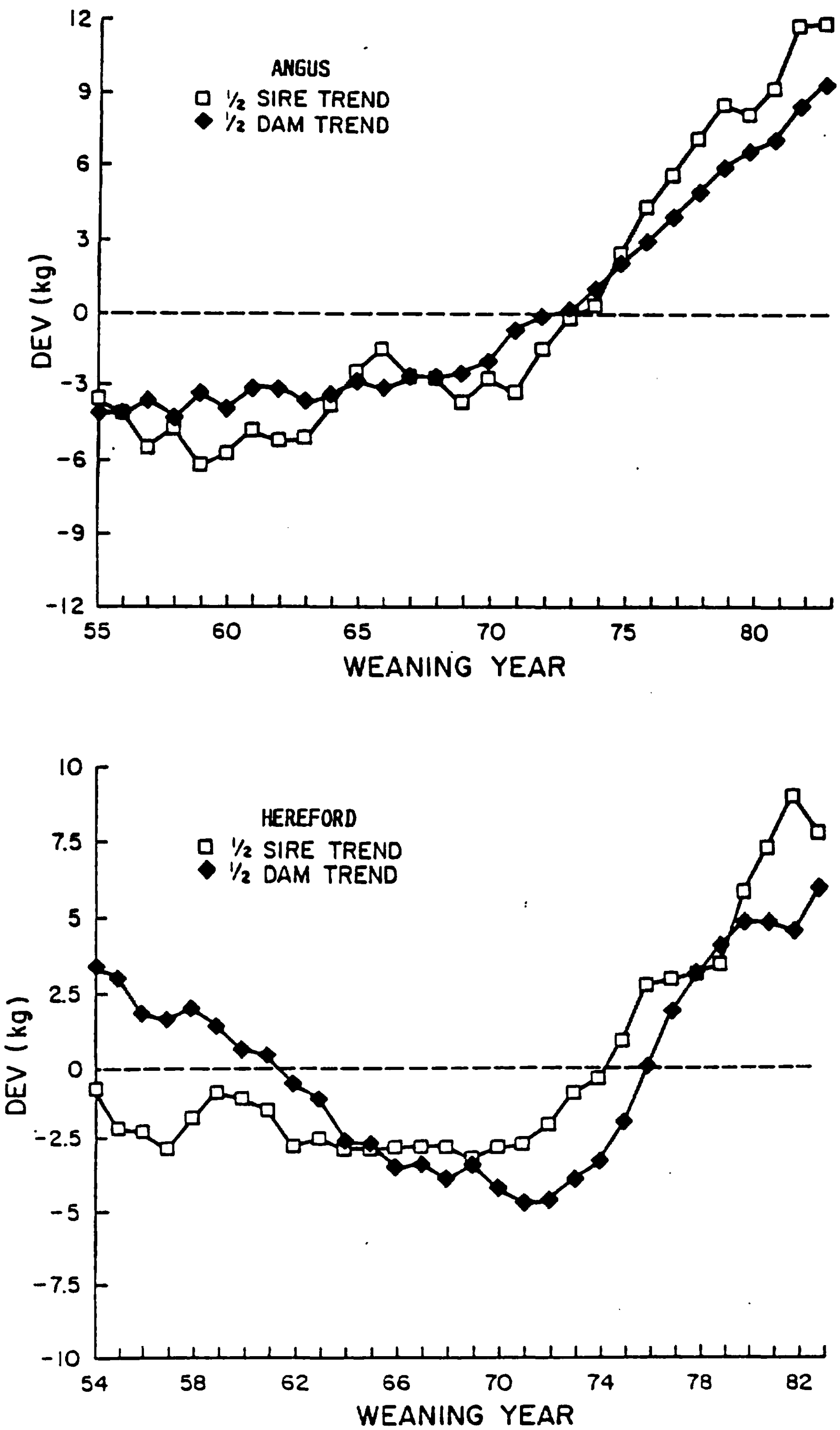


Figure 2. Long-term sire (weaning weight EPD) and dam trends (weaning weight EPD plus maternal breeding value) for Virginia Angus and Hereford herds (Nadarajah et al., 1987).

Unfortunately, breed evaluation experiments have not utilized national cattle evaluation EPD's as a part of their analysis of breed effects. Indeed, available EPD's on AI sires have rarely been utilized in the design, conduct or analysis of cattle breeding experiments despite their seemingly obvious utility. One comprehensive breed evaluation program that has utilized large numbers of AI sires with currently available EPD's is the Germ Plasm Evaluation (GPE) Program of the U.S. Meat Animal Research Center. This experiment has evaluated most of the breeds with active national cattle evaluation programs. Prior analyses of GPE data has not utilized information on the EPD's of the sires that were used, but a reanalysis of the GPE data using the analysis described in the preceding paragraph is underway.

Table 1 shows GPE breed constants from original published analyses. Similarly, tables 2, 3 and 4 show mean EPD's for birth, weaning and yearling weights, respectively, for the bulls used in GPE, for all 1970-born bulls in each breed and for all 1984-born bulls. In several cases, the MARC bulls were only modestly representative of the 1970-born population, and differential genetic trends within the breeds often resulted in large disparities between MARC bulls and 1984-born sires. When the actual performance of the crossbred calves born in GPE was regressed on the EPD's of their sires, the observed relationships were 1.11 $\pm$ .12 lb birth weight/lb of birth weight EPD, .81 $\pm$ .15 lb weaning weight/lb weaning weight EPD and 1.59 $\pm$ .17 lb yearling weight/lb yearling weight EPD. These values are very close to the expected value of 1.0 for birth and weaning weight but are considerably larger than expected for yearling weight. Very similar EPD regressions of 1.18 $\pm$ .20, .75 $\pm$ .24, and 1.82 $\pm$ .52 lb for birth, weaning and yearling weights, respectively, were reported by Mahrt et al. (1989) in matings of Polled Hereford sires to Angus dams.

When EPD regressions were fitted separately for each of the sire breeds used in GPE, the individual regressions did not differ significantly among breeds for any weight trait. Thus, no individual breed EPD's appeared to be more accurate predictors of performance in GPE. Significant differences among GPE sires remained for all weights after adjusting for EPD. However, since many of the sires that were used had relatively low final accuracies, these residual sire effects could be due to either errors in estimation of the true EPD or to reranking of sires in the crossbred matings.

Tables 2, 3 and 4 also show means for GPE breeds with EPD's after adjustment for sampling of sires and for subsequent genetic trend. This was done by adjusting GPE results to the mean EPD of 1970-born and 1984-born bulls in each breed. Adjustments were made using a common regression coefficient for all weights. From these data, the message seems clear that breed differences in growth traits have been reduced substantially in the last 15 years. The mean difference between the average of the Simmental and Charolais and the average of the Hereford and Angus decreased by 30% for birth weight, 40% for weaning weight and 47% for yearling weight between 1970 and 1984. These results point strongly to a need to know the genetic characteristics of the sires being sampled in breed evaluation experiments.

TABLE 1. BREED CONSTANTS FOR DIRECT EFFECTS ON BODY WEIGHT (LB) OF CATTLE IN THE GPE STUDY[a,b]

Cycle	Breed	Birth weight	Weaning (200-d) weight	Long-yearling weight
I	Jersey	-9.5	-24.2	-58.3
	South Devon	4.6	0.0	25.3
	Limousin	5.5	6.6	3.3
	Charolais	10.8	28.6	64.9
	Simmental	9.5	22.0	57.2
II	Red Poll	0.0	-4.4	-36.1
	Brown Swiss	6.8	21.6	31.6
	Gelbvieh	7.3	31.7	48.3
	Maine Anjou	11.9	24.6	67.1
	Chianina	10.7	27.3	42.2
III	Brahman	11.4	26.4	17.9
	Sahiwal	5.1	2.2	-43.2
	Pinzgauer	7.7	8.8	12.9
	Tarentaise	4.0	13.2	7.8
II[d]	Hereford	2.5	-2.8	-4.8
	Angus	-2.5	2.8	4.8

[a]Taken from Laster et al. (1976, 1979), Smith et al. (1976a,b), Gregory et al. (1978a,b,c,d; 1979a,b) and Cundiff et al. (1981, 1984).

[b]Constants are expressed as deviations from the mean of Hereford x Angus crosses and are given as EPD's; i.e., as one half the breed additive effect.

[c]Long-yearling weight is weight at 400 d in heifers and at 405 (Cycle I) or 424 (Cycles II and III) in steers. Table value is the average of heifer and steer constants.

[d]Derived from a diallel crossing experiment associated with Cycle II (Gregory et al., 1978a,c,d).

TABLE 2. BIRTH WEIGHTS OF GPE BREEDS ADJUSTED FOR GENETIC TREND AND SIRE SAMPLING[a]

	EPD			Actual performance		
Breed	M.A.R.C. mean	1970 mean	1984 mean	M.A.R.C.	1970 adjusted	1984 adjusted
Angus	.66	.08	3.33	74.5	73.8	76.7
Hereford	.19	-.41	1.42	78.8	78.1	79.5
Polled Hereford	-.66	.28	.38	77.6	78.6	78.8
Charolais	2.30	.44	.79	87.2	85.1	85.5
Limousin	-.13	-.20	.48	80.5	80.4	81.2
Simmental	1.61	.79	-.26	85.2	84.3	83.1
Gelbvieh	.22	-.60	.17	85.1	84.2	85.0
Tarentaise	.78	-[b]	1.37	81.4	-[b]	82.1

[a]Regression of actual birth weight on birth weight EPD = 1.111 lb/lb.

[b]Tarentaise sires were not available in sufficient numbers in 1970.

TABLE 3. WEANING WEIGHTS OF GPE BREEDS ADJUSTED FOR GENETIC TREND AND SIRE SAMPLING[a]

Breed	EPD M.A.R.C. mean	EPD 1970 mean	EPD 1984 mean	Actual performance M.A.R.C.	Actual performance 1970 adjusted	Actual performance 1984 adjusted
Angus	1.02	-2.47	14.64	433	430	444
Hereford	2.66	-1.04	20.95	437	434	452
Polled Hereford	-5.51	-5.97	.98	436	436	441
Charolais	7.88	.33	2.39	470	464	466
Limousin	-6.57	-2.73	2.22	449	452	456
Simmental	-4.72	-4.30	.91	464	465	469
Gelbvieh	2.31	-1.18	3.86	472	469	470
Tarentaise	.31	-[b]	5.05	448	-[b]	452

[a]Regression of actual weaning weight on weaning weight EPD = .809 lb/lb.
[b]Tarentaise sires were not available in sufficient numbers in 1970.

TABLE 4. YEARLING WEIGHTS OF GPE BREEDS ADJUSTED FOR GENETIC TREND AND SIRE SAMPLING[a]

Breed	EPD M.A.R.C. mean	EPD 1970 mean	EPD 1984 mean	Actual performance M.A.R.C.	Actual performance 1970 adjusted	Actual performance 1984 adjusted
Angus	6.02	-2.31	26.54	822	809	855
Hereford	2.95	- .42	33.47	822	817	871
Polled Hereford	-7.44	-7.28	1.09	818	818	832
Charolais	13.50	.65	4.39	906	885	891
Limousin	-9.06	-3.43	4.30	833	842	854
Simmental	-8.91	-5.04	4.26	884	890	905
Gelbvieh	1.81	- .86	5.08	888	884	893
Tarentaise	.33	-[b]	5.93	822	-[b]	831

[a]Regression of actual yearling weight on yearling weight EPD = 1.590 lb/lb.
[b]Tarentaise sires were not available in sufficient numbers in 1970.

The GPE project is one of the few breed evaluation projects to both sample a comprehensive set of available breeds and use predominantly AI sires with available EPD's. Data from the diallel cross described by Comerford et al. (1987) also appear to meet these criteria. However, a very large body of data from similar, but less comprehensive projects also exists. Much of this data used purchased cattle or cattle produced by natural-service sires that either did not have EPD's or would have been evaluated with only very low accuracy. The utility of such experiments depends on the assumption that the animals used in the experiment were a representative, random sample of the breed as a whole. In many cases, this assumption would be reasonable, but, without EPD's on the sires of the cattle, cannot usually be documented.

One particularly useful attempt to pull together breed evaluation data from a wide range of locations in the Southern Region is the S-10 regional bulletin of Wyatt and Franke (1986). In that study, data from ten southern states were combined to estimate breed direct and maternal effects and overall average direct and maternal heterosis. The study used a model originally put forth by Gardner and Eberhart (1966) as modified by Robison et al. (1981). Breed constants (direct and maternal) from this study are shown for birth and weaning weight in tables 5 and 6, respectively. Constants are expressed as breed EPD's, or as one half the breed additive direct or maternal effect. Most conclusions from this study basically support those of the GPE study, although there are some exceptions, the most notable of which is the very low estimate of the Simmental maternal effect reported by Wyatt and Franke (1986).

One attractive aspect of current national cattle evaluation procedures is that they fully utilize available data from breeders' herds and are therefore not dependent on results from research herds. Thus, data for use in the 'real world' comes from the 'real world'. There are, of course, a great many 'real world' commercial crossbreeding programs using sires of more than one breed to produce contemporary progeny from a variety of cow types. It would be nice if this data could be captured and also allowed to contribute to the development of breed constants. However, there are several factors which make this difficult.

First, these industry programs are not 'designed' in the experimental sense. That is, they are not set up to provide unbiased estimates of breed effects and heterosis, so many perfectly reasonable crossbreeding programs may not provide much clear information on breed constants. However, the models used by Wyatt and Franke (1986) are quite general and could potentially extract considerable information from industry crossbreeding data.

A more serious difficulty, however, is that data on industry crossbreeding programs do not reside on any single data set. With the exception of grading-up programs in recently imported breeds, these data are not associated with existing breed association data files. A substantial amount of crossbreeding data may exist in state BCIA files, but is still not readily available in a consistent format. Thus, an effort to derive breed constants from industry crossbreeding data would be time-consuming.

TABLE 5. DIRECT AND MATERNAL BREED CONSTANTS FOR BIRTH WEIGHT (LB) OF CATTLE IN THE SOUTHERN REGION[a,b]

Breed	Direct		Maternal	
	No.	Constant	No.	Constant
Brahman	7,249	8.1	5,589	-6.7
Brangus	884	3.6	681	- .6
Brown Swiss	1,895	6.1	1,222	5.1
Charolais	4,295	14.0	1,809	-2.9
Friesian	986	4.8	479	5.7
Hereford	24,299	2.9	22,134	.1
Santa Gertrudis	1,510	7.4	780	-1.3
Simmental	1,399	7.3	448	3.4
Shorthorn	1,641	6.3	1,065	-1.8

[a]Wyatt and Franke (1986).

[b]Constants are expressed as deviations from the Angus (nos. are approximately 23,503 for direct effect and 21,757 for maternal effect for Angus) and are given as EPD's; i.e., as one half the breed additive effect.

TABLE 6. DIRECT AND MATERNAL BREED CONSTANTS FOR WEANING WEIGHT (LB) OF CATTLE IN THE SOUTHERN REGION[a,b]

Breed	Direct		Maternal	
	No.	Constant	No.	Constant
Brahman	7,249	2.8	5,589	4.1
Brangus	884	9.5	681	18.2
Brown Swiss	1,895	28.4	1,222	32.8
Charolais	4,516	46.2	2,030	4.5
Friesian	1,166	7.6	696	46.0
Hereford	25,014	3.5	22,315	-10.5
Santa Gertrudis	1,510	17.4	780	22.8
Simmental	1,766	63.7	448	-13.4
Shorthorn	1,641	14.7	1,065	-19.3

[a]Wyatt and Franke (1986).

[b]Constants are expressed as deviations from the Angus (nos. = 23,503 and 21,757 for Angus direct and maternal effects, respectively) and are given as EPD's; i.e., as one half the breed additive effect.

Breed x Environment Interactions. The utility of any single set of breed performance constants will be a direct function of the importance of breed x region or other breed x environment interactions. As noted previously, our present within-breed sire evaluation procedures recognize that significant sire x environment interactions may exist. However, specific sire by region interactions have not generally been very important. Thus, when sires are used in many herds across the country, the resulting sire EPD's represent useful averages of expected progeny performance across a range of herds and environments. If breed x environment interactions are modest and not associated with region or some other readily identifiable environmental factor, an approach to deriving breed constants parallel to that used to derive EPD's is appropriate; the breed constants could be derived as averages over a range of environments and interpreted as such. If breed x environment interactions are important, then breed constants would have to be developed for each environment. Appropriate data to do this would be available for some, but not all, environments. The propriety of deriving a set of breed constants from any single experiment (such as GPE) will be critically contingent on the magnitude of these breed x environment interactions, and Larry Cundiff will review the topic of breed x environment interaction in the next talk (Cundiff, 1989).

Prognosis

1. Tables of accurate, broadly representative breed constants that could be combined with existing within-breed EPD's would be useful to anyone involved in marketing or purchasing sires of more than one breed, presumably for use in crossbreeding programs.

2. Use of within-breed EPD's to predict crossbred performance requires that bulls rank the same in purebred and crossbred matings. While this may not be true for threshold traits such as calving ease, it will likely be essentially correct for most weight traits. This assertion can be tested whenever sires with known EPD have been used in breed evaluation experiments.

3. The applicability of a single set of national breed constants will depend on the extent of interactions between breed effects and identifiable environmental conditions. If these interactions are important, then multiple sets of breed factors would be required.

4. Development of breed constants would ideally come from data sets in which the sires used to produce the crossbred progeny had EPD's. This would insure adjustment of breed constants for sampling of sires and would allow adjustment of breed constants for future within-breed genetic trend.

5. Marriage of breed constants and within-breed EPD's would be facilitated by definition of a common base for reporting within-breed EPD's. This is not a requirement on genetic grounds; differences in the base among breeds can generally be accommodated in the derived breed constants. However, on psychological grounds, a similar mean and range in EPD's among breeds is comforting and convenient for people dealing with multiple breeds.

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GENOTYPE-ENVIRONMENT INTERACTION ACROSS AND WITHIN BREEDS[1]

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Genetic variation is vast among and within breeds for bioeconomic traits important to beef production such as growth rate, milk production, mature size, feed efficiency and components of carcass composition and quality. The range for differences between breeds is comparable to that within breeds for most traits. Expected progeny differences (EPD's) computed across breeds from experimental data relative to EPD's computed within breeds from field data (Notter, 1989) could provide for more effective use of this variation by commercial producers to optimize performance levels in their herds. Climatic conditions and feed resources used for beef production also vary greatly in the United States. The purpose of this presentation, will be to review experimental evidence concerning the importance of genotype-environment interactions among and within breeds for traits that are important in cow herds, in growing-finishing, and in processing segments of production. Understanding of these interactions is important in establishing appropriate analysis procedures to obtain EPD's across and within breeds. Understanding of genotype-environment interactions is also important in breeding to match genetic potential with the climate, feed resources and market opportunities.

Genotype-Environment Interactions Among Breeds

At the Roman L. Hruska U. S. Meat Animal Research Center (MARC) we have evaluated progeny of 20 different sire breeds resulting from topcross matings to Hereford, Angus or F_1 cross dams in the Germ Plasm Evaluation (GPE) Program. Experiments involving topcross comparisons out of Hereford or Angus dams have also been conducted at other locations representing diverse environments in North America. In some instances, we cooperated by using exactly the same germ plasm at different locations (e.g., Subtropical Agricultural Research Station, [STARS], Brooksville, Florida; Livestock and Range Research Station [LARRS], Miles City Montana) while in other instances independent samples [some sires in common, some not] of germ plasm were evaluated (e.g., Agriculture Canada stations at Brandon, Manitoba; and Manyberries, Alberta; Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma). Results for bioeconomic traits important in cow herds will be reviewed from these experiments.

Data will be presented in graphic form to facilitate visualization of interactions. Figure 1 portrays four possible outcomes. Data in figure 1 could represent any characteristic expressed as a ratio (e.g., weaning weight ratio). Figure 1a (upper-left) depicts a difference in genotype (breed group 1 > breed group 2) in two equal environments (Env 1 = Env 2),

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with no genotype-environment interaction. Figure 1b (upper-right) depicts a difference in genotype (breed group 1 > breed group 2) and a difference in environment (Env 1 - Env 2) with no genotype-environment interaction. Figure 1c (lower-left) depicts a genotype-environment interaction where there is a change of rank between genotypes in the two separate environments (breed group 1 > breed group 2 in Env 1, but vice versa in Env 2). Figure 1d (lower-right) depicts a genotype-environment interaction where there is a change in magnitude of the advantage of one genotype over the other but not a change in rank in the two environments (breed group 1 > breed group 2 in Env 1 and in Env 2 but the advantage is greater in environment 1). The lines depicting response for each breed group in the two environments are parallel when there is no interaction. The lines depicting response for each breed group in the two environments are not parallel when genotype-environment interactions are important and actually cross when there is a change in rank of the genotypes in the two environments.

Weaning Weight

Bos indicus versus Bos taurus crosses in temperate versus subtropical environments. Average weaning weights of progeny out of F_1 cross *Bos taurus* x *Bos taurus* cows [Hereford x Angus reciprocal crosses (HAX) and Pinzgauer x Hereford and Pinzgauer x Angus (PX)] and *Bos indicus* x *Bos taurus* cows [Brahman x Hereford and Brahman x Angus (BMX) and Sahiwal x Hereford and Sahiwal x Angus (SWX)] shown in figure 2 are from a recent analysis of data obtained at MARC, Clay Center, Nebraska and STARS, Brooksville, Florida (Olson et al., unpublished data). The F_1 cows were all produced at MARC in Cycle III of the GPE program. A sample of about 60 females of each breed group were transferred to STARS, Brooksville, Florida shortly after weaning at about 7 months of age to provide for comparisons with about 100 females of each breed group which remained at MARC. The females were maintained under management regimes considered appropriate for each region.

Weaning weights summarized in figure 2 are for all spring calvings of females ranging from 2 - 7 yr of age at MARC and all winter calvings of females ranging from 3 - 7 yr of age (about 30 months at first calving in January) at STARS. The advantage of *Bos indicus* x *Bos taurus* F_1 cows over *Bos taurus* x *Bos taurus* was much greater in Florida than in Nebraska. Progeny of Pinzgauer crosses tended to be heavier than those of Sahiwal crosses in Nebraska but progeny of Sahiwal crosses were heavier than those of Pinzgauer crosses in Florida. Otherwise, the interactions reflect a large change in magnitude of breed group differences rather than a reranking.

Wyatt and Franke (1986) reported estimates for weaning weight for progeny of F_1 cows from data pooled over 23 different locations in the Southern Region (contributing efforts to Regional Project S-10 from Texas, Louisiana, Mississippi, Kentucky, Alabama, Georgia, Florida, S. Carolina, North Carolina, and Virginia). Weaning weights for progeny of Hereford x Angus (HAX), Brown Swiss (BX), Simmental (SX) and Charolais (CX) sired F_1 cows in the Southern Region were remarkably similar to those of corresponding breed groups at MARC, while progeny weaning weights of Brangus (Bg), Santa Gertrudis (SgX), Holstein (HoX) and Brahman (BmX) sired F_1 cows tended to be greater in the Southern Region than at MARC (Figure 3). Again, a relatively greater advantage of *Bos indicus* over *Bos taurus* germ plasm is reflected in the Southern Region as compared to Nebraska.

These results indicate that EPD's across breeds should be derived separately from experiments conducted in temperate and subtropical regions if *Bos indicus* breeds are to be compared to *Bos taurus* breeds. Also, allowance should be made for differential effects of heterosis in *Bos indicus* x *Bos taurus* breed crosses than in *Bos taurus* x *Bos taurus* breed crosses. Estimates of heterosis have been about twice as large in *Bos indicus* x *Bos taurus* breed crosses as in *Bos taurus* x *Bos taurus* breed crosses for weaning weight and other traits (e.g., Cartwright et al., 1964; Koger et al., 1975).

<u>Bos taurus breed crosses in temperate environments</u>. Average weaning weights for progeny of F_1 cross cows are shown in figure 4a (left) for Charolais (CX), Limousin (LX), Simmental (SX) sired and Hereford x Angus F_1 cross cows at MARC (Cundiff et al., 1986), and in Canada at Brandon, Manitoba and Manyberries, Alberta (Fredeen et al., 1974). Average weaning weights for progeny of F_1 cross cows are shown in figure 4b (center) for Red Poll (RX), Tarentaise (TX), Pinzgauer (PzX), and Simmental (SX) sired F_1 crosses and for Hereford x Angus F_1 cross cows (HAX) at MARC and Miles City, Montana (Reynolds and Urick, 1985). Average weaning weights for progeny of F_1 cross cows are shown in figure 4c (right) for Jersey (JX), Hereford x Angus (HAX), Brown Swiss (BX) and Simmental (SX) sired F_1 crosses at MARC (Cundiff et al., 1986) and Stillwater, Oklahoma (Frahm and Marshall, 1985). The difference between HAX and other F_1 crosses was greater at MARC than at Miles City, but performance of the different F_1 crosses at Brandon, Manitoba; Manyberries, Alberta; and Stillwater, Oklahoma paralleled performance of corresponding breed groups at MARC. There is no reranking of breed groups at different locations for weaning weight. These results indicate that genotype-environment interactions are not important for weaning weight among *Bos taurus* breed crosses in temperate regions and that EPD's across *Bos taurus* breeds could be derived from one or more experiments conducted under temperate conditions.

Birth Weight and Calving Assistance

<u>Bos indicus versus Bos taurus crosses in temperate versus subtropical environments</u>. Average birth weights of progeny out of F_1 cross *Bos taurus* x *Bos taurus* cows [Hereford x Angus reciprocal crosses (HAX) and Pinzgauer x Hereford and Pinzgauer x Angus (PX)] and *Bos indicus* x *Bos taurus* cows [Brahman x Hereford and Brahman x Angus (BMX) and Sahiwal x Hereford and Sahiwal x Angus (SWX)] are shown in figure 5 (Olson et al., unpublished). Average calving assistance for F_1 cross cows calving at 2 through 6 years of age at MARC and 3 through 6 years of age in Florida are also shown in figure 5.

Birth weights were significantly lighter in Florida than in Nebraska. The reduction in birth weight from Nebraska to Florida was greater in progeny of *Bos taurus* x *Bos taurus* F_1 dams than in progeny of *Bos indicus* x *Bos taurus* dams. Average birth weights were 20 and 23 lb lighter in Florida than in Nebraska for progeny of Pinzgauer and Hereford or Angus sired F_1 dams and 15 and 17 lb lighter in Florida than in Nebraska for progeny of Brahman and Sahiwal cross dams, respectively.

Progeny out of Hereford x Angus dams were 4 lb heavier than those out of Brahman sired F_1 dams in Nebraska while those out of Brahman sired F_1 dams were 4 lb heavier than those out of Hereford x Angus dams in Florida. The advantages of lighter progeny birth weights for *Bos indicus* x *Bos taurus* cross cows are reflected in lower calving difficulty for *Bos indicus* x *Bos taurus* cross cows, especially in Nebraska. Indications are that genotype-environment interactions are of sufficient magnitude to warrant separate analysis of EPD's across breeds in temperate and subtropical environments if *Bos indicus* and *Bos taurus* sources of germ plasm are to be compared for birth weight or calving ease.

Bos taurus breed crosses in temperate environments. Average birth weights for progeny of F_1 cross cows are shown in figure 6 (left) for Charolais (CX), Limousin (LX), Simmental (SX) sired and Hereford x Angus F_1 cross cows at MARC (Cundiff et al., 1986) and in Canada at Brandon, Manitoba and Manyberries, Alberta (Fredeen et al., 1974). Progeny of Simmental and Charolais sired F_1 dams had comparable birth weights at each location and were heavier than progeny of Limousin and Hereford or Angus sired F_1 crosses at MARC, Brandon, and Manyberries. Changes in ranking among locations, associated with small differences in birth weight, are likely not significant.

Average birth weights for progeny of F_1 2-year-old females are shown in figure 7a (upper left) for Red Poll (RX), Tarentaise (TX), Pinzgauer (PzX), and Simmental (SX) sired F_1 crosses and for Hereford x Angus F_1 cross cows (HAX) at MARC (Cundiff et al., 1986) and Miles City, Montana (Reynolds and Urick, 1985). Average birth weights for progeny of F_1 2-year-old females are shown in figure 7b (upper right) for Jersey (JX), Hereford x Angus (HAX), Brown Swiss (BX) and Simmental (SX) sired F_1 crosses at MARC (Cundiff et al., 1986) and Stillwater, Oklahoma (Frahm and Marshall 1985). Percentage calving assistance for the corresponding 2-year-old F_1 crosses and locations are also shown in figure 7c (lower left) and 7d (lower right). Birth weights for Tarentaise and Hereford or Angus sired F_1 crosses paralleled each other at MARC and Miles City. Birth weights of progeny of Pinzgauer sired F_1 heifers were comparable to Red Poll and Simmental sired F_1 heifers at MARC but 4 or 5 lb heavier at Miles City.

Rankings among breed groups for calving difficulty were not the same at MARC and Miles City. Red Poll sired F_1 heifers required more assistance at calving than Simmental, Pinzgauer, Tarentaise and Hereford or Angus sired F_1 crosses at MARC, but required less assistance at calving than Simmental or Pinzgauer crosses at Miles City. It is not clear whether these fluctuations in rank are due to true genotype-environment interaction or due to sampling errors (chance). Sampling errors are larger for binomial traits (difficult versus not difficult) and the data for calving assistance in first calf heifers are estimated from fewer numbers of observations than for other traits.

Rankings and differences for progeny birth weight and calving assistance in Oklahoma were remarkably similar to those for corresponding breed groups at MARC. Results indicate that although use experimental results from as many herds as possible would help to increase accuracy of across breed EPD estimation, breed-experimental herd interactions are not so large that it would be essential to provide useful information on breed differences that can be expected by commercial producers for breed differences in birth weight and calving ease.

Postweaning Growth and Carcass Traits

A variety of feed resources are used during the early postweaning period in the U.S., but virtually all slaughter cattle are finished for slaughter on diets containing relatively high levels of grain. Feeding grain is economical because it reduces the average age of cattle at slaughter relative to grazing systems and consequently reduces maintenance costs which accrue daily during the finishing period. Historically, when steers were finished on pasture, propensity to fatten at a young age was considered desirable. However, propensity to fatten became a handicap as we shifted to increased use of feed grains in diets of growing-finishing cattle. Also, the medical profession advocates limiting fat and caloric content in human diets which has stimulated interest in opportunities to produce leaner beef with lower fat and caloric content. Significant genetic variation exists among and within breeds in lean tissue growth rate, carcass composition and muscle leanness (Cundiff et al., 1986).

Genotype-environment interactions have been studied for diverse biological types of breeds differing widely in lean tissue growth potential on a variety of growing finishing programs in the U.S. Results from one such study are summarized for final slaughter weight in figure 8 and for carcass characteristics in figure 9 (Smith et al., 1977). The small type steers were comprised predominantly of crosses among the Hereford, Angus, Shorthorn, Red Poll, and Jersey breeds. The large type steers were at 50% or more Charolais, Brown Swiss, Chianina, Gelbvieh, Maine Anjou, or Limousin breeding. Differences between biological types were evaluated in five feeding regimes:

A = winter growing ration (48% corn silage, 50% alfalfa haylage, 2% supplement;2.18 Mcal ME/kg) for 134 days, grazing on cool and warm season grasses for 133 days, followed by a 6-day adjustment period, and then a 60% forage ration (40% corn silage, 20% alfalfa haylage, 36% cracked corn, 4% supplement; 2.84 Mcal ME/kg) for 98 days.
B = Same as regime A, except a 20% forage ration (20% alfalfa haylage, 75% cracked corn, 4% supplement; 2.84 Mcal ME/kg) for 98 days.
C = A complete 96.6% forage ration (76.6% corn silage, 20% alfalfa haylage, 3.4% supplement; 2.40 Mcal ME/kg) for 315 days following weaning.
D = Same as regime C, except a more energy dense finishing diet (20% alfalfa haylage, 75% cracked corn, 4% supplement; 2.84 Mcal ME/kg) for the last 105 days.
E = A 60% forage diet (40% corn silage, 20% alfalfa haylage, 36% cracked corn, 4% supplement; 2.84 Mcal ME/kg) for 266 days following weaning.

Results showed no indication of genotype-environment interaction among the different biological types in the five growing-finishing regimes for growth (figure 8). The advantage of the large type over the small type steers in weight at slaughter was very consistent for all five growing-finishing regimes, even though the differences between the biological types and the differences among the growing finishing regimes were highly significant for final weight. Indications are that EPD's across breeds for growth to yearling or slaughter ages obtained under one growing-finishing system could be used to predict response to selection of breeds in another growing-finishing system.

Likewise no interaction was indicated between biological type and the five growing finishing regimes for rib eye area (figure 9). Differences among the biological types in fatness characteristics (fat thickness, 9-10-11th rib fat percentage) and for retail product percentage were generally consistent across all growing finishing regimes (figure 9); except that differences in fat thickness and 9-10-11th rib fat content did tend to increase as energy density of the growing finishing regime increased. High energy diets tend to magnify expression of EPD's across breeds for fatness, and some allowance should be made for this if inference is to be drawn to growing-finishing systems involving grazing periods or low energy growing diets. Similarly, interactions were not significant for growth and carcass traits between biological type and dietary energy level in reports by Ferrell et al., (1978) and Prior et al., (1977).

Genotype-Environment Interactions Within Breeds

Temperate versus Subtropical Environments. Genotype-environment interactions have been studied in a classic experiment conducted cooperatively by USDA-ARS and Montana State University at Miles City, Montana and the USDA-ARS and University of Florida at Brooksville, Florida (Butts et al., 1971; Koger et al., 1979; Burns et al., 1979). The experiment involved two lines of Hereford Cattle:

MT (Line 1) - A closed line of Hereford cattle selected for growth at the USDA-ARS station, Miles City, Montana since 1934 with an accumulated average inbreeding coefficient of about 20%.
FL (Line 6) - A line of Hereford cattle which had been selected for growth and reproduction for about 10 years at the USDA-ARS station at Brooksville, Florida. The FL (line 6) population was more heterogeneous in genetic background and was not inbred.

Following a reciprocal exchange of the cattle, growth characteristics (Butts et al. 1971, Burns et al., 1979) and reproduction characteristics (Koger et al., 1979) of the two lines of cattle were evaluated at Miles City, Montana and at Brooksville, Florida.

Line x location interaction was highly significant for all traits evaluated including birth and weaning weight (figure 10) and reproduction traits. The locally developed line was superior to the introduced line at both locations. In a second phase of the experiment, the line 1 cattle were selected for growth and reproduction in Florida (Line F 4) for an 11 year period. They showed marked improvement in reproduction and growth performance in Florida. Line F 4 cattle outperformed calves by line M 1 sires in Florida even though the dams were of Florida origin. However, calves by line F 4 sires were inferior to those by line M 1 sires in Montana. It was concluded that when subtropical versus temperate environments are involved, genetic adaptation to the local environment is important and merits serious consideration in selection of seedstock and sources of semen. Results from this experiment indicate that within breed EPD's for herds in temperate regions should be computed separately from those for herds in subtropical regions.

Sire-Environment Interactions. Sire-region, sire-herd/region and sire-contemporary group interactions have been evaluated for weaning weight (table 1) and birth weight (table 2) using field data obtained in numerous herds throughout the U.S. involving large numbers of Simmental (Nunn et al., 1978; Buchanan and Nielsen, 1979; Tess et al., 1979), Maine Anjou (Buchanan and Nielsen, 1979), Polled Hereford (Bertrand et al., 1985) and Limousin (Bertrand et al., 1987) sires. Sire-environment interactions have generally been significant for weaning weight (table 1) and have often been significant for birth weight (table 2). Magnitude of sire-contemporary group interaction variance has been greater than that for sire-herd/region which has in turn been greater than that for sire-region (Bertrand et al., 1985; Bertrand et al., 1987). Estimates of genetic correlations of sire EPD's between regions have averaged about .5 (.64 in Polled Hereford, Bertrand et al., 1985; .55 or .66 if adjusted for dam MPPA in Limousin, Bertrand et al., 1987; .32 in Simmental, Buchanan and Nielsen, 1979) for weaning weight, indicating that there may be considerable reranking of sire EPD's in different regions.

Although, these interactions have slowed the rate of genetic change within breeds, significant genetic change has accrued in response to selection for growth within breeds (e.g., Hough and Benyshek, 1988). Preliminary estimates of genetic trends in the Hereford and Angus breeds are reflected in table 3, comparing progeny of 23 Hereford bulls (13 polled and 10 horned) and 16 Angus bulls sampled broadly and born since 1982 to 10 Herefords (5 polled and 10 horned) 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 three of five calf crops (final weights are for two of five calf crops) being produced in Cycle IV of the GPE Program. Indications are that significant change for growth to slaughter ages has accrued in both Herefords and Angus between the late 1960's and the early 1980's. This change was expected in view of the selection emphasis that seedstock breeders in both of these breeds have placed on growth rate and skeletal size during this period.

Summary and Conclusions

In temperate versus subtropical environments with *Bos taurus* versus *Bos indicus* breeds, breed group x location interactions are significant and large for most traits. In temperate regions with *Bos taurus* breeds, breed group x location interactions are: 1) relatively large for lowly heritable traits (e.g., calving ease), 2) can be significant but are usually not large for moderately heritable traits (e.g., birth and weaning weight), and 3) are generally not significant for highly heritable traits (e.g., final slaughter weight, and most carcass traits). Results indicate that across breed EPD's obtained from one or more appropriately designed experiments in a temperate (or a subtropical) environment could be used to predict response to selection of breeds in herds maintained under temperate (or subtropical) conditions, especially for traits that are moderate (e.g., weaning weight) or highly heritable (final weight, or carcass traits). Analysis of data from more experiments may be required to accurately assess calving assistance.

In temperate versus subtropical environments, within breed genotype-environment interactions are large and significant for most traits. Cattle selected in temperate environments are not as well adapted to the subtropics as cattle selected in the subtropics and vice versa. Within breed EPD's for herds located in subtropical regions should be computed from herds located in subtropical regions and EPD's for herds in temperate regions should be computed from herds located in temperate regions. Results indicate that this would increase accuracy of selection in both regions and might also lead to improved marketing opportunities for export of semen to different climatic regions of the world.

Sire-herd and sire-contemporary group interactions are generally significant, and although they tend to reduce accuracy of selection, significant genetic response has accrued within breeds in response to selection based on EPD's averaged across regions, herds and contemporary groups.

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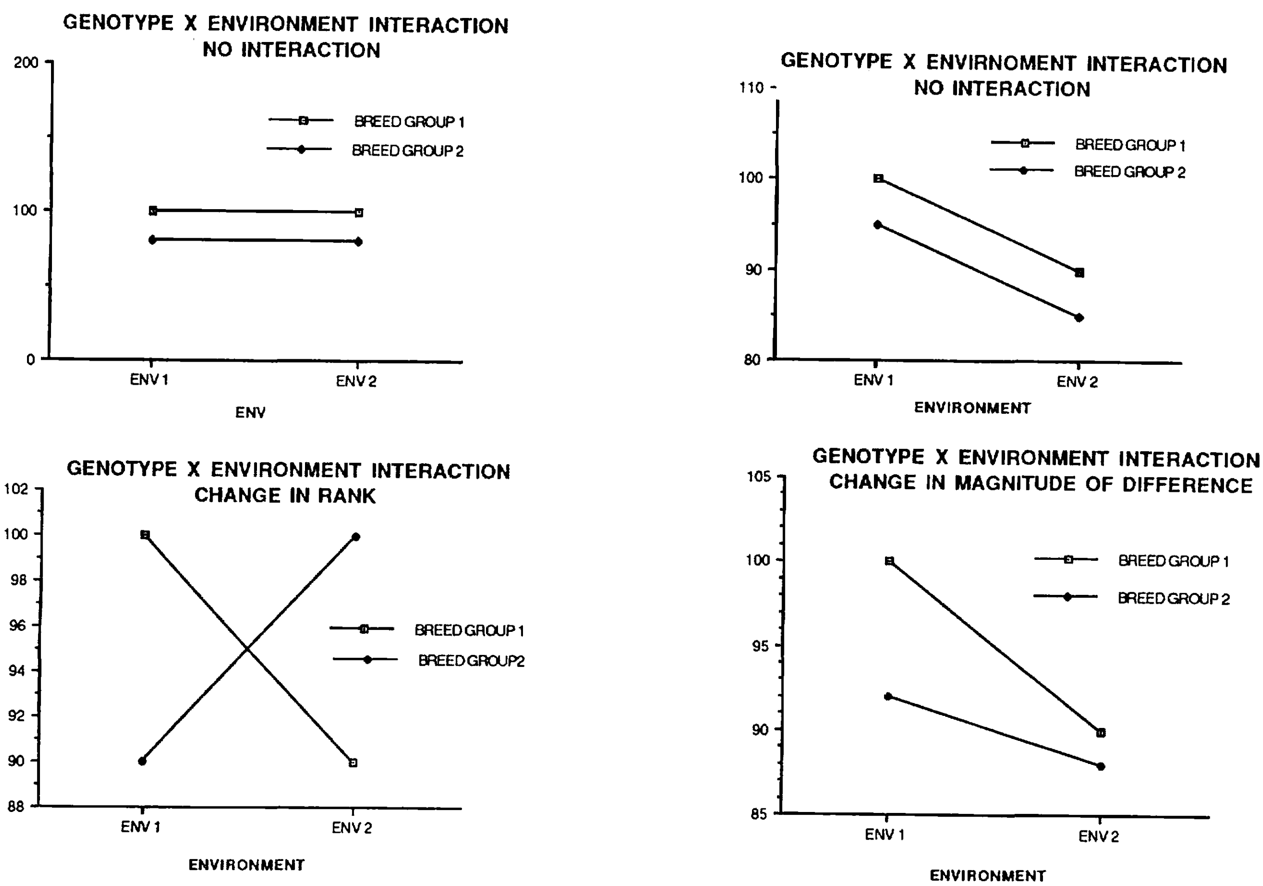


Figure 1. Four possible outcomes for a trait expressed as a ratio. Figure 1a. (upper-left) depicts a difference in genotype (breed group) in two equal environments with no genotype-environment interaction. Figure 1b. (upper- right) depicts differences in genotype and environment with no genotype- environment interaction. Figure 1c. (lower-left) depicts a genotype-environment interaction where there is a change of rank between genotypes in the two environments. Figure 1d. (lower-right) depicts a genotype- environment interaction where there is a change in magnitude of the advantage of one genotype over the other but not a change in rank in the two environments.

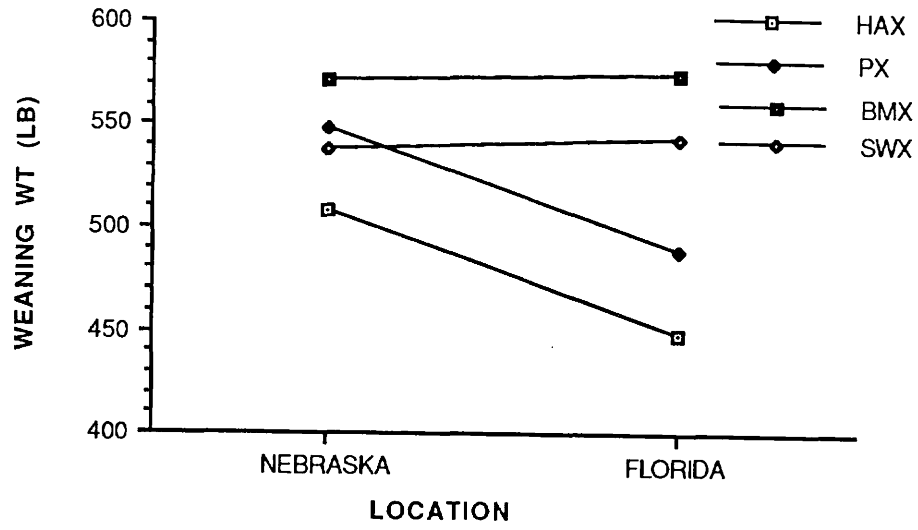


Figure 2. Average weaning weights of progeny out of F_1 cross Hereford x Angus and Angus x Hereford (HAX), Pinzgauer x Hereford and Pinzgauer x Angus (PX), Brahman x Hereford and Brahman x Angus (BMX) and Sahiwal x Hereford and Sahiwal x Angus (SWX)] cows at MARC, Clay Center, Nebraska and STARS, Brooksville, Florida (Olson et al., unpublished).

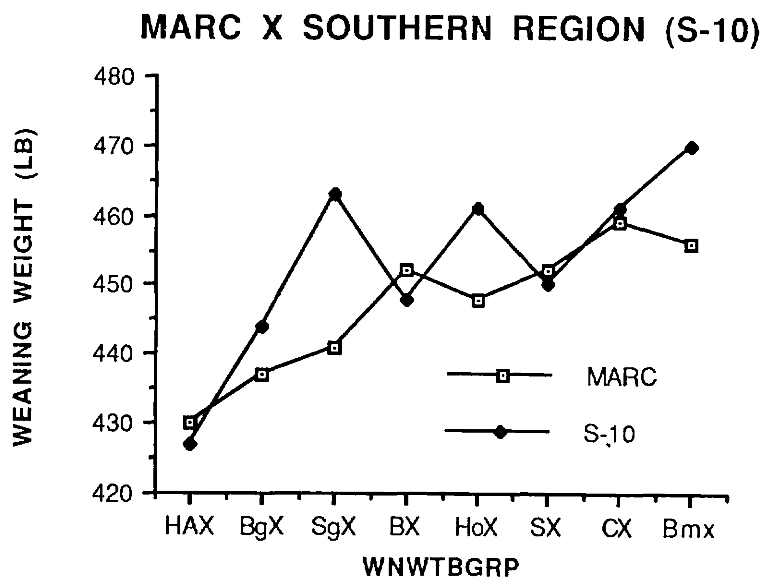


Figure 3. Average weaning weight for progeny of Hereford x Angus (HAX), Brangus (BgX), Santa Gertrudis (SgX), Brown Swiss (BX), Holstein (HoX), Simmental (SX), Charolais (CX) and Brahman (BmX) sired F_1 cows at 23 different locations contributing to Southern Regional Project S-10 (Wyatt an Franke, 1986) and at MARC (Cundiff et al. 1986).

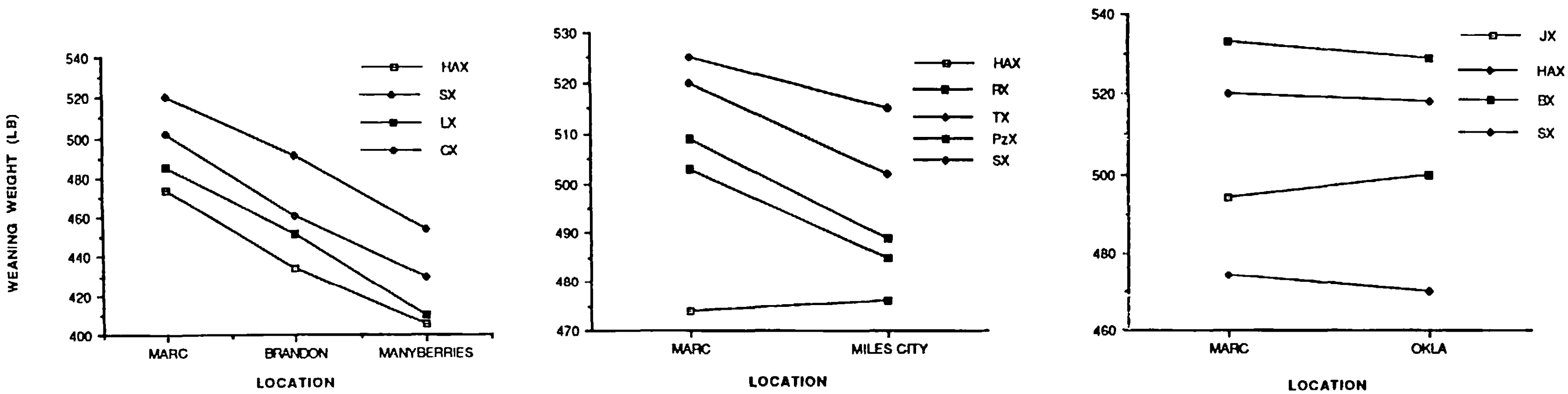


Figure 4. Average weaning weights for progeny of Hereford x Angus (HAX), Simmental (SX), Limousin (LX) and Charolais (CX) F_1 cows at MARC (Cundiff et al., 1986), Agriculture Canada stations at Brandon, Manitoba and Manyberries, Alberta (Fredeen et al., 1977); HAX, Red Poll (RX), Tarentaise (TX), Pinzgauer (PzX) and Simmental (SX) F_1 cows at MARC and LARRS, Miles City, Montana (Reynolds and Urick, 1984) and Jersey (JX), HAX, Brown Swiss (BX) and SX cows at MARC and Oklahoma State University, Stillwater (Frahm and Marshall, 1985).

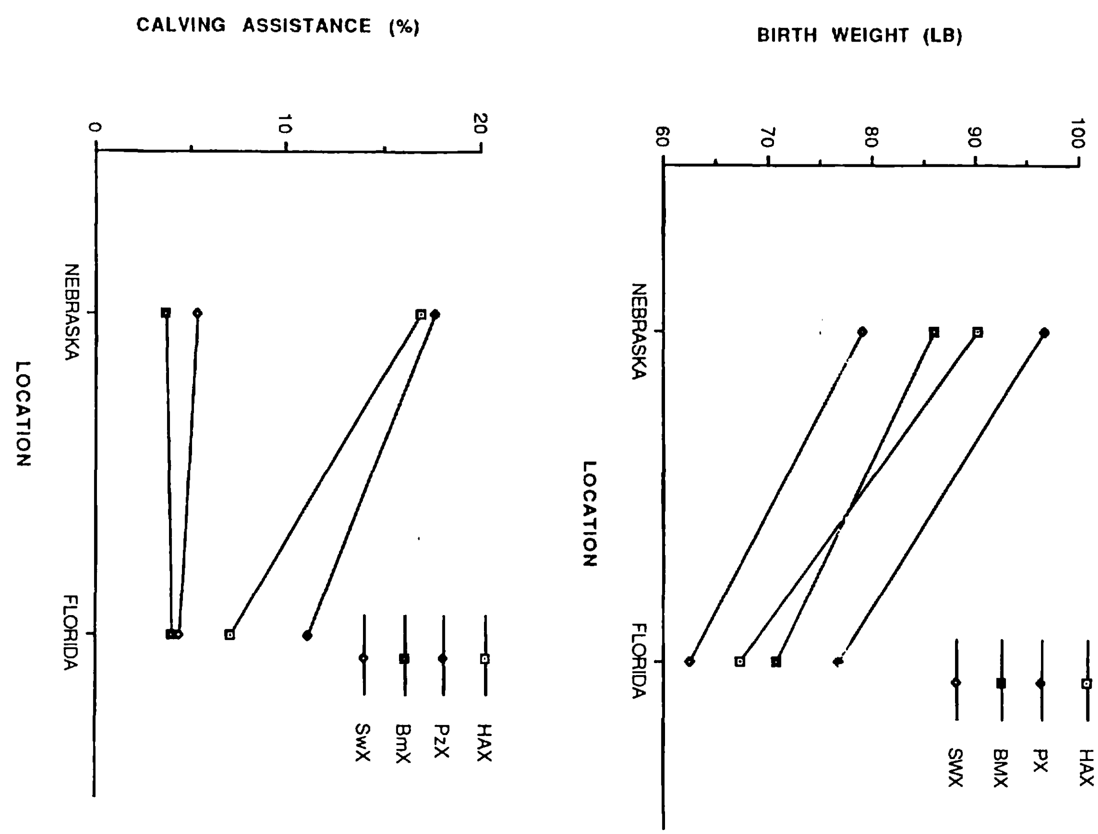


Figure 5. Average birth weight and calving assistance of progeny out of F_1 cross Hereford x Angus and Angus x Hereford (HAX), Pinzgauer x Hereford and Pinzgauer x Angus (PX), Brahman x Hereford and Brahman x Angus (BMX) and Sahiwal x Hereford and Sahiwal x Angus (SWX)] cows at MARC, Clay Center, Nebraska and STARS, Brooksville, Florida (Olson et al., unpublished).

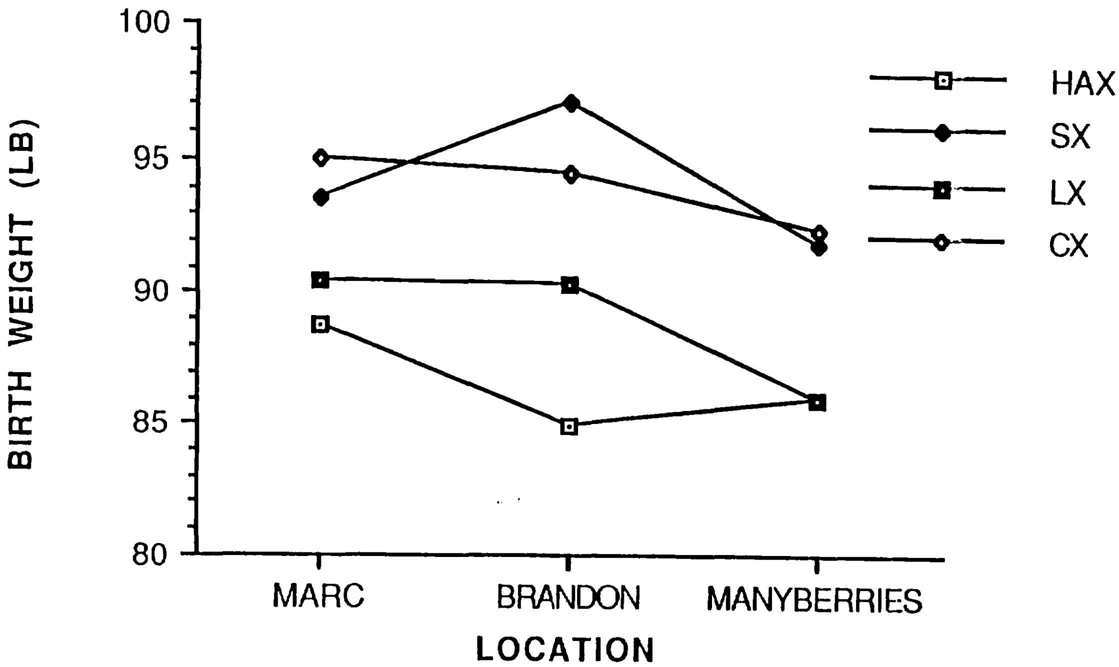


Figure 6. Average birth weights for progeny of Hereford x Angus (HAX), Simmental (SX), Limousin (LX) and Charolais (CX) F_1 cows at MARC (Cundiff et al., 1986) and at Agriculture Canada stations at Brandon, Manitoba and Manyberries, Alberta (Fredeen et al., 1977).

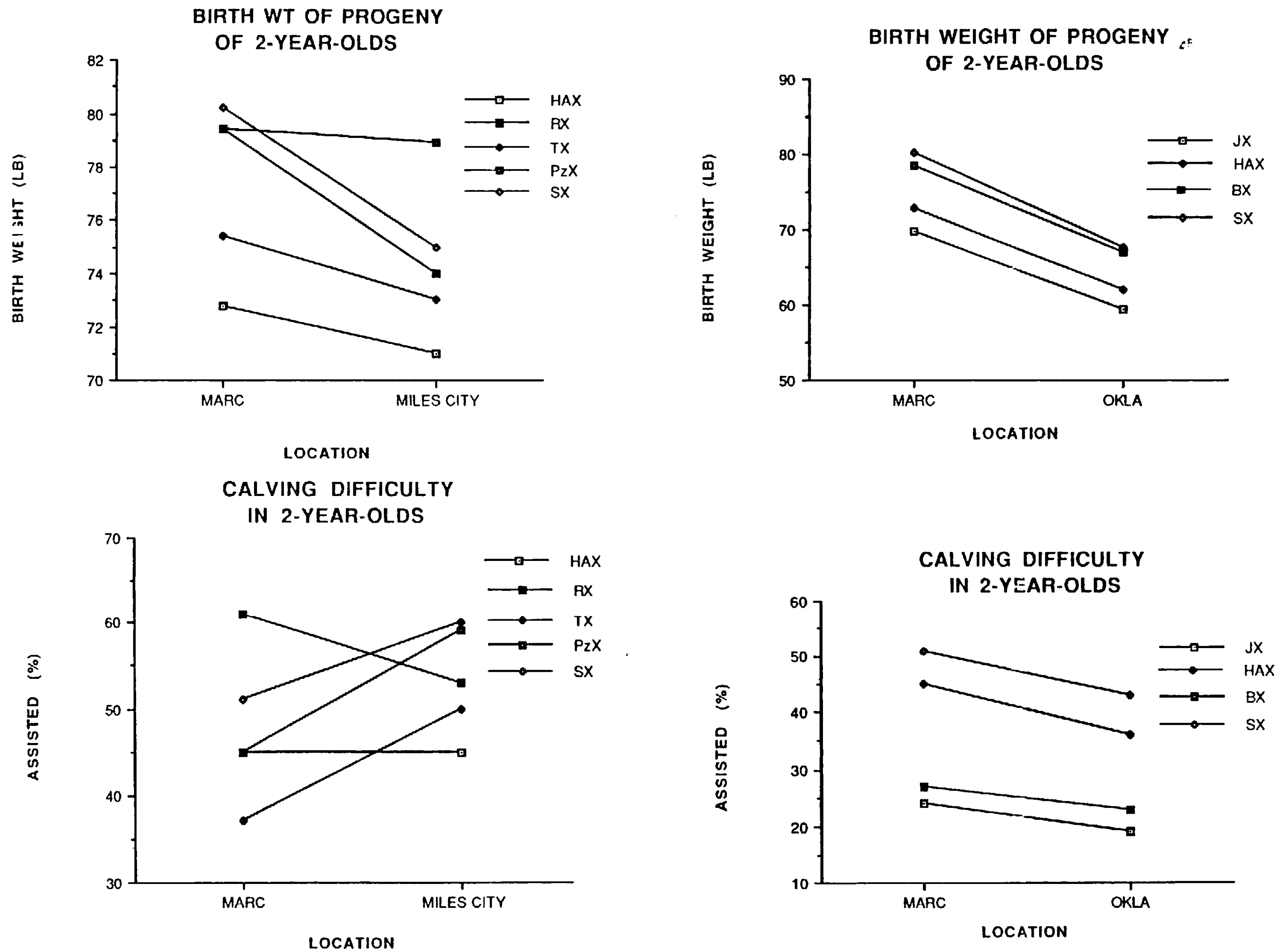


Figure 7. Average birth weights and percentages for calving assistance for progeny of Hereford x Angus (HAX), Red Poll (RX), Tarentaise (TX), Pinzgauer (PzX) and Simmental (SX) sired F_1 cross 2-yr-old females at MARC (Cundiff et al., 1989) and LARRS, Miles City, Montana (Reynolds and Urick, 1984) and Jersey (JX), HAX, Brown Swiss (BX) and SX cows at MARC and Oklahoma State University, Stillwater (Frahm and Marshall, 1985).

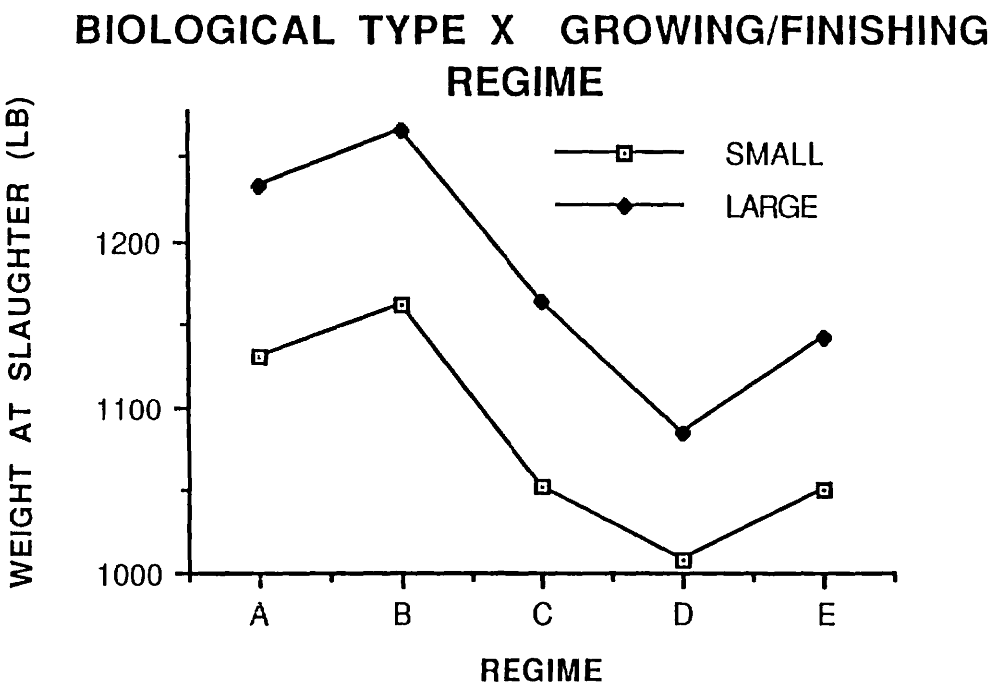


Figure 8. Average weights at slaughter of steers representing large and small biological types on five growing-finishing regimes: A = winter growing, summer grazing, 60% forage finishing diet, B = same as A except 20% forage finishing diet, C = 96.6 % forage diet, D = 96.6 % forage diet switched to 60% forage finishing diet, E = 60% forage diet (Smith et al., 1977).

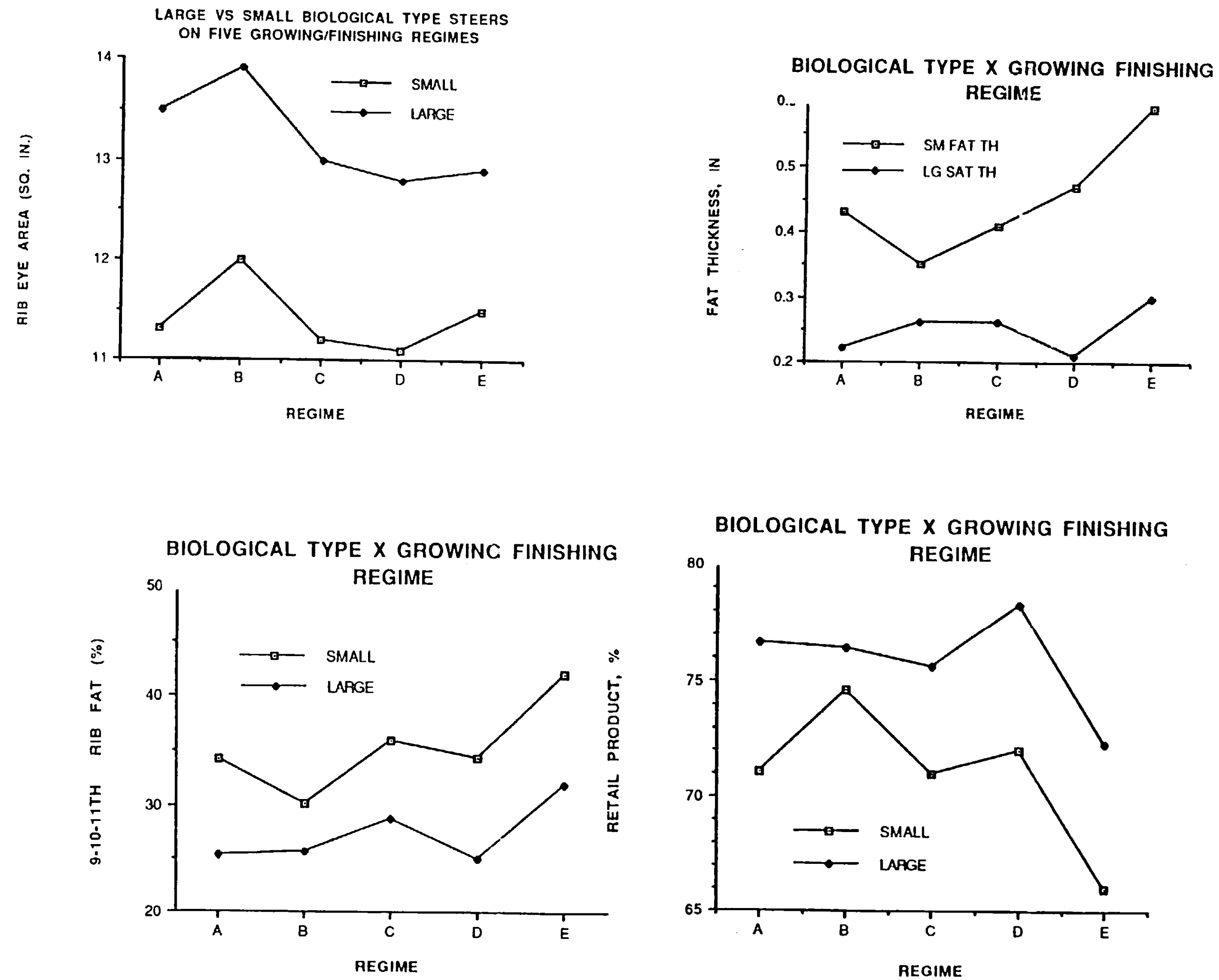
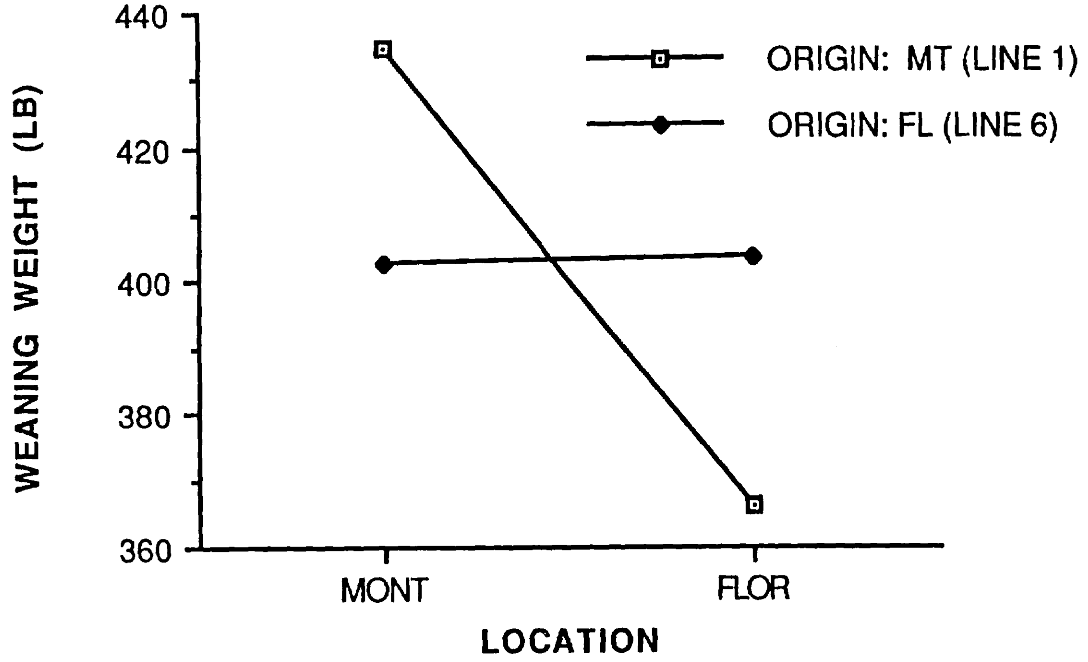


Figure 9. Averages for rib eye area (upper left), fat thickness (upper right), 9-10-11th rib fat content (lower right) and retail product percentage of carcasses of steers representing large and small biological types on five growing-finishing regimes: A = winter growing, summer grazing, 60% forage finishing diet, B = same as A except 20% forage finishing diet, C = 96.6 % forage diet, D = 96.6 % forage diet switched to 60% forage finishing diet, E = 60% forage diet (Smith et al., 1977).



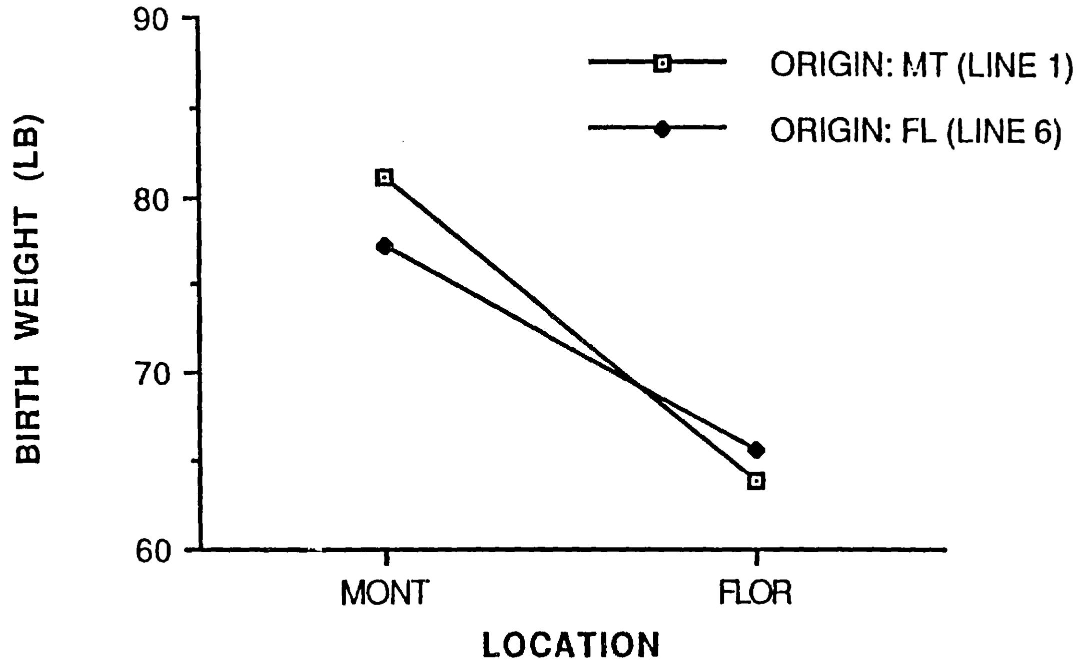


Figure 10. Averages for weaning weight and birth weight of progeny of Herefords originating in Montana (line 1) and Herefords originating in Florida (line 6) in both the Montana (LARRS, Miles City, Montana) and Florida (STARS, Brooksville, Florida) environments (Burns et al., 1979).

TABLE 1. SIRE-ENVIRONMENT INTERACTIONS FOR WEANING WEIGHT

Source/Breed	Significant-	Not significant
Sire-region		
Simmental	Nunn et al. (1978)	
Simmental	Buchanan & Nielsen (1979)	
Maine Anjou	Buchanan & Nielsen (1979)	
Simmental		Tess et al. (1979)
P. Hereford	Bertrand et al. (1985)	
Limousin	Bertrand et al. (1987	
Sire-herd in region		
Simmental	Tess et al. (1979)	
P. Hereford	Bertrand et al. (1985)	
Sire-contemporary group		
P. Hereford	Bertrand et al. (1985)	
Limousin	Bertrand et al. (1987	

TABLE 2. SIRE-ENVIRONMENT INTERACTIONS FOR BIRTH WEIGHT

Source/Breed	Significant-	Not significant
Sire-region		
Simmental		Nunn et al. (1978)
Simmental	Buchanan & Nielsen (1979)	
Maine Anjou	Buchanan & Nielsen (1979)	
Simmental		Burfening et al. (1985)
Limousin	Bertrand et al. (1987)	
Sire-herd in region		
Simmental		Burfening et al. (1985)
P. Hereford	Bertrand et al. (1985)	
Sire-contemporary group		
P. Hereford	Bertrand et al. (1985)	
Limousin	Bertrand et al. (1987	

TABLE 3. GENETIC CHANGE IN HEREFORD AND ANGUS BREEDS---PROGENY OF BULLS BORN IN LATE 1960'S (ORIGINAL) VERSUS PROGENY OF BULLS BORN IN MID 1980'S (CURRENT)[a]

Breed group	Number weaned	Birth weight lb	200 d wn. wt. lb	Steers slaughtered number	Steers slaughtered weight, lb
Hereford sires					
Original	121	79.7	440.9	33	1030
Current	167	83.9	462.1	44	1084
Difference		4.2	21.2		54
Angus sires					
Original	124	75.8	443.5	36	1030
Current	160	81.3	454.4	46	1100
Difference		5.5	10.9		70

[a] Preliminary results from GPE Program at MARC

CARCASS EXPECTED PROGENY DIFFERENCES

J. K. Bertrand, L. L. Benyshek, D. E. Little, M. H. Johnson,

L. A. Kriese and J. W. Arnold

The need to identify sires that can produce progeny with desireable carcass characteristics is probably more important now than ever before and should become increasingly more important in the future. The mandate to the beef industry from the consumer is the production of a lean and consistently palatable product. The key words are lean and consistent. As discussed by Benyshek et al. (1988), each year the beef industry produces an excess of at least 500 million pounds of fat for those carcasses above yield grade 2. This excess fat represents the energy in more than one million yield grade 2 carcasses weighing 650 pounds. It also appears that the beef industry is moving towards a system where the packer will be trimming and sizing cuts for the retail package. This kind of system will reward those producers that can consistently produce the type of product desired by the packer (Allen, 1987).

The solution to the problems of too much fat in and nonuniformity of the end product cannot be solved by feeding and management alone. It will require genetic manipulation using crossbreeding and accurate sire selection. The use of bulls with carcass genetic values in the form of expected progeny differences should help to increase uniformity of the end product in a crossbreeding system. Allen (1987) suggests that fewer breeds of beef cattle will be used in the future because of the perception of the packing industry on the inability of certain types of cattle to consistently fit their criteria for a uniform quality product. It is important that all breeds move in the direction of research and development of carcass expected progeny differences in order to identify sires that can deliver the type of quality product the industry will demand.

The production of genetic values for carcass traits is possible, but the amount of work and research to be done in this area should not be underestimated. The purpose of this paper is to examine some of the possibilities and problems associated with computing carcass expected progeny differences.

Genetic Parameters. Before a genetic evaluation can become a reality, good estimates of the heritabilities and genetic and environmental relationships between important traits must be obtained. Table 1 presents some heritability estimates given by Benyshek et al. (1988). The heritabilities are generally in the moderate to high range indicating that carcass traits respond well to selection. Most of the previous research done on heritabilities for carcass traits have used data involving British breeds. Every breed interested in generating carcass genetic values needs to initiate projects to obtain heritabilities and genetic correlations immediately.

Genetic correlations from several literature sources are presented in Table 2. The data in this table were from steer and heifer carcasses. The negative relationship between ribeye area and fat thickness indicates that selection for ribeye area or against fat thickness should improve carcass merit. The genetic correlation between fat thickness and marbling are variable; however, the latest studies using field data (Benyshek et al., 1988 and Wilson and Rouse, 1988) found that the genetic correlations between these two traits were .08 and -.30, respectively. This may indicate that it is possible to reduce outside fat while maintaining an acceptable level of marbling.

An analysis of ultrasound field data on yearling Hereford bulls was done at the University of Georgia. One result of this study was an estimate between ribeye area and fat thickness. This difference in the genetic relationship between these two traits compared to those found with steer and heifer data makes it difficult to combine ultrasound data on bull progeny with actual carcass measures on steer progeny to get genetic values. More research is needed with carcass data from bulls to understand why this positive correlation occurred and to understand how bull and steer carcass data can be effectively used together to generate carcass genetic values.

Traits. The carcass traits that have been identified by the industry at the present time as the most important are fat thickness, ribeye area and marbling. The main reason for this is probably the use of these traits in yield grade, cutability % and quality grade determination and the possibility of measuring these traits on the live animal. Table 3 gives some genetic correlations between ribeye area and fat thickness with % retail product. These genetic correlations are moderate to high in magnitude indicating some response may be obtained for % retail product if ribeye area and fat thickness genetic values are used in a selection program. Rouse et al. (1988) reported that % round may be a better predictor than fat thickness and ribeye area of the actual retail yield in a carcass. Ultrasound may provide a mechanism for measuring other traits besides ribeye area and fat thickness to predict how much edible product is produced.

Marbling is a difficult trait to measure in the live animal. Ultrasound technology will be the key to providing a measure of carcass palatability by indicating marbling or some other more objective measure. There may also be some indicator traits that can be used to identify sires that can pass the potential to marble to their offspring. For example, at the University of Georgia an analysis of data from the American Hereford Association (AHA) designed carcass evaluation program examined relative growth rate (Fitzhugh and Taylor, 1971) as an indicator of genetic merit for marbling. This carcass data from AHA was obtained on a weight constant basis (i.e. the steers were slaughtered when they reached a weight of 1,190 lb.). The 2,411 carcass records represented 137 sires which were connected across weaning and slaughter contemporary groups. Relative growth rate (RGR) was computed as the natural log of final weight minus the natural log of on-test weight divided by days on feed. Relative growth rate is average daily gain relative to body weight. Results indicated that RGR and test average daily gain were much the same trait when the endpoint is weight constant (r_g between RGR and Test ADG = .92). Neither RGR or Test ADG had a strong relationship with fat thickness or ribeye area. However, both RGR and Test ADG were highly related to marbling score in these data (genetic correlation = .60 and .64, respectively). Both RGR and test ADG under weight constant endpoint conditions appeared to be good genetic indicators of marbling. The two traits had very small phenotypic and environmental correlations with marbling, ribeye area and fat thickness. If these genetic correlations are accurate, testing bulls to a weight rather than to an age may be beneficial in finding bulls which would sire progeny with increased marbling. These results need further validation including other breeds.

Ultrasound technology. The high costs involved with the collection of actual carcass data and the fact that only dead animals make an actual carcass record dictate that ultrasound technology be used to measure carcass attributes on the live animal. Recio et al. (1986) found correlations between actual fat thickness and ultrasound fat thickness measures and for actual ribeye area and ultrasound ribeye area measures of .76 and .50, respectively. Turner et al. (1989) found correlations between actual fat thickness and ultrasound fat thickness measures and for actual ribeye area and ultrasound ribeye area measures as high as .94. At the ultrasound certification program held at Texas A&M, the range of the participants for correlations between actual carcass measures of ribeye area or fat thickness and ultrasound measures of these two traits was .29 to .87. However, the average correlation for the technicians that met the certification criteria was a respectable .78. A very encouraging result was an average repeatability score of greater than .90 for technicians that were certified. This indicated that each technician was consistent in measuring techniques across cattle and therefore, any differences between technicians could be removed as part of a contemporary group effect and would probably not cause any bias in a genetic evaluation using ultrasound data. More research needs to be conducted with ultrasound to improve the measurement techniques, to improve the hardware to measure carcass quality (palatability) and to increase portability of the ultrasound unit.

TABLE 1. HERITABILITY ESTIMATES FROM SEVERAL LITERATURE SOURCES

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

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

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

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

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

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

TABLE 2. GENETIC CORRELATIONS BETWEEN PERFORMANCE CHARACTERISTICS FROM SEVERAL LITERATURE SOURCES[a]

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

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

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

[c]Source 2 ADG weaning to yearling.

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

TABLE 3. GENETIC CORRELATION BETWEEN % RETAIL PRODUCT WITH RIBEYE AREA AND FAT THICKNESS

	Ribeye area	Fat thickness
Koch et al. (1982)	.53	-.74
Dinkel & Busch (1973)	.20	-.88

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A National Focus on Carcass Evaluation

Darrell Wilkes
(presented by Gary Wilson)

National Cattlemen's Association

Good morning. It's indeed a pleasure for me to be with you this morning and I would like to thank the Beef Improvement Federation for inviting me to participate with such an illustrious panel.

We have been offered a tremendous amount of information the past two days, and I'm sure we all have learned a great deal. Ultra-sound measurements of carcass traits in live cattle, electronic identification, instrument grading and carcass EPD's are part of the national focus of the beef industry. During this year's NCA convention, these items, along with value-based marketing, carcass trait selection/environment interaction and establishing EPD's for use across all breeds, were actively discussed. NCA's commercial cattlemen are particularly interested in the implementation of across-breed EPD's.

The ironic thing about today's discussion and enthusiasm for carcass trait selection is that we were discussing the same things ten to fifteen years ago. In fact, many of our breed associations spent a lot of money and staff time collecting carcass data to complement their sire summaries, but once collected, no one used it. When asked why, the common response was, "why should I?" "I don't get paid for it."

Knowing what happened ten years ago, I ask the simple question, "What's changed about today's marketing system that leads us to believe cattlemen will be rewarded for carcass trait selection?" True, our industry has gone through some dramatic changes during the past ten years. Ultra-sound technology has made it possible for cattlemen to measure carcass characteristics in live feeders and breeding stock. Producer attitude has changed from one of raising cattle to one of producing beef. Today's cattlemen are much more aware of consumer attitudes and demands.

One thing that hasn't changed is the way we market fed cattle. In general, the price received is based on the animal's ability to grade Choice and hang a Yield Grade 3 carcass. Basically, this is the only target the industry has with an associated value, and it has led us to a discount versus discount-free marketing system and average pricing of live cattle.

Discount Free cattle grade Choice and Prime, are Yield Grade 1, 2 and 3 and have a carcass weight of 600-800 lb.

Discount cattle grade less than Choice, are Yield Grade 4 and 5, are too big or too small, have poor conformation, are dark cutters or stags.

Fifty percent of today's cattle carcasses receive no discounts. Fifteen percent of the graded carcasses receive a discount. Thirty-five percent are not graded and receive discounts for obviously missing the Choice 3 and better target.

In recent years, feeders who have a high population of potential discount cattle will mix them with superior cattle and ask the packer buyer to purchase the entire pen. Decreasing supplies has enabled this habit to proliferate. Feeders know that packers must keep the slaughtering and processing lines full in order to maintain operation efficiency. Packers, knowing that they're getting inferior cattle along with the superior retaliate by quoting average prices. The result is a marketing system that reflects the greatest value difference between Choice and no-roll (carcasses which are not graded) and between Yield Grade 3 and 4.

Choice quality has become such a dominate thought in the marketing minds of the industry that feeders are trying to make every animal grade Choice. Some cattle will marble at a young age and grade Choice with fewer days on feed. Others take more time, and some you can feed forever and they will never grade Choice. In trying to make all cattle grade Choice, the current marketing system is producing Yield Grade 3, 4 and 5 carcasses that are too fat for today's consumer.

Do not misinterpret my comments regarding Choice quality beef. It is a very important segment of our beef grading system. In fact, U.S. marbling scores are the mainstay of our industry. They influence retail value difference between low marbling and high marbling beef by as much as $185/carcass. They set the palatability of our product apart from the rest of the world. Consumer "surveys" have shown that above all other consideration for buying food, taste appeal overwhelmingly outranks all others. Consumers have openly endorsed the palatability characteristics associated with Choice beef. Color, flavor, texture and juiciness are important to them. Ninety percent of the graded carcasses in the U.S. grade Choice and we eat every bit of it. We need to protect and nurture the Choice market.

The problem is not the Choice target, the problem is it's the only target with an associated value. If we hope to encourage carcass trait selection, then the marketing system must provide an economic incentive to do so. It must assure cattlemen that there are various degrees of value associated with carcass traits and that, if they select for them, they will be rewarded for it. This type of marketing system has come to be known as a value-based marketing system. One that will identify additional market targets and value differences.

The 1988 increased grading of Select carcasses is a classic example of identifying and increasing our market targets. In 1987, 2.2 percent of the graded beef carcasses were graded Good. In November of that year, the "Good" grade name was changed to "Select". By the end of 1988, 7.7 percent of graded carcasses were graded Select. What caused the increase? It was the industry's response to the 1986 Consumer Retail Beef Study, which told us three things. One, a majority of the consumers prefer the taste appeal of beef, however, a significant number of consumers are willing to sacrifice some taste for leanness. Two, regardless of the consumer's reasons for buying beef, both factions preferred beef cuts with little or no fat trim. Third, consumers preferred the name Select over Good.

Reacting to the study's results, the National Cattlemen's Association supported Public Voice, a consumer interest group, in petitioning USDA to change the grade name to Select. In November 1987, USDA officially changed the name. In early 1988, four of the nation's largest meat retailers started marketing the attributes of Select beef, raising Select grading to 7.7 percent. So far in 1989, Select grading has leveled off to a 7.3 percent monthly average. Marketing experts tell us that the industry needs another large retailer to start marketing Select in order to significantly boost Select grading to 12 or 13 percent. Once that's accomplished, they predict live price quotation and trading for Select cattle will be included in market negotiations.

Where are all the Select carcasses coming from? They're coming from the current no-roll mix. Eighty percent of the no-roll mix will qualify for Select. Of that 80 percent, 65-70 percent are Select Yield Grade 1 and 2; a very lean, nutritious product that consumers have identified as one they prefer. Over the past few months, meat retailers have told us that, on average, Select 1 and 2 carcasses are costing them $1 to $2 more per cwt than Choice 3 carcasses. This bit of information points out two important facts to the industry. One, that many of the live fed cattle that are currently being discounted because they will not grade Choice are being awarded a higher retail value as a Select rolled carcass. Two, it backs up my earlier comment that Yield Grade 3's are too fat to meet consumer demands.

The 1987-88 Beef Retail Market Basket Study showed that the average fat trim on beef retail cuts across the country was .12 inches. That's a far cry from the .4 to .8 inches of fat found on a typical Yield Grade 3 steak. The study went on to show that there was 27 percent less fat on retail beef than there was just two years earlier.

Packer and retailer close trim programs have produced today's leaner beef. Yesterday, Dr. Cross told us that the close trim programs have done all they can do to make our product more attractive to the consumer. It's now up to the producers to genetically trim their cattle to enhance the value of beef.

With all of this in mind, what should the national focus be regarding carcass evaluation? First, as producers and feeders, let's remember that we are responsible for the production of beef. Our breeding and feeding programs must reflect the consumer's preference for taste and leanness as outlined in the Consumer Beef Retail Study. Please note that loin-eye area was not mentioned as a problem by consumers. Dr. Turner, in his comments yesterday regarding carcass composition, said that we probably don't need to increase loin-eyes too much, particularly in females. I would add, with portion sizes decreasing in all foods and the daily red meat consumption recommendation being 6 ounces; let's not make loin-eye area the single trait selection fad of the nineties. Let's also realize that, although it is extremely important that we genetically trim our product, brood cows need to be able to function and survive in the environment in which they are raised. Therefore, fleshing ability will continue to be an important factor for cold climates. Hopefully, meeting the consumer's preference for leanness with easy fleshing cows can be accomplished with terminal sires.

The national focus for carcass evaluation should coincide with the targets of the value-based marketing (VBM) system. What will the targets be? In keeping with the consumers' theme of taste appeal and leanness, I believe Prime, Choice, Select and Yield Grades 1 and 2 will be the foundation of the value-based marketing system.

How quickly will value-based marketing become a reality? In the next two weeks, the VBM Task Force will be appointed. NCA will appoint five to six members representing the producer/feeder interest. The Beef Industry Council will appoint five to six members representing the packer/retailer interest. Together, the task force will identify problems impeding progress toward a VBM system; prioritize research needs designed to eliminate the impediments; and draft a multi-year plan that will lead to the implementation of a VBM system. Industry experts predict five to eight years before VBM becomes a reality.

What will the research needs be? A key element to VBM will be the objective measurement of live animals and carcasses for leanness, marbling and loin-eye area. Yesterday, Dr. Cross told us that instrument grading will take five to eight years to perfect and that we need to start now. Therefore, instrument grading will probably be number one. We need a carcass consist study to tell us what we are actually producing today. The last one was conducted by USDA in 1973. At that time, five to six British breeds and two or three European breeds made up the national cowherd. Today, we have over seventy breeds represented in the national herd. All of us realize the importance of genetic variation, but how has product consistency and tenderness been affected by the addition of so many breeds? Another area of study is the establishment of carcass EPD's. Like instrument grading, EPD research is going to take some time and many industry leaders believe we must get started now.

Due to the research needs, implementation of VBM appears to be on a five to eight year track. That coincides nicely with the expansion of the national herd and the length of time needed to increase fed cattle supplies. VBM doesn't mean anything at the present time because fed cattle supplies are so low, packers will take anything to get beef in the cooler. However, when supplies increase to the point where packers can get choosy again, will cattlemen be producing the right kind? Remember, packers and retailers know what the consumers want and what they're willing to pay. As producers and feeders, we need to be sure we're producing what they can sell. It is extremely important to all segments of the beef industry that we produce a product that reflects the consumer's preference for taste and lean. If we fail to do that, we will continue to lose market shares to chicken, pork and fish.

It is also important that we change from a marketing system that encourages average prices to one that recognizes additional market targets and value differences. Producers told us ten years ago that if they don't get paid for carcass traits, they won't select for carcass traits. If we don't change the system, they won't hesitate to tell us again.

GENETIC PREDICTION COMMITTEE
MINUTES
13 MAY 1989, NASHVILLE, TENNESSEE

The chairman, Dr. Larry Cundiff, called the meeting to order 2:15 p.m. in the main meeting room of the Hyatt Regency Hotel. Initial attendance was in excess of 100.

The first order of business was a discussion of the revised proposal for the National Animal Evaluation Program Guidelines by Willham. Prior to the meeting, the proposal had been sent to the members of the committee asking that suggestions be brought to the BIF meeting. One excellent suggestion was made by Quaas. Because of the large numbers in attendance no attempt was made to revise the proposal since only a few had copies. The symposium speakers generated much interest in the possibility of generating across breed EPDs. As a result, Willham proposed that the guidelines not be finalized for board approval until after the Genetic Prediction Conference this fall. The current proposed guidelines appears in the appendix of these minutes.

Then Willham reported on the plans of the Third Genetic Prediction Workshop to be held this fall. A handout of the plans appears in the appendix of these minutes. An early December 1989 date was proposed, but the discussion favored a late October 1989 meeting date so that a final guidelines could be completed by the mid-year meeting of the BIF board in November of 1989. Much discussion and consensus is needed before the ideas presented at the symposium and this meeting could be incorporated with the guidelines. Therefore, after this meeting the guidelines could be completed. As a result, the workshop agenda will include presentations and time for discussion of at least the following topics: 1) Across breed EPDs, 2) Body composition EPDs using live animal measures and carcass evaluations, and 3) Other selected topics such as EPDs for the reproductive complex and mature size and methodology problems. There will be much to discuss and time will be devoted such that a consensus among researchers and industry leaders can be developed. New names were added to the invitation list. Willham will continue to develop the particulars for the workshop.

Because of airline schedules, Dr. Keith Bertrand was next on the programs and discussed Genetic Prediction of Body Composition with a review of his symposium presentation. This paper appears elsewhere. The motion was made and seconded that guidelines should be formed for live animal measures of body composition and that only live animal measures by certified persons be used. A straw vote was held by Cundiff and approximately one-third of those in attendance favored the motion. None were opposed, but the point was made that procedures and certification were still part of the necessary research.

Cundiff then introduced a set of guidelines for the KSU program for carcass evaluation by Larry Corah. It was suggested that the design of the program would logically be a part of this committees guidelines but that the measuring procedure guidelines were a responsibility of another committee. The guidelines appear in the appendix of these minutes.

Then Dr. Merlin Nielsen first and Dr. Jim Brinks presented papers on the genetic prediction of reproduction. These appear in the appendix of these minutes. Lively discussion followed the presentations. Calving date has possibilities; however, the need for an inventory system for reproduction is desperately needed. The records necessary for evaluation need to be put in place. Nichols suggested that there be no guidelines for serving capacity or we would have the animal rights people on us.

Dr. Doyle Wilson presented a preliminary report on the genetic prediction of mature size and composition. He reported on the Angus Association project to gather appropriate data. Numerous good suggestions were made in the discussion that followed.

Then Dr. David Notter reviewed his symposium paper on EPDs across and within breeds. There are four pieces of information necessary to generate across breed EPDs. The first is true breed mean differences. The second is comparable bases for the breeds. The third is within breed EPDs. And the fourth is estimates of heterosis. Base adjustments are likely to be traumatic for the breeds since the EPDs will change. A fixed uniform base of say

1985 animals for the 1990 summary followed by 1986 animals for the 1991 summary was suggested as being appropriate to handle this nuisance parameter. The US MARC breed comparison data was suggested as a good start for the first piece of information. It was suggested that the new NC-196 project involved some 20 stations around the country and even included 7 projects with Zebu. Objective one of the project might be used to add data to the breed comparisons and that project could be responsible for updating the necessary breed constant table. Several straw votes were taken, but the point was made that the breed associations needed to be involved in the development. Thus, an excellent and very timely topic was generated for the genetic prediction workshop. The discussion was lively and many good suggestions and observations were made. Clearly, much though and discussion will be necessary to arrive at consensus. Such can not be done without consensus. Notters paper appears elsewhere in the proceedings.

Dr. Dale Van Vleck presented a paper on genetic grouping-direct and maternal effects. This appears in the appendix of these minutes. Little discussion followed since the hour was approaching 5 p.m. and for some reason the Grand Old Opry seemed to be calling.

This was a difficult meeting in that many were in attendance, but much was accomplished in terms of good ideas and observations. The meeting was adjourned at 5:15 p.m. by Chairman Cundiff.

Respectfully submitted,

Richard L. Willham
Secretary

APPENDIX

1. Guidelines Proposal
2. Genetic Prediction Announcement
3. KSU guidelines
4. Nielsen paper
5. Brinks paper
6. Wilson outline
7. Van Vleck paper

Initial Report--Carcass Data Collection

At the 1988 Beef Improvement Federation meeting held in Albuquerque, New Mexico, it was recommended that Larry Cundiff appoint a committee to review the guidelines for carcass data collection and make recommendations on BIF's possible involvement with some National Carcass Data Collection programs.

Larry Cundiff appointed a committee consisting of: Larry Corah, Chairman; Bob Koch, Doyle Wilson, Larry Benyshek, Michael Dikeman, Russell Cross and Larry Cundiff. This committee was convened on October 6, 1988 at Kansas City, Airport Holiday Inn, with additional representatives from the National Cattlemen's Association--Darrell Wilkes and Gary Wilson; and Jim Gibb was asked to attend representing breed associations.

At the meeting, Doyle Wilson and Larry Benyshek reviewed carcass data needs as they pertain to the development of carcass EPD's for national sire summaries. Larry Corah and Russell Cross reviewed two possible programs designed to allow producers the opportunity to collect carcass data. Darrell Wilkes discussed the development of a National Carcass Data Collection program.

The Committee recommended:

1. By the 1989 BIF meting, this appointed committee review the current guidelines for carcass data collection and make suggestions for possible changes.

2. It was recommended that this committee work closely with the Ultrasound Committee that was developed, to establish a certification program for individuals that will be utilizing ultrasound equipment for establishing carcass information such as fat cover and loineye area. Jim Gibb agreed to serve as liaison individual between this BIF Carcass Data Committee and the Ultrasound Committee.

3. It was recommended that the two proposals submitted by Texas A&M and Kansas State University be written and properly promoted, as both offer opportunities for cattle producers to collect carcass data. Specifically, the Texas A&M program would allow national carcass data collection through utilization of both the ultrasound equipment and an on site carcass collection team. Both programs would have appropriate charges. Specifically, the Kansas program would allow producers desiring progeny data out of various sire lines to put cattle in feedlot to collect both gain data and carcass data on progeny fed under uniform environmental conditions. Both Russell Cross and Larry Corah were encouraged to pursue expansion of the program to allow greater opportunities for producers to participate in carcass data collection.

Interim report submitted by: Larry R. Corah, Kansas State University, Chairman, Carcass Collection Committee

SUGGESTED GUIDELINES FOR CARCASS DATA COLLECTION

BACKGROUND

There is considerable evidence that the beef cattle industry is moving into an era of specification production to meet the current demands of the consuming public. To produce a nutritious, high quality uniform product for the consuming public, considerably more carcass information needs to be available on various sire lines within a breed.

The following proposal outlines a design to help purebred producers and commercial cattlemen identify those sire lines that can allow the industry to produce the type of beef product that the consuming public desires.

OBJECTIVE

To provide a centralized testing locations whose purpose would be to evaluate the feedlot performance and carcass desirability of progeny from known beef sires.

DATA COLLECTED AND ELIGIBILITY

Following the arrival of the cattle at a commercial or private feedlot there would be an approximate 21 day adaptation period before the start of the official feeding test. All steers should be routinely processed upon arrival and should be pre-conditioned and weaned at least 30 days prior to consignment.

It would be our suggestion that the progeny data be collected on steers, however, heifer data can also be useful. For a test to be a sire evaluation, the data qualifying for a breed association sire summary for carcass traits at least two sires must be represented with a minimum of 5 head and preferably 20 head per sire consigned. In order to evaluate sires within a breed, one of the sires used must be a reference sire. If no reference sire is used across herds, the comparison will be within herd. To be sure that your carcass data will qualify for a sire summary with your respective breed associations, it is encouraged that you call your national association prior to consigning cattle to a test.

For the progeny out of a sire to be considered a contemporary group, the following criteria must be considered:

a) Calves in each contemporary group need to either be born from heifers or cows. Calves out of a contemporary group that has heifers as mothers cannot be compared to another contemporary group that has cows as mothers unless a common sire is used in each age of dam contemporary group.

b) Either heifers or steers could comprise a contemporary group, but a contemporary group made up of heifers cannot be compared to a contemporary group comprised of steers unless again a common reference sire is represented in each group. In other words, we can compare sires A, B and C, even though A had only heifer calves and B had only steer calves as long as sire C had an adequate number of progeny represented in each sex contemporary group.

c) The breed of dam is an extremely important part of the contemporary group. To compare contemporary groups, they have to come out of dams of similar breeding.

d) All animals within a contemporary group must be born within a 90 day period to be evaluated against each other.

All the data collected should be on an individual basis. Upon arrival, the cattle should be frame scored and ultrasonic equipment used to determine when the desired fat cover has been reached.

During the duration of the trial, rate of gain should be recorded with the cattle slaughtered when all of the contemporary group consigned by an individual reach a compositional endpoint of .4 inch fat cover and do not exceed a live weight of 1300 pounds.

The program should be in a position to cooperate with a national or state breed association in developing guidelines specific for their needs. For instance, if they have a desired compositional endpoint or end weight, there needs to be flexibility in the program to accommodate these needs. The number of cattle needed to adequately genetically evaluate a sire could be determined by the breed association.

DATA COLLECTION - OPTIONS

Option A: Feedlot Performance and USDA Carcass Grading Data

1. Feedlot Data:

    a. Frame Score
    b. Fat Thickness on Test (ultrasound)
    c. Average Daily Gain

2. Carcass Data: When progeny in the sire evaluation program are slaughtered, qualified personnel should be available to collect the following carcass data at cooperating slaughter plants. At time of slaughter, all animals will be individually tagged for identification and the carcass data collected following a 24 hour chill.

    a. Hot Carcass Weight
    b. Adjusted Preliminary Yield Grade (Fat Thickness)
    c. Rib-eye Area
    d. Percent Kidney, Heart and Pelvic Fat

e. USDA Yield Grade (nearest 0.1)
f. Carcass Maturity
g. Degree of Marbling
h. Carcass Quality Grade
i. Any abnormalities of lean, color, firmness and/or texture will be noted.

Option B: Warner - Bratzler Shear Force Analysis

If the owner of a beef sire desires an objective evaluation of tenderness on progeny it would be advantageous if a Warner-Bretzler analysis could be made.

1. Will include all the data collected in option A.

2. A 12th rib steak should be obtained from each individual, identified and returned to the meat laboratory.

3. Rib steaks should be vacuum packaged and aged for 12 days postmortem at 36 degrees F.

4. Following vacuum aging, all steaks should be broiled to an internal temperature of 158 degrees F and eight 1/2" cores removed.

5. Eight cores will be sheared using a 4200 series Instron with Warner - Bratzler shear attached. Mean peak shear force values could then be provided.

Genetic Prediction and Selection for Reproduction in Beef Cattle

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I will address only a portion of this broad topic. Opportunities for selection to increase conception rate, reduce gestation length, produce earlier calving date and increase twinning frequency are highlighted. After addressing these four areas (calving date actually includes variation in conception rate and gestation length), I will focus on data recording needs and possible situations for implementation of effective selection.

Conception Rate for a Breeding Service.

Background. Azzam, Keele and Nielsen (1988) reviewed the literature for estimates of heritability for conception rate (trait of the service sire, potential dam and potential calf) and non-return rate (mean conception rate) of service sires. Expectations were derived to explain variation in the various estimates. The model for the success or failure of conception included three breeding values (A_o, direct; A_m, maternal; and A_p, paternal) and three environmental sources (E_o, unique for the potential calf; E_m, common maternal for a potential dam; and E_p, common for services of a sire).

After studying a wide array of heritability estimates, it appears that E_p is a larger source of variation than A_p. Maternal breeding value, A_m, seems to be the largest source of genetic variation and A_o appears to be of no importance. As a proportion of phenotypic variance in conception rate, the variances of other components are approximately: A_m, .02; A_p, .0025; A_o, 0; E_p, .005, assuming covariances are zero. Thus heritabilities of conception probability as a trait of the calf, potential dam and service sire for a single record are approximately .03, .02 and .0025. The correlation between service records of a sire (different females) is approximately .0075. As a trait of the potential calf, heritability estimates are not useful because they contain four times the variance in E_p.

Genetic Prediction. Since heritabilities are so low, the only hopes for much accuracy in selection to increase conception rate would come through selection among 1) service sires with many records to change A_p and among 2) sires with many daughters with conception records to change A_m. Accuracy for ranking sires for these two criteria from simply using only their own repeated performance as service sires or through their daughters is:

1) Service sire, h^2 = .0025, re = .0075 (repeatability)

number of services	50	100	200	500
accuracy	.30	.38	.45	.51

2) Sire of daughters, $h^2 = .02$, $t = .005$ (correlation among daughters)

number of daughters	50	100	200	500
accuracy	.45	.58	.71	.85

The accuracy of evaluating service sires for A_p reaches a limit of .58 due to the presence of E_p effects that are confounded with A_p. Large numbers of services or daughters, which is more demanding yet, are needed to attain accurancies of .5.

Possible Selection Response. Beginning with a mean conception probability of .70, the phenotypic variance of individual services is .21. The standard deviations for A_m and A_p are .065 and .023, respectively. With accuracy of .40 for selection of service sires and sires of new daughters and intensity of 1.4 (very optimistic) of their selection and a generation interval of 5 years, the predicted response is .0025 increase per year in conception probability. Under this optimistic approach, it would take more than 40 years to increase conception rate on a service from .70 to .80. The variance would decrease further as conception probability increased, slowing response further yet.

Gestation Length

Background. Several reports (including Everett and Magee, 1965; Phillipson, 1976; Burfening et al., 1981; Gaillard and Chavaz, 1982; Azzam and Nielsen, 1987a and Wray et al., 1987) have investigated the magnitude of direct (A_o) and maternal (A_m) breeding value effects as sources of variation in gestation length. The proportion of the phenotypic variance due to variance in A_o (genes of the calf) breeding value appears to be about .40 and that due to variance in A_m (genes of the dam) breeding value about .07. The correlation between these two breeding values seems to be negative at about -.40. Thus, they are undesirably related from a selection response standpoint, but perhaps not from a biological one.

Besides accounting for the usual effects of contemporary groups, fixed adjustments for sex, single vs. twin and age of dam are needed. First parity of dam is about 3 days shorter than third and later; second parity is about 1 day shorter than later pregnancies. Bull calves have a 2-day longer gestation than heifer calves. Gestation of a twin pregnancy appears to be 5 days shorter than for a single heifer calf.

Genetic Prediction. Because a large portion of the variance in gestation length is due to variance in direct breeding value effects, selection of young animals with estimated breeding value dependent heavily on their own gestation length seems optimal. Ranking of animals should be for overall breeding value merit, defined as the sum of direct and maternal breeding values. The negative genetic correlation between direct and maternal is considered in the selection criterion. Accuracy of selection of young males and females is then at least .60.

Possible Selection Response. Azzam and Nielsen (1987b) estimated response per year for selection to shorten gestation period. Estimates for the selection scenarios, varying selection intensity and generation length, ranged from .90 to 1.00 days per year. There must be some limit where further reduction would be detrimental to survival. The favorable correlated response to shorter gestation length is a decrease in birth weight, and maybe dystocia. The more direct, obvious reason for shorter gestations is to give cows more time to return to estrous cycling hence maximizing the number of breeding opportunities during the breeding season.

Calving Date

Background. Bourdon and Brinks (1983) studied calving date and calving interval as measures of reproduction. With fixed breeding seasons, they suggested that calving date would be more heritable and be a better selection criterion because it also has direct economic value (older calves weigh more at fixed weaning date). Itulya (1980), Azzam and Nielsen (1987a) and Meacham and Notter (1987) are some of the studies which have investigated the nature and magnitude of genetic variation in calving date.

Calving date, although easy to measure, is determined by many variables. Age at puberty, stage of estrous cycle at the start of breeding season, conception probability and gestation length all contribute to variation in calving dates of heifers. For second and later calvings, the same sources, with replacement of length of postpartum anestrus for age at puberty, contribute to the variation. Thus there are many possible genetic and non-genetic sources of variation. It can be viewed as both a trait of the dam calving and of the new calf.

Genetic Prediction. When calving date or birth date was treated as a measure on the calf, heritability estimates have ranged from about .10 to .20. As a trait of the dam, heritability estimates have been between .05 and .15. It appears that direct (A_o) breeding values are at least as important as maternal (A_m) breeding values for contributing variation. The possible correlation between direct and maternal effects is unclear. Because the magnitude of direct effects in the calf is appreciable, it appears that selection on a criterion early in the animal's life should be reasonably accurate. Use of more data from relatives, however, is more helpful here than with one of the components, gestation length.

Possible Selection Response. Azzam and Nielsen (1987b) completed the prediction calculations using their estimates of genetic parameters (.09 and .03 for proportions of phenotypic variance due to A_o and A_m, respectively; -.38 for the correlation between breeding values). The definition of overall net breeding value was the sum of A_o and A_m. For various selection scenarios, response (earlier calving date) in a fixed breeding season was .55 to .75 days per year of selection. A limit would eventually be reached, and as it approached, variance for selection would decrease. Variance in stage of estrous cycle at the start of the breeding season should always be present and serve as something to reduce heritability.

Twinning

Background. Probably the most opportune area for selection to improve reproduction in beef cattle lies in increasing the rate of twinning from the present level of .5 to 3%, depending on breed (Morris and Day, 1984). Variation in twinning seems to be due mainly to ovulation rate, not success of embryos. Thus twinning can be studied as a trait of the reproducing female. Besides the low frequency in most populations, occurrence of twin births is influenced by parity of the female; first parity has the lowest frequency. Thus selection at a young age based only on first parity occurrence is hampered. However, selection on ovulation rate measured over several cycles even at young ages, should increase accuracy.

Genetic Prediction. Most estimates of heritability have been low. In a population where twinning rate is only .5 to 1%, heritability is probably .02 and repeatability about .06. Level of heritability and repeatability, as well as the variance, are dependent on the frequency. Population screening attempts in four experiments (one at MARC, others in Australia, France and New Zealand) have been successful in attaining subpopulations with higher twinning frequency (usually over 10%), thus increasing the parameters. For example, Gregory et al. (1988) estimate heritability at .06 and repeatability at .07 in their higher twinning herd.

With such low heritability, ranking of sires on several daughters' performance would be required to gain reasonable accuracy. If we were to attempt to rank sires in an industry as opposed to a nucleus subpopulation, many daughters are needed if the frequency is only .005 and heritability is .02 and repeatability is .06. Accuracies of ranking sires for number of daughters with one (1) and two (2) records each are:

1) number of daughters	50	100	200	500
accuracy	.45	.58	.71	.85

2) number of daughters	50	100	200	500
accuracy	.56	.70	.81	.91

If heritability was only .01 and repeatability was .05, the accuracies would be:

1) number of daughters	50	100	200	500
accuracy	.33	.45	.58	.75

2) number of daughters	50	100	200	500
accuracy	.44	.57	.70	.84

Another possibility has been suggested by many people. That is to measure ovulation rate through several (up to 30?) cycles. Azzam (unpublished) has taken a look at ranking young males and females on their adult female relatives ovulation rates. In a subpopulation with high multiple ovulation rate, Gregory et al. (1988) estimated heritability at .06 and repeatability at .07. Accuracies of estimating breeding values of young animals when their adult relatives have either 17 or 30 measurements each are .42 and .46, respectively.

Possible Selection Response. With accurate collection of all calving records, selection for twinning could be carried out in an industry recording/selection scheme like we currently practice for weight measures. However, young sires would need to produce at least 100 daughters each to have a reasonable level of accuracy. Fairly intense selection (1 in 20) among progeny tested sires could be done through artificial insemination. With a population starting at a frequency .005 and intense selection among progeny tested sires as described, response could be .005 to .006 per year. With increasing frequency, response would be faster due to an increase in variance and accuracy.

Alternatively, selection on ovulation rate would need to be done under controlled conditions. Repeated measurement of corpora lutea requires skill and uniform conditions for the cycling females. Selection on ovulation rate could be initiated in subpopulations, screened for high twinning or multiple ovulation frequency. Azzam's (unpublished) predictions for a juvenile MOET scheme (super ovulation, embryo transfer of selected yearling heifers; breeding heifers and bulls ranked on adult female relative's repeated ovulation counts) are about .007 to .008 in multiple ovulators per year, and hopefully, twinning rate. Selection response from this elite subpopulation would then be disseminated to the industry through transfer of sires.

Final Considerations

Selection to increase conception rate or decrease gestation length or produce earlier calving dates in the calving season could all be attempted under our present industry structure. Birth dates are already part of our normal recording for a variety of reasons. We would expect them to be reasonably accurate. Selection using conception rate or gestation length measures requires new additions to the recording systems. We would need to record and add to the data system every service date, both natural and artificial services. This is a tremendous addition of data and would be costly for accurate recording and in data storage. Thus selection on earlier calving date, the complex measure of several sources of variation, seems most feasible under our present working structures.

With improved recording of twinning, we could attempt to practice selection under our present industry structure. However, the low frequency in our breeds versus in highly screened samples limits effective heritability. It appears that a better strategy for increasing twinning then is to form large elite herds, screened for extremely high twinning rate. Use of repeated multiple ovulation measures could be used in these herds with concentrated technical expertise. Environmental variation could be lessened further under stricter control of the animals. This could further enhance heritability along with the boost from higher frequency. Thus I would recommend selection in these intensive, elite herds as the procedure to increase twinning rate. The high cost of the selection process would be easily offset through eventual use of sons in part of the industry with feed resources and management to support cows producing twins.

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Genetic Grouping: Direct and Maternal Effects

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Introduction

Effects of genetic groups can be included in models used for genetic evaluation to account for prior selection that resulted in base animals for which records are not available to the genetic evaluation. If base animals are from one birth period and all are selected in the same way, then one genetic group is sufficient. A single genetic group is implied when genetic groups are not included in the model used for evaluation. Base animals, by necessity as well as logically, usually are defined as those most recent ancestors that do not have records or collateral descendants. Nearly all, if not all, data sets for genetic evaluation include records associated with base animals from different time periods and selection paths. Quaas and Pollak at the Kansas City Workshop (1987) discussed the consequences of ignoring genetic group effects. If selection has occurred, then ignoring differences in groups has two major consequences in prediction of breeding values. Essentially, the predictions involve regression to the average group effect rather than to the appropriate group effects. Rankings of animals with base ancestors from different time periods and selection paths can be affected. The other consequence arises when new data are added that include base animals from later time periods. Evaluations of older animals with no new information (records or relatives) may change, i.e., float, because the implied assumption that the base for the evaluation has been set by an unchanging base population is not correct.

Quaas and Pollak (1987) outlined the simple steps needed to add genetic groups to a model that did not include maternal effects. They used their modified equations (Quaas and Pollak, 1981) for predicting breeding values (the Q-P transformation) and the rules Westell (1984) found for forming the equations by first including equations for base animals and then absorbing those equations. The resulting Q-P-W equations can be readily converted to reduced animal model (Quaas and Pollak, 1980) equations -- the RAM-Q-P-W equations.

The purpose of this note is to discuss a simple extension of those results when maternal genetic effects and maternal group effects are included in the model.

Models with Maternal Group Effects

The equations can be set up easily if three conditions are met: 1) the solution vectors for direct and maternal breeding values include the same animals, 2) the most recent female ancestor without records of each animal with a record is included in both the direct and maternal breeding value vectors, and 3) both parents of the most recent female ancestor without records are assigned to the same genetic group she would have been assigned for a model that ignores maternal effects.

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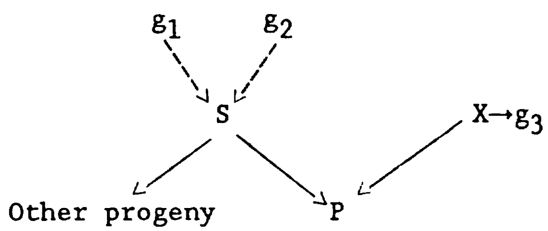
Quaas and Pollak (1981) assigned group effects to records with the **Q** matrix. The **Q** matrix weights group effects, g_i, associated with most recent ancestors without records by their numerator relationships to the animals with a record. In the following example, the row in **Q** associated with animal P has 1/4, 1/4 and 1/2 as its elements.

In the following pedigree, S and X do not have records:



The genetic groups of the parents of S are g_1 and g_2, whereas X, as a base animal, is assigned to group 3. Animal S is treated differently from X because S is indicated to have at least one other progeny in the data set, i.e., is an ancestor of collateral descendants, P and other progeny. The direct additive genetic value of P is $a_P^* = a_P + g_1/4 + g_2/4 + g_3/2$ where a_P is the deviation of the additive genetic value of P from the function of genetic group effects of P's most recent ancestors, $\mathbf{Qg}_a$.

In general, $\mathbf{a}^* = \mathbf{a} + \mathbf{Qg}_a$ where

$\mathbf{a}^*$ is the vector of breeding values for direct effects,

$\mathbf{a}$ is the vector of deviations of direct genetic values from the appropriate functions of genetic group effects,

$\mathbf{g}_a$ is the vector of genetic group effects, and

Q is the matrix that associates the fractions of genetic group effects with the breeding values in $\mathbf{a}^*$.

Simple rules for models with maternal effects comparable to the rules for forming the Q-P-W equations require that:

$\mathbf{a}^* = \mathbf{a} + \mathbf{Qg}_a$ and $\mathbf{m}^* = \mathbf{m} + \mathbf{Qg}_m$ where

$\mathbf{m}^*$ is the vector of maternal breeding values,

$\mathbf{m}$ is the vector of deviations of maternal genetic values from the appropriate functions of maternal genetic group effects,

$\mathbf{g}_m$ is the vector of maternal genetic group effects, and

$\mathbf{Q}$ is the same for both $\mathbf{a}^*$ and $\mathbf{m}^*$, i.e., base animals are assigned to direct and maternal genetic groups in exactly the same way.

Details of the development are described by Van Vleck (1989a) and rules for setting up the reduced animal model equations with direct and maternal genetic groups are discussed in Van Vleck (1989b). The following discussion demonstrates how little modification is needed to incorporate direct and maternal genetic group effects in animal model evaluations.

Comparison Of Equations With And Without Group Effects

All animals with records, animals without records but with collateral descendants (sires, for example), and animals without records that are mothers of animals with records are included in the vectors ($\mathbf{a}$ and $\mathbf{m}$) for both the direct and maternal genetic effects. The genetic groups essentially act as proxy parents so that vectors of effects of genetic groups substitute for the effects of the base animals; $\mathbf{g}_a$ for direct genetic effects and $\mathbf{g}_m$ for maternal genetic effects. If, as Quaas and Pollak (1987) suggested, the number of such groups are relatively few, then few extra equations are added when including genetic group effects. All that needs to be done for each animal that has one or two base animals as parents is to assign those parents to groups by selection path and time period. Westell's rules automatically generate the proper coefficients for the modified equations -- the Q-P-W equations, as will be seen later.

Solution vectors.

The solution vectors for the two cases are:

No groups

$$\begin{bmatrix} \hat{\mathbf{a}} \\ \\ \hat{\mathbf{m}} \end{bmatrix}$$

Groups

$$\begin{bmatrix} \hat{\mathbf{a}}^* \\ \hat{\mathbf{g}}_a \\ \hat{\mathbf{m}}^* \\ \mathbf{g}_m \end{bmatrix} = \begin{bmatrix} \hat{\mathbf{a}}+\mathbf{Q}\hat{\mathbf{g}}_a \\ \hat{\mathbf{g}}_a \\ \hat{\mathbf{m}}+\mathbf{Q}\hat{\mathbf{g}}_m \\ \hat{\mathbf{g}}_m \end{bmatrix}$$

With grouping and the Q-P modification, $\mathbf{a}^*$ and $\mathbf{m}^*$ correspond to predicted breeding values for direct and maternal effects with the genetic group effects, $\mathbf{g}_a$ and $\mathbf{g}_m$, incorporated automatically. The number of extra equations is relatively few (for $\mathbf{g}_a$ and $\mathbf{g}_m$). As Quaas and Pollak (1987) described, the extra computations are trivial for the direct effects model and also will be minor when maternal effects are considered.

For illustration, fixed effects and non-genetic maternal effects will be ignored but are considered by Van Vleck (1989a, 1989b).

Notation.

$\mathbf{Z}$ is a matrix that associates the vector of additive direct genetic effects, $\mathbf{a}$, with records in $\mathbf{y}$, ($\mathbf{Z} = \mathbf{I}$ except that the diagonal is zero for animals in $\mathbf{a}$ without records),

$\mathbf{S}$ is a matrix that associates the vector of additive maternal genetic effects, $\mathbf{m}$, with records in $\mathbf{y}$, (each row of $\mathbf{S}$ will have a single 1 except that the entire row will be null for animals without records).

The single trait mixed model equations will be multiplied through by the residual variance, σ_e^2; thus let

$$\begin{bmatrix} \alpha & \lambda \\ \lambda & \gamma \end{bmatrix} = \sigma_e^2 \begin{bmatrix} \sigma_a^2 & \sigma_{am} \\ \sigma_{am} & \sigma_m^2 \end{bmatrix}^{-1}$$ where

σ_a^2 is additive direct genetic variance,

σ_m^2 is additive maternal genetic variance, and

σ_{am} is covariance between additive direct and additive maternal genetic effects.

$\mathbf{A}$ is the numerator relationship matrix among animals with effects included in $\mathbf{a}$ and $\mathbf{m}$. If base animals are included, then $\mathbf{A}^{-1}$ can be computed by rules of Henderson (1976).

$\mathbf{W}$ is the matrix of coefficients calculated by the rules of Westell (1984) for the Q-P-W equations (the Quaas and Pollak modified equations after base animals are absorbed). The partition of $\mathbf{W}$ is such that $\mathbf{W}_{11}$ is the diagonal block associated with animals in $\mathbf{a}^*$ or $\mathbf{m}^*$, $\mathbf{W}_{22}$ is the diagonal block associated with $\mathbf{g}_a$ or $\mathbf{g}_m$ and $\mathbf{W}_{12}$ is the corresponding off-diagonal block.

The Equations.

The similarity of the equations without and with genetic groups in the model can be easily shown in matrix notation.

The mixed model equations (MME) without groups:

$$\begin{bmatrix} \mathbf{Z'Z} + \alpha\mathbf{A}^{-1} & \mathbf{Z'S} + \lambda\mathbf{A}^{-1} \\ \mathbf{S'Z} + \lambda\mathbf{A}^{-1} & \mathbf{S'S} + \gamma\mathbf{A}^{-1} \end{bmatrix} \begin{bmatrix} \hat{\mathbf{a}} \\ \hat{\mathbf{m}} \end{bmatrix} = \begin{bmatrix} \mathbf{Z'y} \\ \mathbf{S'y} \end{bmatrix} .$$

The Q-P-W equations with groups:

$$\begin{bmatrix} \mathbf{Z'Z}+\alpha\mathbf{W}_{11} & \alpha\mathbf{W}_{12} & \mathbf{Z'S}+\lambda\mathbf{W}_{11} & \lambda\mathbf{W}_{12} \\ \alpha\mathbf{W}_{12}' & \alpha\mathbf{W}_{22} & \lambda\mathbf{W}_{12}' & \lambda\mathbf{W}_{22} \\ \mathbf{S'Z}+\lambda\mathbf{W}_{11} & \lambda\mathbf{W}_{12} & \mathbf{S'S}+\gamma\mathbf{W}_{11} & \gamma\mathbf{W}_{12} \\ \lambda\mathbf{W}_{12}' & \lambda\mathbf{W}_{22} & \gamma\mathbf{W}_{12}' & \gamma\mathbf{W}_{22} \end{bmatrix} \begin{bmatrix} \hat{\mathbf{a}}^* \\ \hat{\mathbf{g}}_a \\ \hat{\mathbf{m}}^* \\ \hat{\mathbf{g}}_m \end{bmatrix} = \begin{bmatrix} \mathbf{Z'y} \\ \mathbf{0} \\ \mathbf{S'y} \\ \mathbf{0} \end{bmatrix} .$$

The correspondence between MME and Q-P-W equations with groups is even more striking if additional notation is introduced:

Let $\mathbf{Z}_+'\mathbf{Z}_+ = \begin{bmatrix} \mathbf{Z'Z} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} \end{bmatrix}$, $\mathbf{S}_+'\mathbf{S}_+ = \begin{bmatrix} \mathbf{S'S} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} \end{bmatrix}$, $\mathbf{Z}_+'\mathbf{S}_+ = \begin{bmatrix} \mathbf{Z'S} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} \end{bmatrix}$ with

$$\hat{\mathbf{a}}_+ = \begin{bmatrix} \hat{\mathbf{a}}^* \\ \hat{\mathbf{g}}_a \end{bmatrix} \quad \text{and } \hat{\mathbf{m}}_+ = \begin{bmatrix} \hat{\mathbf{m}}^* \\ \hat{\mathbf{g}}_m \end{bmatrix} .$$

Then the Q-P-W equations with groups are:

$$\begin{bmatrix} \mathbf{Z}_+'\mathbf{Z}_+ + \alpha\mathbf{W} & \mathbf{Z}_+'\mathbf{S}_+ + \lambda\mathbf{W} \\ \mathbf{S}_+'\mathbf{Z}_+ + \lambda\mathbf{W} & \mathbf{S}_+'\mathbf{S}_+ + \gamma\mathbf{W} \end{bmatrix} \begin{bmatrix} \hat{\mathbf{a}}_+ \\ \hat{\mathbf{m}}_+ \end{bmatrix} = \begin{bmatrix} \mathbf{Z}_+'\mathbf{y} \\ \mathbf{S}_+'\mathbf{y} \end{bmatrix} .$$

Basically, the only difference between the Q-P-W equations with groups and the mixed model equations without groups is equations for the direct and maternal group effects with zero right hand sides and zero, least-squares coefficients which are accounted for by $\mathbf{W}$.

Calculation of $\mathbf{A}^{-1}$ and $\mathbf{W}$.

Westell's rules for calculating $\mathbf{W}$ turn out to be simple modifications of Henderson's rules for calculating $\mathbf{A}^{-1}$. Both sets of rules make use of a list of animals, an, with corresponding lists of sires, s, and dams, d. When groups are included in the model, if the sire or dam of an animal in $\mathbf{a}$ or $\mathbf{m}$ is a base animal, the group of the sire, g_s, or group of dam, g_d, replaces s or d. In calculation of $\mathbf{A}^{-1}$, each animal listed as a sire (in s) or a dam (in d) also must appear in the vector of animal identification numbers, an. In calculation of $\mathbf{W}$, the proxy groups, g_s or g_d, do not appear in the list of animal identification numbers.

The contributions to $\mathbf{A}^{-1}$ and to $\mathbf{W}$ are shown for the three possibilities.

<u>Sire and dam not base animals</u>

$\mathbf{A}^{-1}$

	an	s	d
an	2	-1	-1
s	-1	1/2	1/2
d	-1	1/2	1/2

$\mathbf{W}$

	an	s	d
an	2	-1	-1
s	-1	1/2	1/2
d	-1	1/2	1/2

(If the animal is inbred, these elements are modified as described by Quaas (1976, 1988).)

<u>One parent a base animal</u>

The base parent is the dam

$\mathbf{A}^{-1}$

	an	s	g_d
an	4/3	-2/3	-
s	-2/3	1/3	-
g_d	-	-	-

$\mathbf{W}$

	an	s	g_d
an	4/3	-2/3	-2/3
s	-2/3	1/3	1/3
g_d	-2/3	1/3	1/3

The base parent is the sire

$\mathbf{A}^{-1}$

	an	g_s	d
gn	4/3	-	-2/3
g_s	-	-	-
d	-2/3	-	1/3

$\mathbf{W}$

	an	g_s	d
an	4/3	-2/3	-2/3
g_s	-2/3	1/3	1/3
d	-2/3	1/3	1/3

<u>Both parents are base animals</u>

$\mathbf{A}^{-1}$

	an	g_s	g_d
an	1	-	-
g_s	-	-	-
g_d	-	-	-

$\mathbf{W}$

	an	g_s	g_d
an	1	-1/2	-1/2
g_s	-1/2	1/4	1/4
g_d	-1/2	1/4	1/4

The rules for calculating **W** lead to thinking of groups as being proxy parents with the proxy group effect (selection path and time period effect) being a representative effect of a parent of that time period and selection path. In terms of computing, space is left in the least-squares equations and right hand sides for the equations for effects of proxy parent groups. The rules for **W** generate the proper coefficients for the Q-P modified equations.

These rules have been described extensively (Westell, 1984; Westell et al., 1984, 1988; Quaas, 1988; Wiggans et al., 1988) for an animal model with genetic groups and additive direct effects. The only part new here is to emphasize that the extension to maternal effects and maternal genetic groups is easy if the base dam (without records herself) is included in **a** and **m** ($\mathbf{a}^*$ and $\mathbf{m}^*$) and if both of her parents are assigned to the genetic group she would have been assigned to. Then the nice form of the Q-P-W equations described here will result.

<u>Reduced Animal Model Equations</u>

Examination of the Q-P-W equations will reveal that equations for non-parents can be absorbed as easily as done by Quaas and Pollak (1980) for a model without groups. Rules are given for a single trait model in Van Vleck (1989b).

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REPRODUCTION AND GROWTH COMMITTEES

Because of many common interests and concerns, the Reproduction and Growth Committees met together. The meeting was therefore called to order at approximately 2:15 p.m. by Keith Vander Velde, Chairman of the Reproduction Committee. Henry Gardiner co-chaired the meeting as Chairman of the Growth Committee.

The first item of discussion was in regard to the need for adjustment factors for pelvic area of bulls and with a particular need for a common point of comparison for those bulls coming off central tests.

The discussion was initiated with a presentation by Gene Deutscher of the University of Nebraska at North Platte. In addition to the material he presented in the general session the day before, he presented some additional data on pelvic measurements of bulls collected from various stations by the University of Missouri. The data summarized work from 13 test stations over a 7-year period. The bulls on which the data were collected ranged in age from 300-450 days and in weight from 700 to 1430 pounds. The three breeds the discussion of potential adjustment factors were centered upon were Angus, Simmental and Polled Hereford because of larger numbers. Smaller data sets on Gelbvieh, Charolais and Limousin bulls were also presented.

Pelvic area adjustment factors based on age from the Angus, Simmental and Polled Hereford data were suggested to be .23, .25 and .29 cm^2/day, respectively. Since these figures were not significantly different, it was suggested that an average adjustment factor of .25 cm^2/day could be used for all breeds. Therefore, the proposed formula for such an adjustment would be:

Adjusted 365-D pelvic area =
Actual pelvic area (cm^2) + .25 cm^2 (365,^{D} - actual age, D)

In addition, the presenter suggested an alternate adjustment factor for weight. This was again suggested based on the aforementioned Angus, Simmental and Polled Hereford data. The suggested weight adjustment factors were .07, .10 and .11 cm^2/lb., respectively. Again due to lack of significant differences between breeds, an average adjustment factor of .09 cm^2 per lb. was suggested. The resulting adjusted formula therefore being proposed as:

Pelvic area (cm^2) adjusted to a constant weight =
Actual pelvic area (cm^2) + .09 cm^2 (constant weight, lb- actual weight, lb)

Deutscher suggested that pelvic area could be adjusted for either age or for weight, but should not be adjusted for both.

Discussion among those present indicated that there was a need for BIF to suggest a pelvic area adjustment factor for bulls. There was concern expressed by some in regard to adjusting for weight, a genetically affected trait, rather than for age. In addition, a constant 365-day age is what is used as a point of common comparison for all other traits.

After considerable discussion, a motion was made and seconded for Chairman Vander Velde to appoint a committee to evaluate the available data and recommend a standard pelvic area adjustment factor for bulls. This should then be recommended to the BIF Board for inclusion in the revised BIF Guidelines. The motion passed unanimously.

Chairman Vander Velde then appointed the following subcommittee for such propose: Wayne Wagner (W. Va.), Gene Deutscher (NE), Jim Brinks (CO), Merlyn Nielsen (NE) and Jerry Lipsey (MO). Vander Velde will serve as chairman of this subcommittee.

In addition, it was suggested that age adjustment factors be developed for scrotal circumference and be included in the new BIF guidelines as well.

The chairman solicited ideas for potential topics to be developed by the program committee for future BIF Conventions in the areas of reproduction and growth. Those suggested included:

- Fertility of Performance Tested Bulls
- Gestation Length and its Effect on Dystocia
- Genetic Factors Affecting Dystocia (another presentation might summarize data evaluating environmental factors affecting birth weight).
- How far should we go in promoting large scrotal circumference? Is there a problem with going too far?

Chairman Gardiner indicated the list of age of dam adjustments and birthweight adjustments for the various breeds was being updated for the new BIF Guidelines. It was suggested by those in attendance that these lists be made available to bull tests as soon as they are completed. This could be done through either Charlie McPeake, the BIF Executive Secretary or Gary Weber of the USDA/CES.

A motion was made and seconded to recommend that the Guidelines be put in looseleaf (or fact sheet) form to allow the publication to be kept more current with updates. The motion passed unanimously. If this format is adopted, it was suggested that each fact sheet be dated.

The joint Reproduction and Growth Committee meeting adjourned at 3:45 p.m.

Respectively Submitted,

Doug L. Hixon

Doug L. Hixon
Acting Secretary

Central Test Committee Minutes

The Central Test Committee was called to order on Friday, May 12, 1989 in Nashville, Tennessee. There were approximately 150 people in attendance. Dr. James Wilton and Paola de Rose of the University of Guelph reported on the calculation of Expected Progeny Differences for central test bulls in Ontario. A paper on this topic is included in the 1989 BIF proceedings.

Keith Vander Velde, Dave Kirkpatrick and Wayne Wagner discussed their efforts at promoting low birth EPD bulls in their respective test stations. Details are included in "Identifying, Qualifying and Merchandising Calving Ease Sires in Central Test Stations."

Dave Buchanan and John Hough are serving on a subcommittee to explore the use of central test data in calculation of EPD's. To do this they need data from several test stations. John Hough reported that there was little response to their last request for data and that they will try again. It was suggested that they report on their progress at the next meeting.

Revision of the BIF Guidelines was discussed. A subcommittee composed of Ron Bolze, Ronnie Silcox, Larry Olson and Larry Nelson was named to rewrite the Central Test Section of the guideline based on input from the committee.

Respectfully Submitted,
Ronnie Silcox, Secretary

Minutes of Beef Improvement Federation
Board of Directors Meeting

May 11 through May 13, 1989
Hyatt Regency
Nashville, Tennessee

The BIF Board of Directors held two meetings in conjunction with the 1988 Annual Convention at the Hyatt Regency in Nashville, Tennessee. The first was a luncheon meeting held on Thursday May 11, 1989 from 11:00 a.m. until 2:00 p.m.. The second was held on Saturday, May 13, 1989, from 6:30 a.m. until 7:30 a.m..

Attending the board meeting were Bob Dickinson, president; Jack Chase, vice-president; Roger L. McCraw, executive director; Charles A. McPeake, executive director-elect; Daryl Strohbehn and Doug Hixon, regional secretaries; Frank Baker, Paul Bennett, John Crouch, Larry Cundiff, Henry Gardiner, Bruce Howard, James H. Leachman, Craig Ludwig, Marvin Nichols, Jim Spawn, Keith Vander Velde, Wayne Vanderwert, Gary Weber, and Leonard Wulf.

Those directors not attending the meeting were Ron Bolze, Mark Cowan, Dixon Hubbard, Harvey Lemmon, Richard Whitman, and Darrell Wilkes.

Also in attendance were Gary Wilson, sitting in for Darrell Wilkes, David Kirkpatrick, Brian Pogue, Cathy Lasby and Peter Kuehni.

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

Minutes of the mid-year board meeting. Minutes of the mid-year board meeting held November 3 and 4, 1988, at the Airport Hilton in Kansas City, Missouri, were distributed to each director by McCraw. President Dickinson declared the minutes approved as printed.

Treasurer's Report. McCraw provided copies of the treasurer's report for the calendar year 1988 and for 1989 from January to April 30. copies of these reports are attached. He discussed presentation for convention expenses in the financial report and gave a detailed accounting of expenses and income. Jack Chase moved for acceptance of the treasurer's report. The motion was seconded by John Crouch and approved.

Membership Report. McCraw distributed copies of the membership report, a copy is attached. The report showed that 33 state organizations, 23 breed associations and 15 other firms or organizations have paid dues as of April 25, 1989. This total of 71 paid members represents a steady number when compared to last year at the same time.

Convention Plans. David Kirkpatrick welcomed the board to Tennessee and gave a review of the plans for the Convention.

He indicated there were 355 pre-registered for the Convention. He also expressed some concern that a problem may exist since the banquet would only seat 350 people. He added that graduate students election not to attend the banquet may eliminate the problem. Kirkpatrick suggested no refunds for pre-pay registrations.

John Crouch and Doug Hixon moved and seconded that no refunds be permitted. Board discussion followed with emphasis to be a bit more lenient on refunds. The board suggested to set a price for pre-pay and another price when paying at convention.

Bruce Howard moved to table the motion and wait until later to determine if there is a major problem. Craig Ludwig seconded. Motion carried.

Kirkpatrick stated the general session is setup for 450 with a guarantee of 340 for the luncheon and banquet. He detailed time and kind of transportation for the tour of Tennessee Walking Horses and Jack Daniel's distillery.

David was congratulated on the excellent job he and fellow Tennesseans had done in hosting BIF.

Plans for 1990 Convention. Brian Pogue introduced Cathy Lasby and Peter Kuehni as key people that would be assisting with the 1990 convention. Cathy welcomed BIF to Canada and presented planning information for the convention. The convention is to be held May 23-27, 1990, in Hamilton, Ontario at the Royal Connaught Hotel. The hotel accommodates 450 people. This is approximately a one hour drive from Toronto. The tours would be with local tourist attractions in mind along with both purebred and commercial cattle stops.

Cathy also provided a list of 8 committees that have been established for the convention. Brian talked additionally about display and other information. Peter presented ideas for the program and asked for feedback. There was some concern for overlap of topics and desires information before mid-year board meeting.

Gary Wilson suggested a marketing structure.

Discussion and suggestions followed since there is some problem with BIF since program planning is organized at the mid-year board meeting. Henry Gardiner suggested a national update on performance. Frank Baker suggested there be time set aside for major key points and that the committees would have to meet.

John Crouch recommended two days with one-half of each day being devoted to symposia and the other one-half to committee meetings.

Cathy presented their proposed agenda. Registration goal is 400 people 100 from Ontario, 100 from Canada, and 200 from the U.S.. She handed out several kinds of information that was already adequately prepared. Hotels costs, were estimated at $65.00 per night Canadian money.

Cathy asked about sponsorships during the convention and there was no opposition from the board but started a discussion of pros and cons dealing with a trade show. Bruce Howard made comments dealing with the acceptability of sponsorships but cautioned against a trade show taking away from BIF.

Frank Baker emphasized that BIF does not want to manage a trade show, but the host were welcome to have a trade show.

John Crouch moved that a decision of whether or not to have a trade show be made by the host. Keith Vander Velde seconded. Motion carried.

Meeting site for 1991 Convention. McCraw discussed invitation of Hawaii to host the 1991 meeting. There was some concern since the meeting is being held in Canada in 1990. Bruce Howard suggested that Hawaii's' location might attract more producers from Australia. It was suggested that a solicitation of host states might be an appropriate means of obtaining interested hosts.

Director elections. McCraw discussed elections along with eligibility, he asked the following to serve as chairmen:

Western Region - Doug Hixon
Central Region - Henry Gardiner
Eastern Region - Paul Bennett
Breed Assn. - John Crouch
At large - Each region would nominate and the entire group would vote on and elect.

Committee Charges. McCraw talked briefly about the committees and the charges to the committees. Gary Weber was asked to give the charge. McCraw gave committee room assignments.

Revision of Guidelines. McCraw stated that a complete revision of the guidelines is aimed at a completion time of spring 1990. Frank Baker was asked to edit new guidelines. He responded by stating he wanted to visit with Gary Weber concerning word processing and to simply think about it before committing his services.

National Judging Contest Support. McCraw discussed the continuation of support for performance classes in national judging contests. Keith Vander Velde moved for continuation. John Crouch seconded. Motion carried.

Central Regional Secretary's position. Dickinson informed the board that Daryl Strohbehn had asked that a replacement be found. After some discussion Daryl agreed to serve one more year, but emphasized that a replacement
would be needed at that time.

BIF meeting financial assistance for students. McCraw informed the board that several universities had inquired about the possibilities of pricing structure for students and in particular graduate students attending BIF meetings. After discussion, Frank Baker moved that policy be adapted as follows:

1. Students could register at approximately 20% of full fee.
2. Student registration would include proceedings.
3. Student registration would not include meals.

Doug Hixon seconded. Motion carried.

Sunshine Unlimited Inc. Software. McCraw said he has been contacted concerning software and marketing through BIF. After discussion no action was taken.

Genetic Prediction Workshops. McCraw shared information with the board that Dick Willham is proposing another workshop to be held probably in December, 1989, possibility with the efforts also of Frank Baker and Winrock International. He suggested that the event needed to be approved by the board as an official BIF Function. John Crouch moved that the workshop be approved as an official BIF function, the Executive Director's travel be paid to the meeting, and financial support in the amount of $1000.00. Keith Vander Velde seconded and the motion carried.

Revision of Fact Sheets. Daryl Strohbehn, chairman reported that he had personally visited with several authors and progress was being made toward revision.

4th World Congress on Genetics Applied to Livestock Production. McCraw reported he had received a request for financial support for the 4th World Congress on Genetics applied to Livestock Production to be held July 23-27, 1990, in Edinbough, Scotland. BIF had given $1000.00 support when the meetings were held in Nebraska. Larry Cundiff explained what they had done in hosting the meeting in Nebraska. Some emphasis was made that if support was given that BIF should receive a copy of the proceedings. John Crouch moved that BIF support the meetings with $1000.00 along with an understanding that BIF would receive a copy of the proceedings. Keith Vander Velde seconded and the motion carried.

Election of Officers. Henry Gardiner, chairman of the nominating committee, recommended a continuation of 2 year offices and moved that the following slate of officers be nominated: president, Jack Chase; vice-president, James Leachman. Crouch seconded. Dickinson opened the floor for other nominations. Strohbehn moved acceptance of recommendation of nominating committee and Paul Bennett seconded. Motion carried.

BEEF industry leaders. McCraw visited about nominations for 25 men that have contributed greatly to the beef industry. Stressed that nominations should be sent in quickly since there is a May 31 deadline. There was further discussion about group or BIF nomination but Warren Kester understood it to be individuals.

No action was taken.

Change of Executive Directorship. McCraw thanked BIF for the opportunity given to him during the last 3 years. He thinks there is tremendous growth potential for BIF in the coming years. He discussed Oklahoma State University's policies dealing with printing of BIF materials and also stated that an OSU secretary could be used with financial support from BIF.

NCA extends invitation. McCraw explained that NCA has extended an invitation to BIF to hold the mid-year board meeting in conjunction with the NCA summer meeting to be held July 25-29, 1989 in Columbus, Ohio. Keith Vander Velde moved to accept invitation and Leonard Wulf seconded. Discussion followed dealing with dates and timing. Motion failed.

Mid-Year Board Meeting. Dickinson requested suggestions on a place and time for the mid-year board meeting. After discussion it was agreed upon that the meeting would be held November 1-3, 1989, in Kansas City at the Airport Holiday Inn.

Awards at 1989 Convention. The following awards were presented:

Seedstock Producer of the Year - Glenn Debter, Alabama
Commercial Producer of the Year - Jerry Adamson, Nebraska
Continuing Service Award - Roger McCraw, North Carolina
Ambassador Award - Forrest Bassford, California
Pioneer Awards - Roy Beeby, Oklahoma; Will Butts, Tennessee; John Massey, Missouri.

There being no further business the meeting was adjourned.

Respectfully Submitted,

Charles A. McPeake
BIF Executive Director

CAM:lls

BEEF IMPROVEMENT FEDERATION
FINANCIAL STATUS - CALENDAR YEAR 1988
by
Roger L. McCraw

Assets	1-1-88	12-31-88
Checking Account	$ 7,354.43	$ 1,632.91
Money Market Account	3,745.95	31,419.75
Certificate of Deposit	36,159.30	10,000.00
TOTAL	$47,259.68	$43,052.66

1988 BIF Income

Dues		$10,128.50
Proceedings		386.00
Guidelines		501.00
Interest		2,464.50
Refund		25.49
Convention		
Registration fees and Proceedings	18,769.13	
Donations raised in New Mexico	1,800.00	
Coffee Break Sponsors	400.00	
Reimbursement - NAAB and GPE-9	283.35	21,252.48
TOTAL		$34,757.97

1988 BIF Expenses

Salary and Taxes (secretary)		$ 2,350.37
Office Supplies		212.84
Postage		987.29
Printing		312.54
Plaques - Perf. Judging Class		70.50
Directors' Travel		1,507.21
Telephone		11.36
Carpenter and Klatskin		45.00
Colorado Dept. of State		10.00
Discount on Foreign Checks		60.64
Service Charge - Checking Account		3.50
Board Meeting - May		501.00
Board Meeting - Mid-Year		846.47
KSU - Genetic Prediction Meeting		97.67
Convention		
Pens	330.59	
Folios and note pads	675.00	
Ribbons	79.31	
Plaques	504.92	
Printing	2,747.17	
Photos	223.20	
Travel - Speakers	4,854.86	
Postage	1,511.09	
Refund of registration	80.00	
Key chains	430.00	
Joe Hayes (Banquet speaker)	300.00	
Luncheon (5/12)	2,898.00	
Luncheon (5/13)	2,516.00	
Banquet (5/13)	4,916.25	
Breakfast (5/14)	2,015.00	
Coffee breaks	1,147.10	
Service charges	2,378.88	
Audio-visual equipment	955.00	
Taxes	909.68	
Ranch Tour (meals, buses, etc)	2,066.36	
Expenses for Parker	107.58	
NAAB and GPE-9 meeting	283.35	
Discount on foreign checks	14.26	31,943.60
TOTAL		$38,959.99

BEEF IMPROVEMENT FEDERATION

FINANCIAL STATUS
January 1, 1989 - April 30, 1989

Assets

Checking Account		$ 6,314.70
Money Market Account		46,603.58
TOTAL		$52,918.28

Income

Dues		$ 9,900.00
Proceedings		144.00
Guidelines		102.00
Interest		1,425.83
TOTAL		$11,571.83

Expenses

Secretary's Salary		$ 284.26
Supplies		146.33
Postage		414.54
Discount on Foreign Checks		35.66
Convention		
Printing	337.05	
Postage	488.37	825.42
TOTAL		$ 1,706.21

PAID
BIF MEMBER ORGANIZATIONS AND AMOUNT
FOR DUES - 1989
AS OF APRIL 25, 1989

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

BIF MEMBERS WHO HAVE NOT PAID
MEMBERSHIP DUES FOR 1989,
as of April 25, 1989

State BCIA's	
New York	$100.00
Northeast Kentucky	$100.00
Breed Associations	
Canadian Aberdeen Angus	$ 50.00
Canadian Blonde D'Aquitaine	$ 50.00
Others	
Agricultural Business Research Institute	$ 50.00
Agricultural Canada	$100.00
King Ranch	$ 50.00

The Seedstock Breeder Honor Roll of Excellence

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

Richard McLaughlin	IL	1980
Bob Dickinson	KS	1981
Clarence Burch	OK	1981
Lynn Frey	ND	1981
Harold Thompson	WA	1981
James Leachman	MT	1981
J. Morgan Donelson	MO	1981
Clayton Canning	CAN	1981
Russ Denown	MT	1981
Dwight Houff	VA	1981
G. W. Cornwell	IA	1981
Bob & Gloria Thoma	OR	1981
Roy Beeby	OK	1981
Herman Schaefer	IL	1981
Myron Aultfathr	MN	1981
Jack Ragsdale	KY	1981
W. B. Williams	IL	1982
Garold Parks	IA	1982
David A. Breiner	KS	1982
Joseph S. Bray	KY	1982
Clare Geddes	CAN	1982
Howard Krog	MN	1982
Harlin Hecht	MN	1982
Willard Kottwitz	MO	1982
Larry Leonhardt	MT	1982
Frankie Flint	NM	1982
Gary & Gerald Carlson	ND	1982
Bob Thomas	OR	1982
Orville Stangl	SD	1982
C. Ancel Armstrong	KS	1983
Bill Borror	CA	1983
Charles E. Boyd	KY	1983
John Bruner	SD	1983
Leness Hall	WA	1983
Ric Hoyt	OR	1983
E. A. Keithley	MO	1983
J. Earl Kindig	MO	1983
Jake Larson	ND	1983
Harvey Lemmon	GA	1983
Frank Myatt	IA	1983
Stanley Nesemeier	IL	1983
Russ Pepper	MT	1983
Robert H. Schafer	MN	1983
Alex Stauffer	WI	1983
D. John & Lebert Shultz	MO	1983
Phillip A. Abrahamson	MN	1984
Rob Bieber	SD	1984
Jerry Chappell	VA	1984
Charles W. Druin	KY	1984
Jack Farmer	CA	1984
John B. Green	LA	1984
Ric Hoyt	OR	1984
Fred H. Johnson	OH	1984
Earl Kindig	VA	1984
Glen Klippenstein	MO	1984
A. Harvey Lemmon	GA	1984
Lawrence Meyer	IL	1984
Donn & Sylvia Mitchell	CAN	1984
Lee Nichols	IA	1984
Clair K. Parcel	KS	1984
Joe C. Powell	NC	1984
Floyd Richard	ND	1984
Robert L. Sitz	MT	1984
Ric Hoyt	OR	1985
J. Newbill Miller	VA	1985
George B. Halterman	WV	1985
Davis McGehee	KY	1985
Glenn L. Brinkman	TX	1985
Gordon Booth	WY	1985
Earl Schafer	MN	1985
Marvin Knowles	CA	1985
Fred Killam	IL	1985
Tom Perrier	KS	1985
Don W. Schoene	MO	1985
Everett & Ron Batho & Families	CAN	1985
Bernard F. Pedretti	WI	1985
Arnold Wienk	SD	1985
R. C. Price	AL	1985
Clifford & Bruce Betzold	IL	1986
Gerald E. Hoffman	SD	1986
Delton W. Hubert	KS	1986
Dick & Ellie Larson	WI	1986
Leonard Lodden	ND	1986
Ralph McDanolds	VA	1986
Roy D. McPhee	CA	1986
W. D. Morris & James Pipkin	MO	1986
Clarence Van Dyke	MT	1986
John H. Wood	SC	1986
Evin & Verne Dunn	CAN	1986
Gknn L. Brinkman	KS	1986
Jack & Gini Chase	WY	1986
Henry & Jeannette Chitty	FL	1986
Lawrence H. Graham	KY	1986
A. Lloyd Grau	NM	1986
Mathew Warren Hall	AL	1986
Richard J. Putnam	NC	1986
Robert J. Steward & Patrick C. Morrissey	OR	1986
Leonard Wulf	MN	1986
Charles & Wynder Smith	GA	1987
Lyall Edgerton	CAN	1987
Tommy Branderberger	TX	1987
Henry Gardiner	KS	1987
Gary Klein	ND	1987
Ivan & Frank Rincker	IL	1987
Larry D. Leonhardt	WY	1987
Harold E. Pate	AL	1987
Forrest Byergo	MO	1987
Clayton Canning	CAN	1987

James Bush	SD	1987
Robert J. Steward & Patrick C. Morrissey	OR	1987
Eldon & Richard Wiese	MN	1987
Douglas D. Bennett	TX	1988
Don & Diane Guilford & David & Carol Guilford	CAN	1988
Kenneth Gillig	MO	1988
Bill Bennett	WA	1988
Hansell Pile	KY	1988
Gino Pedretti	CA	1988
Leonard Lorenzen	OR	1988
George Schlickau	KS	1988
Hans Ulrich	CAN	1988
Donn & Sylvia Mitchell	CAN	1988
Darold Bauman	WY	1988
Glynn Debter	AL	1988
William Glanz	WY	1988
Jay P. Book	IL	1988
David Luhman	MN	1988
Scot Burtner	VA	1988
Robert E. Walton	WS	1988
Harry Airey	CAN	1989
Ed Albaugh	CA	1989
Jack & Nancy Baker	MO	1989
Ron Bowman	ND	1989
Jerry Allen Burner	VA	1989
Glynn Debter	AL	1989
Sherm & Charlie Ewing	CAN	1989
Donald Fawcett	SD	1989
Orrin Hart	CAN	1989
Leonard A. Lorenzen	OR	1989
Kenneth D. Lowe	KY	1989
Tom Mercer	WY	1989
Lynn Pelton	KS	1989
Lester H. Schafer	MN	1989
Bob R. Whitmire	GA	1989

Seedstock Breeder of the Year

John Crowe	CA	1972
Mrs. R. W. Jones	GA	1973
Carlton Corbin	OK	1974
Leslie J. Holden	MT	1975
Jack Cooper	MT	1975
Jorgensen Brothers	SD	1976
Glenn Burrows	NM	1977
James D. Bennett	VA	1978
Jim Wolf	NE	1979
Bill Wolfe	OR	1980
Bob Dickinson	KS	1981
A. F. "Frankie" Flint	NM	1982
Bill Borror	CA	1983
Lee Nichols	IA	1984
Ric Hoyt	OR	1985
Leonard Lodoen	ND	1986
Henry Gardiner	KS	1987
W.T. "Bill" Bennett	WA	1988
Glynn Debter	**AL**	**1989**

The Commercial Producer Honor Roll of Excellence

Chan Cooper	MT	1972
Alfred B. Cobb, Jr.	MT	1972
Lyle Eivens	IA	1972
Broadbent Brothers	KY	1972
Jess Kilgore	MT	1972
Clifford Ouse	MN	1973
Pat Wilson	FL	1973
John Glaus	SD	1973
Sig Peterson	ND	1973
Max Kiner	WA	1973
Donald Schott	MT	1973
Stephen Garst	IA	1973
J. K. Sexton	CA	1973
Elmer Maddox	OK	1973
Marshall McGregor	MO	1974
Lloyd Mygard	ND	1974
Dave Matti	MT	1974
Eldon Wiese	MN	1974
Lloyd DeBruycker	MT	1974
Gene Rambo	CA	1974
Jim Wolf	NE	1974
Henry Gardiner	KS	1974
Johnson Brothers	SD	1974
John Blankers	MN	1975
Paul Burdett	MT	1975
Oscar Burroughs	CA	1975
John R. Dahl	ND	1975
Eugene Duckworth	MO	1975
Gene Gates	KS	1975
V. A. Hills	KS	1975
Robert D. Keefer	MT	1975
Kenneth E. Leistritz	NE	1975
Ron Baker	OR	1976
Dick Boyle	ID	1976
James D. Hackworth	MO	1976
John Hilgendorf	MN	1976
Kahua Ranch	HI	1976
Milton Mallery	CA	1976
Robert Rawson	IA	1976
William A. Stegner	ND	1976
U.S. Range Exp. Sta.	MT	1976
John Blankers	MN	1977
Maynard Crees	KS	1977
Ray Franz	MT	1977
Forrest H. Ireland	SD	1977
John A. Jameson	IL	1977
Leo Knoblauch	MN	1977
Jack Pierce	ID	1977
Mary & Stephen Garst	IA	1977
Odd Osteross	ND	1978
Charles M. Jarecki	MT	1978
Jimmy G. McDonnal	NC	1978

Victor Arnaud	MO	1978
Ron & Malcolm McGregor	IA	1978
Otto Uhrig	NE	1978
Arnold Wyffels	MN	1978
Bert Hawkins	OR	1978
Mose Tucker	AL	1978
Dean Haddock	KS	1978
Myron Hoeckle	ND	1979
Harold & Wesley Arnold	SD	1979
Ralph Neill	IA	1979
Morris Kuschel	MN	1979
Bert Hawkins	OR	1979
Dick Coon	WA	1979
Jerry Northcutt	MO	1979
Steve McDonnell	MT	1979
Doug Vandermyde	IL	1979
Norman, Denton & Calvin Thompson	SD	1979
Jess Kilgore	MT	1980
Robert & Lloyd Simon	IL	1980
Lee Eaton	MT	1980
Leo & Eddie Grubl	SD	1980
Roger Winn, Jr.	VA	1980
Gordon McLean	ND	1980
Ed Disterhaupt	MN	1980
Thad Snow	CAN	1980
Oren & Jerry Raburn	OR	1980
Bill Lee	KS	1980
Paul Moyer	MO	1980
G. W. Campbell	IL	1981
J. J. Feldmann	IA	1981
Henry Gardiner	KS	1981
Dan L. Weppler	MT	1981
Harvey P. Wehri	ND	1981
Dannie O'Connell	SD	1981
Wesley & Harold Arnold	SD	1981
Jim Russell & Rick Turner	MO	1981
Oren & Jerry Raburn	OR	1981
Orin Lamport	SD	1981
Leonard Wulf	MN	1981
Wm. H. Romersberger	IL	1982
Milton Krueger	MO	1982
Carl Odegard	MT	1982
Marvin & Donald Stoker	IA	1982
Sam Hands	KS	1982
Larry Campbell	KY	1982
Lloyd Atchison	CAN	1982
Earl Schmidt	MN	1982
Raymond Josephson	ND	1982
Clarence Reutter	SD	1982
Leonard Bergen	CAN	1983
Kent Brunner	KS	1983

Tom Chrystal	IA	1983
John Freitag	WI	1983
Eddie Hamilton	KY	1983
Bill Jones	MT	1983
Harry & Rick Kline	IL	1983
Charlie Kopp	OR	1983
Duwayne Olson	SD	1983
Ralph Pederson	SD	1983
Ernest & Helen Schaller	MO	1983
Al Smith	VA	1983
John Spencer	CA	1983
Bud Wishard	MN	1983
Bob & Sharon Beck	OR	1984
Leonard Fawcett	SD	1984
Fred & Lee Kummerfeld	WY	1984
Norman Coyner & Sons	VA	1984
Franklyn Esser	MO	1984
Edgar Lewis	MT	1984
Boyd Mahrt	CA	1984
Don Moch	ND	1984
Neil Moffat	CAN	1984
William H. Moss, Jr.	GA	1984
Dennis P. Solvie	MN	1984
Robert P. Stewart	KS	1984
Charlie Stokes	NC	1984
Milton Wendland	AL	1985
Bob & Sheri Schmidt	MN	1985
Delmer & Joyce Nelson	IL	1985
Harley Brockel	SD	1985
Kent Brunner	KS	1985
Glenn Harvey	OR	1985
John Maino	CA	1985
Ernie Reeves	VA	1985
John E. Rouse	WY	1985
George and Thelma Boucher	CAN	1985
Kenneth Bentz	OR	1986
Gary Johnson	KS	1986
Ralph G. Lovelady	AL	1986
Ramon H. Oliver	KY	1986
Kay Richardson	FL	1986
Mr. & Mrs. Clyde Watts	NC	1986
David & Bev Lischka	CAN	1986
Dennis &Nancy Daly	WY	1986
Carl & Fran Dobitz	SD	1986
Charles Fariss	VA	1986
David J. Forster	CA	1986
Danny Geersen	SD	1986
Oscar Bradford	AL	1987
R. J. Mawer	CAN	1987
Rodney G. Oliphant	KS	1987
David A. Reed	OR	1987
Jerry Adamson	NE	1987
Gene Adams	GA	1987
Hugh & Pauline Maize	SD	1987
P.T. McIntire & Sons	VA	1987
Frank Disterhaupt	MN	1987
Mac, Don & Joe Griffith	GA	1988
Jerry Adamson	NE	1988
Ken, Wayne & Bruce Gardiner	CAN	1988
C. L. Cook	MO	1988
C.M. & D.A. McGee	IL	1988
William E. White	KY	1988
Frederick M. Mallory	CA	1988
Stevenson Farmily	OR	1988
Gary Johnson	KS	1988
John McDaniel	AL	1988
William A. Stegner	ND	1988
Lee Eaton	MT	1988
Larry D. Cundall	WY	1988
Dick & Phyllis Henze	MN	1988
Jerry Adamson	NE	1989
J.W. Aylor	VA	1989
Jerry Bailey	ND	1989
James G. Guyton	WY	1989
Kent Koostra	KY	1989
Ralph G. Lovelady	AL	1989
Thomas McAvoy, Jr.	GA	1989
Bill Salton	IA	1989
Lauren & Mel Shuman	CA	1989
Jim Tesher	ND	1989
Joe Thielen	KS	1989
Eugene & Ylene Williams	MO	1989

Commercial Producer of the Year

Chan Cooper	MT	1972
Pat Wilson	FL	1973
Lloyd Nygard	ND	1974
Gene Gates	KS	1975
Ron Bake	OR	1976
Steve & Mary Garst	IA	1977
Mose Tucker	AL	1978
Bert Hawkins	OR	1979
Jeff Kilgore	MT	1980
Henry Gardiner	KS	1981
Sam Hands	KS	1982
Al Smith	VA	1983
Bob & Sharon Beck	OR	1984
Glenn Harvey	OR	1985
Charles Fariss	VA	1986
Rodney G. Oliphant	KS	1987
Gary Johnson	KS	1988
Jerry Adamson	**NE**	**1989**

Ambassador Award

Warren Kester	*Beef Magazine*	MN	1986
Chester Peterson	*Simmental Shield*	KS	1987
Fred Knop	Drovers Journal	KS	1988
Forrest Bassford	**Western Livestock Journal**	**CO**	**1989**

Pioneer Awards

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

Mel Kirkiede	North Dakota State University	1985
Charles R. Hendeson	Cornell University (retired)	1986
Everett J. Warwick	USDA-ARS (retired)	1986
Glenn Burrows	New Mexico	1987
Carlton Corbin	Oklahoma	1987
Murray Corbin	Oklahoma	1987
Max Deets	Kansas	1987
George F. & Mattie Ellis	New Mexico	1988
A.F. "Frankie" Flint	New Mexico	1988
Christian A. Dinkel	South Dakota State University (retired)	1988
Roy Beeby	**Oklahoma**	**1989**
Will Butts	**Tennessee**	**1989**
John W. Massey	**Missouri**	**1989**

Continuing Service Awards

Clarence Burch	OK	1972
F. R. Carpenter	CO	1973
E. J. Warwick	DC	1973
Robert De Baca	IA	1973
Frank H. Baker	OK	1974
D. D. Bennett	OR	1974
Richard Willham	IA	1974
Lkarry V. Cundiff	NE	1975
Dixon D. Hubbard	DC	1975
J. David Nichols	IA	1975
A. L. Eller, Jr.	VA	1976
Ray Meyer	SD	1976
Don Vaniman	MT	1977
Lloyd Schmitt	MT	1977
Martin Jorgensen	SD	1978
James S. Brinks	CO	1978
Paul D. Miller	WI	1978
C. K. Allen	MO	1979
William Durfey	NAAB	1979
Glenn Butts	PRI	1980
Jim Gosey	NE	1980
Mark Keffeler	SD	1981
J. D. Mankin	ID	1982
Art Linton	MT	1983
James Bennett	VA	1984
M. K. Cook	GA	1984
Craig Ludwig	MO	1984
Jim Glenn	IBIA	1985
Dick Spader	MO	1985
Roy Wallace	OH	1985
Larry Benyshek	GA	1986
Ken W. Ellis	CA	1986
Earl Peterson	MT	1986
Bill Borror	CA	1987
Daryl Strohbehn	IA	1987
Jim Gibb	MO	1987
Bruce Howard	CAN	1988
Roger McCraw	**NC**	**1989**

Organizations of the Year

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

1989 BIF SEEDSTOCK PRODUCER OF THE YEAR NOMINEES

Harry Airey, H. T. A. Charolais Farm, Rivers, Manitoba. Nominated by Directors of Douglas Test Station. Has been involved in cattle business 18 years, currently has 55 head of Charolais cows. Performance testing for 16 years with selection of heifers based on yearling and weaning weight and dam's past performance. For the past 12 years, have had bulls on test at Douglas Test Station. Over 15 years has increased weaning weight 222 pounds and yearling weight 328 pounds. Herd bulls selected for above average ADG, weaning weight and acceptable birth weight. Served as President and Breed Representative of M.B.C.P.A.; Director of Manitoba Charolais Association; 4-H Beef Club Leader; on Manitoba Livestock Performance Testing Board; Named Manitoba's Premiere Purebred Beef Producer in 1988.

Ed Albaugh, Frosty Acres Inc., Adin, California. Nominated by the University of California Cooperative Extension. Forty-two years in the seedstock business with 200-cow Polled Shorthorn herd. Began performance testing in 1948. Has developed a pricing formula for bulls; taking into account conformation grade, semen score, lifetime gain, carcass index of sire's progeny and square inches of rib-eye of sire's progeny; that is tied to commercial prices for the preceding 12 months. Received Floyd S. Charley Memorial Award in 1967 and the California Shorthorn Association Recognition Award in 1988.

Jack & Nancy Baker, Baker Angus Farms, Butler, Missouri. Nominated by the Missouri Beef Cattle Improvement Association. Angus seedstock producers for 35 years with 130 registered cow herd. Produced bull purchased by an A.I. stud which advertised semen 3 years. Sells bulls through Missouri Tested Bull Sale and private treaty. Has kept performance records for 24 years. Served on the Missouri All Breed Bull Sale As Director, Vice President and President; President of West Central Bull Sale. Jack won the 1975 West Central Seedstock Producer award and the Farm management Award in 1972.

Ron Bowman, Bowman Charolais, Bowman, North Dakota. Nominated by the American International Charolais Association. Twenty-seven years in the seedstock business with a 190 Charolais cow herd. Has kept performance records for 27 years. Both replacement heifers and bulls marketed are selected on 205 day weights and index, WDA and birth weights. Uses on the farm test to evaluate his bull calves and has entire herd on computer. Increased 205 day weight from 568 pounds in 1973 to 630 pounds in 1979. Director and past President of the North Dakota Cattle Breeders Association; 1980 Outstanding Young Men of America; Bowman County Agriculturalist of the Year; NDCBA Seedstock Producer of the Year for 1988; 1988 AICA Seedstock Producer of the Year.

Jerry Allen Burner, Trio Farms Inc., Luray, Virginia. Nominated by the Virginia Beef Cattle Improvement Association. Been in the cattle business for 30 years and had a 130 cow Simmental herd since 1971. Has performance tested for 18 years. Weaning weights have increased an average of 113 pounds in 12 years. Produced two bulls which are being marketed nationally. Uses EPD's in selection of both bulls and heifers. County Chairman of FMHA; Director of Page County Farm Bureau; past-Director of the Page County Agricultural and Industrial Fair; Coach of Page County 4-H Livestock Judging team; Director Virginia Beef Cattle Improvement Association; Director of Seedstock Council; Director on the Virginia Beef Industry Board; 1986 Virginia Farm Bureau Virginia Young Farmer of the Year Award.

Glynn Debter, Debter Hereford Farm, Horton, Alabama. Nominated by Alabama Beef Cattle Improvement Association. Forty-one years in the seedstock business with a herd of 265 Hereford cows. Twenty-six years of performance records are used to evaluate each animal's performance. Top-producing cows are used in an embryo transfer program to multiply progeny of proven cows. An on-farm bull testing program is used to evaluate all but a few bulls that go to central test stations for evaluation under different conditions. Alabama Seedstock Producer of the year 1988; Alabama State Farmer Award 1948; American Farmer Award 1952; Alabama Agri-Business Man of the Year 1980; director of Alabama Beef Cattle Improvement Association; director of Alabama Purebred Beef Council; director of Alabama Hereford Association; President of Alabama Hereford Association; lifetime Director of Alabama Cattlemen's Association; President of American Hereford Association.

Sherm & Charlie Ewing, SN Ranch Ltd., Claresholm, Alberta. Nominated by Beefbooster Cattle Alberta Ltd. Fifteen years in the seedstock business with 500-cow Beefbooster M4 strain. The M4 strain is a composite of breeds including Limousin, Gelbvieh, Romagnola and South Devon with a Hereford, Red Angus and Beefmaster base. Bulls are performance tested at Beefbooster Test Station. Weaning weights have increased 227 pounds in 33 years and fertility has jumped from 80-85% with a 60 day breeding season to 91-93% with a 45 day breeding season. Sherm was a founding member of the Alberta Beef Cattle Performance Association and the North American Limousin Foundation. Both Sherm and Charlie are foundation breeders for Beefbooster Cattle Alberta Ltd.

Donald Fawcett, Green Valley Gelbvieh, Ree Heights, South Dakota. Nominated by South Dakota Beef Cattle Improvement Association. Ranching business for 23 years and producing Gelbvieh seedstock for the past 15 years. Herd consists of 400 registered and 100 commercial cows. Uses A.I., individual performance records and sire summary information to maximize genetic progress. Weaning weights have increased 140 pounds and yearling weights have increased 300 pounds over the past 14 years. Seedstock are currently merchandised by private treaty. Past director and vice-president of both the South Dakota Gelbvieh Association and American Gelbvieh Association; received Premier Promoter Award from AGA in 1983. South Dakota Beef Cattle Improvement Association Seedstock Producer of the Year, 1988 and Hand County Crop and Livestock Association, Outstanding Livestock Producer Award, 1981.

Orrin Hart, Willabar Ranch Ltd., Claresholm, Alberta, Canada. Nominated by Canadian Advisory Board for Beef Cattle Improvement. Angus Seedstock producer for 47 years with a breeding herd of 220 females. Using A.I., the best bulls in the Angus breed are selected and embryo transfer is used on cows that have proven their ability to perform . Has been on a performance testing program for 30 years. Selected bulls are placed on off farm bull test for performance testing before sold. Served as President of both Alberta Cattle Breeders and Southern Alberta Cattle Breeders Associations; leader of Claresholm 4-H Beef Club for 10 years; winner of the Alberta Beef Cattle Performance Award in 1988; 1988 Outstanding Beef Producer in the Canadian Beef Cattle Performance Awards.

Leonard A. Lorenzen (deceased), Lorenzen Ranches Inc., Pendleton, Oregon. Nominated by Oregon Cattleman's Association. Lorenzen Ranches has been in the seedstock business for 30 years. One-half of the herd is Red Angus with the remainder being a composite animal comprised of Red Angus, Simmental and Salers. Central test stations were used until numbers made it practical to have an on-farm testing program. Yearling weights have increased 110 pounds in heifers and 125 pounds in bulls, through judicious use of sire summary information, A.I. and embryo transfer. Carcass evaluation is an important tool at Lorenzen Ranches. Director and President of Red Angus Breeders of the Northwest; National director Red Angus Association of America; member board of directors Pacific International Livestock Exposition; 1987 Red Angus Association of America Outstanding Breeder of the Year.

Kenneth D. Lowe, Oak Hollow, Smiths Grove, Kentucky. Nominated by Warren County Cattle Association. Seedstock producer for 10 years with a herd of 130 cows. Uses mainly Angus but in 1988 added a select herd of Gelbvieh cattle. Addition of Gelbvieh Seedstock was done so that previous customers could get fullest benefit from the strong maternal influence the Oak Hollow bulls have already left in their herd. Uses embryo transfer to get a herdsire from an elite proven cow and a proven sire with limited semen. Kenneth is a strong believer in the use of EPD's. Bulls are sold off the farm and buyers are given EPD's for birth weight, weaning weight, yearling weight, milk and combined maternal on the individual and his sire and dam. Director of South Central Kentucky Angus Association and Outstanding Young Farmer Award from Warren County Jaycees.

Tom Mercer, Paintrock Angus Ranch Inc., Hyattville, Wyoming. Nominated by the Wyoming Beef Cattle Improvement Association. Forty years ih the seedstock business with 200 Black Angus, 30 Red Angus and a herd of 150 commercial cows which is being turned into a Salers herd. Goals include production of sound performance-oriented, structurally correct cattle for the surrounding environment. A member of the Angus Herd Improvement Record Program since 1969. In the last two years bred heifers and bulls have been marketed through association sales and by private treaty. Served as President, Vice President and Director of the Wyoming Angus Association; President and Vice President of the Northwest Wyoming Angus Association.

Lynn Pelton, Pelton Simmentals, Burdett, Kansas. Nominated by Kansas Livestock Association. Two hundred cow Simmental herd has been producing seedstock for 16 years. American Simmental Association's performance records have been instrumental in the herds increased productivity. With open A.I., the top proven trait leading bulls are used. Selection of replacement heifers is not based strictly on growth. Moderate size females that will calve and milk are chosen. Percent calf crop has been over 100% for several years because of twinning rate and weaning weights have increased about 200 pounds over 16 years. Bulls are sold through private treaty, state association sales and bull test sales. Served as President and Vice President of Kansas Simmental Association.

Lester H. Schafer, Lester H. Schafer & Son, Buffalo Lake, Minnesota. Nominated by University of Minnesota. Thirty-five years in seedstock with a herd of 106 Horned Herefords. Performance testing for 28 years. Been more concerned with a total performance program than large frame or yearling weight. Now producing cows and bulls with low to moderate birth weight, excellent milk production, adequate frame, moderate to high weaning weight. Philosophy has always been that the efficient production is more important than maximum production. Served as Secretary-Treasurer of the Minnesota Hereford Association for 25 years; board of Minnesota Livestock Breeders Association for 15 years; Minnesota Purebred Breeder of the Year in 1988; County Farm Family of the Year 1980; WCCO Radio Good Neighbor Award in 1985; Minnesota Hereford Association Recognition award; service award from Sibley County Fair Board.

Bob R. Whitmire, Whitmire & Sons Angus Farm, Clermont, Georgia. Nominated by Georgia Cattlemen's Association. Been in the Cattle business 17 years and has had a seedstock herd for 5 years. Performance records on 71 Angus cow herd have been handled by AHIR for four years. Since joining AHIR weaning weights have increased 30 to 40% due to better genetics and forage. Conducts on-farm bull evaluations and regularly tests bulls at Central Bull Test Stations. Served as Director of the State Angus Association; Georgia Purebred Cattleman-of-the-Year; County Association Purebred Breeder-of-the-Year; named Conservation Family-of-the-Year in 1987.

1989 COMMERCIAL PRODUCER AWARD NOMINATIONS

Jerry Adamson, Rocking J. Ranch, Cody, Nebraska. Nominated by American Chianina Association. Runs 1,650 Angus-based crossbred cows and 50 purebred Chianina cows on his 104 year old ranch. His ranch has utilized a computer inventory program performance testing and A.I. to increase weaning weights 155 pounds in twenty-one years. Has successfully used bulls purchased from central test stations. Finishes 500 head annually. Markets about 100 bulls per year from their own breeding program. Jerry follows up on the sale of these bulls by helping the buyers market their cattle. Jerry has been a leader in research and marketing lean or "lite" beef. 1955 Nebraska Stock Growers Association Youth of the Year; 1974 Valentine Jaycees Top Rancher in Cherry County; 1976 4-H leader award in beef; 1984 Knights of Ak-Sar-Ben Agriculture Achievement Award.

J.W. Aylor, J.W.Aylor & Son Farm, Madison, Virginia. Nominated by the Virginia BCIA. Forty years in the cattle business with 532 cows and 50 replacement heifers. Have 350 stockers. 50% of cow herd Angus and 50% crossbred. Angus cows bred basically to Limousin bulls, calves of this cross bring additional premium. Angus-Simmental cross breed mainly to Simmental bulls and Charolais cross cows are bred to Angus bulls. Herd bulls used are performance tested and many come out of the Central Bull Test Stations. Major criteria for bull selection is calving ease. Served on board of Culpeper-Madison Feeder Calf Association for 20 years; Orange-Madison Cooperative Board member for 25 years; Second National Bank Advisory Board, 7 years; Madison County Young Farmers, president 2 years, vice president 2 years; 1985 Culpeper Soil and Water Conservation District Conservation Award; State Young Farmer Award, Runner-up; 1989 Virginia Commercial Producer of the Year Award.

Jerry Bailey, Jerry & Linda Bailey Ranch, Towner, North Dakota. Nominated by North Dakota Beef Cattle Improvement Association. Been in the commercial cattle business for 23 years and conducted performance testing for 18. The beef herd is made up of 175 head of Gelbvieh, Simmental and Red Angus cross brood cows. Gelbvieh and Red Angus bulls are used for replacement heifer production and Charolais bulls are used for feeder calf production. Heifers are selected for moderate size, milk and are of breed combinations that maximize hybrid vigor and fertility. Over 18 years adjusted 205 day weights have increased from 473 to 696 pounds and calving season has been shortened to over 90% of the cows calve within 42 days yielding a uniform set of calves.

James G. Guyton, Dutch X Cattle Co., Buffalo, Wyoming. Nominated by the Wyoming Beef Cattle Improvement Association. Runs 500 Angus-Maine Anjou cross cow herd and has been in the commercial cattle business 40 years. Uses A.I., choosing bulls with high EPD's in traits of economic importance such as birth weight and weaning weight. Weaning weights have increased 150 pounds over 16 years and conception rates have increased from 90 to 98%. Heifer and steer calves have been used in breed evaluation and testing programs by the University of Wyoming. Steer calves have also been marketed as club calves. Director of the Wyoming Beef Cattle Improvement Associated; produced many Grand Champion steers at Johnson County Fair and also produced Grand Champion steer at the Wyoming State Fair.

Kent Koostra, Koostra Farms, Bowling Green, Kentucky. Nominated by the Warren County Cattle Association. Been in commercial cattle business 24 years and has been using performance records for 15 years. About 300-400 head of crossbred heifers are bred to Angus, Brangus or Beefmaster bulls and then are marketed to other producers for beef herd replacements. A computer is used to help keep performance records. Feeder calves are bought at an average weight of 400 pounds and then sold to feedlots at 750 pounds. Kent's farm is a frequent stop for various tours. Vice President of the Warren County Beef Club; member of promotion committee of KBCA; Bowling Green Warren County Chamber of Commerce Outstanding Farmer of the Year 1983; conservation Farmer Award 1982; Rural Leadership award KYFA, 1979.

Ralph G. Lovelady, Lovelady Farms, Randolph, Alabama. Nominated by the Alabama Beef Cattle Improvement Association. Lovelady Farms has been in the commercial cattle business 38 years. The 200-cow herd consists of Angus, Hereford, Holstein, Brown Swiss and Simmental crosses. These cows are bred naturally to Simmental bulls. All herd bulls being used at the present time are sired by trait leaders in weaning weight, yearling weight and maternal ability. Adjusted 205 day weights have increased 82 pounds since joining the Alabama BCIA in 1981. President Chilton County BCIA for past 6 years; current vice president, board member and past treasurer of the Alabama BCIA; Top Farm Family, Centerville Kiwanis Club; Farm Family of the Year, Farm/City Week; Father of the Year Chilton County Cattle Women.

Thomas McAvoy, Jr., Quaker Springs Farm, Washington, Georgia. Nominated by Georgia Cattlemen's Association/Bull Test Committee. Fifteen years in the commercial cattle business. Has been performance testing 150 cow herd for 6 years. Young heifers and cows are bred to Angus or Brangus bulls for small birth weights which means easy calving. Angus, Charolais, Simmental bulls are used on the rest of the Angus crossbred brood cow herd, to produce the desired replacement females and the type of calf buyers prefer. Herd sires are bought at performance tested sales. Wilkes County Commercial Cattleman of the Year 1987 through 1989.

Bill Salton, Salton S7 Inc., Ruthven, Iowa. Nominated by the Iowa Cattlemen's Association. Commercial cattleman for 35 years. Most of the animals in the 404 cow herd are Simmental, Charolais and Angus Crosses, there is some experimentation with other breeds using A.I. but not in large numbers. Best cows are bred A.I. and best performing bull calves are saved to use in herd. Has been measuring performance and carcass quality in the herd for over 20 years. About 100 percent of the calf crop is kept until finishing. Clay County Cattlemen Board of Directors; President of Iowa Forage and Grasslands Council; 1960 Outstanding Young Farmer Award; 1980 Marc Cox Agriculture Conservation Award; 1980 Land O'Lakes Leadership Award; 1980 Kiwanis Outstanding Farmer Agriculture Achievement Award; 1984 Clay County Cattleman of the Year.

Lauren and Mel Shuman, May Ranch, Bridgeville, California. Nominated by Cooperative Extension. Been in the commercial cattle business 13 years. Angus and Polled Hereford sires are emphasized because of their ability to produce quality replacement heifers and highly marketable steers, but Red and Black Brangus bulls are used on first calf heifers for calving ease and hybrid vigor. Cows are culled on the basis of poor fertility, excessive calving interval, or progeny that consistently wean below the herd average. Most bulls purchased since 1979 completed a CBCIA yearling performance test. Calving interval is 90% calved in 60 days and weaning weights have increased 157 pounds in 13 years. Lauren is a board member of the California Beef Cattle Improvement Association and vice-president of the Humboldt County Cattlemen's Association. the Shumans have also won many awards in Commercial Pen classes at the Humboldt County Fair.

Jim Tesher, Jim Tesher Farms, Medora, North Dakota. Nominated by American International Charolais Association. Been in the Commercial cattle business 40 yeas. Jim has used performance records for 20 years. About 20% of the 550 cow herd are Herefords which are bred to Angus and Charolais crosses are all bred to Charolais bulls. Calves are sold to feedlots right off the cow. About 475 stocker cattle are handled annually. Over the last 25 years weaning weights have increased approximately 8 pounds per year. On North Dakota Stockman's Association Advisory Board; North Dakota Commercial Breed Award, 1987; American International Charolais Association Commercial Producer of the Year, 1989.

Joe Thielen, Thielen Farms, Dorrance, Kansas. Nominated by the Kansas Livestock Association. Thielen Farms has been in the commercial cattle business for 18 years. The 400 cow breeding herd is predominantly Simmental based. The sire breeds are Angus, Hereford, Simmental, and Charolais. Operation has expanded to six times its original size since 1971. Weaning weights have increased 170 pounds since 1974. Yearling weights increased more than 250 pounds in the past 12 years. By selecting genetically superior bulls, first calf heifers from these bulls are producing 25% of his replacement females. All replacement heifers are AI'd using synchronization to trait leading bulls for maternal and growth characteristics. The Thielens have cooperated with Kansas State on many projects including steer implant trials, MGA synchronization on heifers and cows, and creep feeding suckling steers. They are 1989 Kansas nominee for BIF Commercial Producer of the Year.

Eugene & Ylene Williams, Circle W. Ranch, Verona, Missouri. Nominated by the Missouri Beef Cattle Improvement Association. Circle W. has been in the commercial battle business for twenty-eight years. Have 150 Angus-Hereford-Simmental cross cows and calve both spring and fall. Angus bulls, purchased through the tested bull sales, are currently used. Performance testing began in 1981. Originally backgrounded calves sold at 16 to 17 months of age weighting 750 to 800 pounds, now selling the same weight but the calves are about 12 months old. Eugene serves on the Missouri Southwest Center's Advisory Board; the Western Missouri Steer Feedout committee; is secretary-treasurer of the Lawrence County Cattlemen's Association; on board of the Missouri Cattlemen's Association and received that group's Cattleman of the Year award in 1986. Ylene has served as Missouri Cow Belles board member and Chairman of the State Beef Cookoff and received the Cowbelle of the Year award in 1986.

BIF SEEDSTOCK PRODUCER OF THE YEAR

Glynn Debter

Mr. Glynn Debter, Debter Hereford Farm of Horton, Alabama received the 1989 Seedstock Producer of the Year Award at the Beef Improvement Federation Convention in Nashville, Tennessee.

Debter, a breeder of registered Hereford cattle since 1948, began with two bred heifers, a planned breeding and merchandizing program and a desire to produce functional, efficient Herefords cattle. Debter Hereford Farm has grown to 265 registered cows and 100 commercial cows that must meet strict performance standards to stay in the Debter program.

Individual performance records have been kept on all cows and calves for 25 years. Debter's complete performance program mandates that as much data be collected as possible and used objectively to breed an elite set of functional Hereford cattle.

Because performance records have always been important to Debter Farm, Glynn has given more attention to sire evaluation and cattle evaluation during the past six years. Cattle evaluation and EPD comparisons for objective performance traits are primary considerations in the Debter selection and culling program. He is recognized as a leader in the American Hereford Association's Total Performance Records Program.

In addition to being a dedicated cattleman, he has served his industry in an unselfish manner promoting the beef industry whenever and wherever possible. Debter is currently serving as president of the American Hereford Association and 2 vice President of the Alabama Cattlemen's Association, the largest state cattlemen's association in the world.

(left to right) Robert McGuire, Glynn and Bobbie Debter, Bob Dickinson.

Glynn Debter is active in community and county affairs. He is a director of Community Bank of Snead, Alabama, Chairman of the livestock committee of the Blount County Agribusiness Center and lends support to youth programs whenever possible. Field days and judging contest are yearly events at Debter Hereford's. Glynn's wife, sons and parents play an important role in the day to day family operated business.

Debter was nominated by the Alabama Beef Cattle Improvement Association.

BIF COMMERCIAL PRODUCER OF THE YEAR

Jerry Adamson

Mr. Jerry Adamson, Rocking J. Ranch, of Cody, Nebraska is the 1989 Beef Improvement Federation Commercial Producer of the year. Adamson received this recognition at the 1989 Beef Improvement Federation Convention in Nashville, Tennessee.

Adamson, his wife Deloris and two sons live on the 104-year-old family owned Rocking J. Ranch in Cherry County, Nebraska. They purchased the ranch from the family in 1966 and under their progressive management the ranch has grown to 16,278 acres (7,000 are leased). The cow herd has more than doubled and through the years has evolved from a straight-bred English breed program to an English cross-breeding program, to the present multibreed cross-breeding program.

The Adamsons raise lean, high quality beef from the Sandhills of Nebraska. Their use of crossbreeding, performance records, innovative management techniques and their unique marketing approach has allowed them to survive and prosper for the past 21 years.

The 1,650-cow outfit is Angus-based with Chianina, Simmental, and Maine-Anjou bulls used for herd sires. A herd of 50 purebred Chianina are kept to raise their own bulls. Seven years ago they began an annual commercial bull sale, offering nearly 100 bulls from their own breeding program. The bulls are all performance tested on the ranch and sell with complete performance records.

(left to right) Bob Dickinson, Jerry and Deloris Adamson.

Each year the records have improved and so have prices. Almost 90 percent of the bulls stay within 100 miles of home. Jerry follows up on his sales by helping each of his bull buyers market their cattle. Many of these cattle sell through brand labeled beef companies featuring lean or light beef. (Jerry furnished part of the cattle for the first light beef research conducted in the United States.)

The Adamsons have recently shipped breeding cattle to Equador and Costa Rica.

Jerry and Deloris have four children, Tracy, Todd, Taylor and Tanya. All the children were active in 4-H work, junior and collegiate rodeo, and showing beef cattle. They all exhibited grand champions at Ak-Sar-Ben (the world's largest 4-H show) and they all have been rodeo champions.

Jerry speaks to many civic, 4-H and FFA chapters across the country. Jerry and Deloris also host many of their operation.

Adamson was nominated by the American Chianina Association.

1989 PIONEER AWARD

Roy Beeby

Roy Beeby, a registered Red Angus breeder from Marshall, Oklahoma, is the winner of the Pioneer Cattle Breeder Award for 1989 from the Beef Improvement Federation. The award was presented during the Beef Improvement Federation meeting in Nashville, Tennessee, to Beeby for his pioneering work in performance records and his improvement of the Red Angus breed.

Beeby, whose name is synonymous with beef cattle improvement, is a graduate of Oklahoma State University, Stillwater, Oklahoma. He took over operation of the family farm near Marshall in 1955 after the death of his father. His first cattle were purchased from Mrs. Sally Forbes, owner of Beckton Farm, Sheridan, Wyoming, the first registered Red Angus herd in the nation.

These foundation cows were shipped to Marshall by train during a sever drought, and Beeby received considerable criticism from old timers in the area. The entire 45 head plus transportation cost a little over $5000. Five years later in 1961, he shipped 30 cows by train back to Spokan, Washington, for $30,000. Since that time, Beeby has sold Red Angus to every state west of the Mississippi, and most of the eastern states as well as to Canada, Mexico, South Africa and Honduras.

Bob Dickinson on the left, and Roy Beeby.

He was elected President of the Red Angus Association of America in 1981, and served on the board of directors various times since 1958 for a total of 11 years. During that time he served as 1st and 2nd Vice-President as well as on the building committee for the national headquarters office building in Denton, Texas. Beeby is also a past director and President of Performance Registry International. He was chosen for the Red Angus Distinguished Service Award. The following year, 1984, he was awarded the Personality of the Year Award from the same association. In 1988, he was instrumental in getting the American International Senepol Association together with the Red Angus Association for program registry processing.

He is married to the former Patricia A. Butterfield of Oklahoma City.

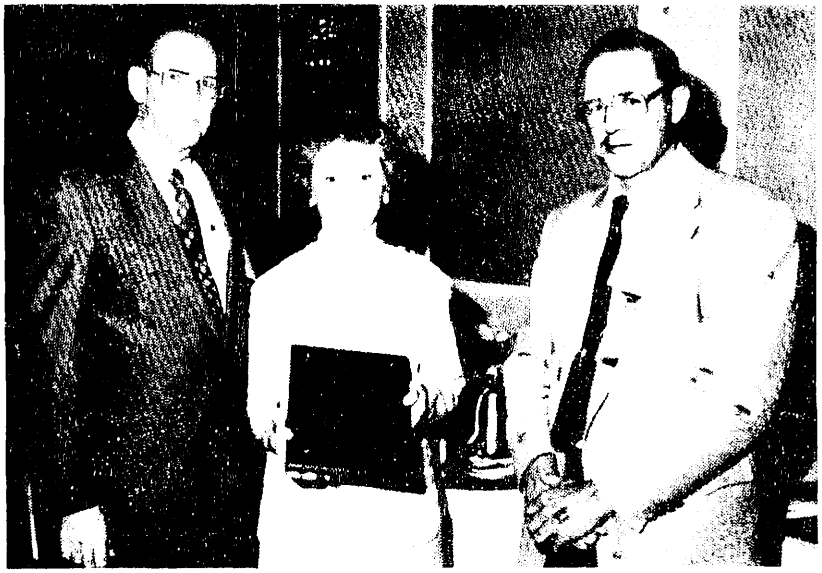
1989 PIONEER AWARD

Will Butts

Will T. Butts, retired USDA-ARS research leader, is winner of the 1989 BIF Pioneer award presented at the 1989 Beef Improvement Federation Convention in Nashville, Tennessee.

Butts was born and raised on a middle Tennessee farm. Following graduation from high school he enlisted in the U.S. Army Air Corps and became a fighter pilot. When he flew his earliest flight he was the youngest fighter pilot in the Eighth Air Force.

After completing his highly decorated military career, for which he received the Distinguished Flying Cross and Air Medal With Eight Oak Leaf Clusters, he enrolled in college at the University of Tennessee where he received his B.S. in Animal Husbandry in 1949 and M.S. in Animal Science in 1951. While working on his M.S. he was an instructor in the Animal Science Department.



(from left to right) Will and Manelle Butts, Bob Dickinson.

Following graduation he and his wife, Manelle, purchased a farm in Davidson county and later was employed by Ralston Purina in sales. He returned to the University of Tennessee and received his PhD in Animal Breeding in 1963. He went to work for the USDA-ARS as a research leader in beef cattle breeding. He was headquartered at Knoxville, Tennessee, and later at Brooksville, Florida. While located at Knoxville Tennessee he served as an adjunct professor in the Animal Science Department at the University of Tennessee and served on numerous graduate student committees.

Butts was one of the pioneer members of the Beef Improvement Federation and helped write the first guidelines. He has published over 60 scientific articles in the last 10 years. He also has served on the advisory board of the Journal of Animal Science Breeding and Genetic Section. Dr. Butts' major research has been involved in genetics by environment interaction studies, evaluation of feeder cattle into predictive slaughter outcome groups and evaluating the relationships between cow size and total efficiency of cow/calf pairs.

He recently retired from USDA-ARS at Brooksville, Florida, and he and his wife now reside in Knoxville, Tennessee.

1989 PIONEER AWARD

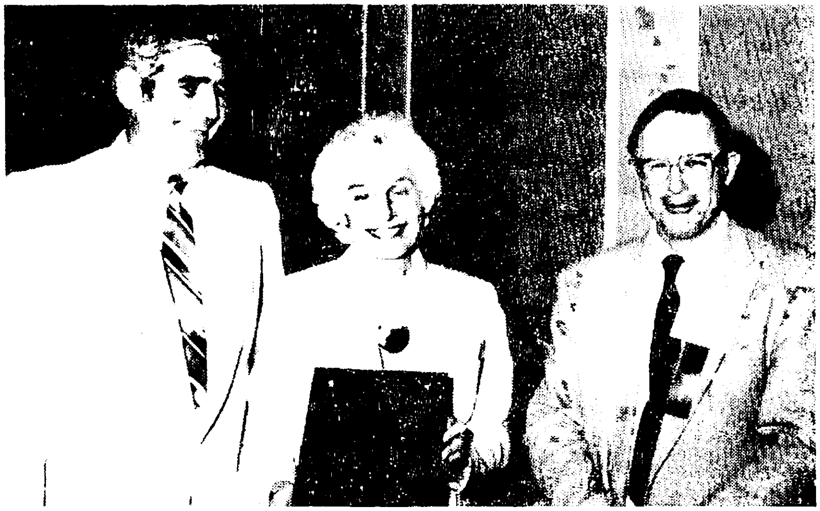
John W. Massey

John W. Massey, professor of Animal Science at the University of Missouri-Columbia, is winner of the 1989 BIF Pioneer Award presented at the 1989 Beef Improvement Federation Convention in Nashville, Tennessee.

Massey, who was born on a livestock farm in Laclede County Missouri, near Lebanon, was honored for his pioneering work in beef cattle performance testing that produced dramatic results for the cattle breeders of Missouri.

Massey's leadership has resulted in a nationally known beef cattle performance testing program. The performance testing program has gained national recognition and was chosen this year as one of four extension programs in Missouri to be submitted to the federal extension service as an example of a state impact program. Since it began in the early 1960's, 120,000 bulls have been tested with a 120-pound improvement in weaning weight and a 300-pound improvement in yearling weight. It is estimated that the improvement of beef cattle weaning weights alone over the past 10 years has added $25 million annual gross to Missouri's economy. Massey is one of the originators of the beef cattle "frame score". The adjustment coefficients for linear measurements in postweaning beef cattle were developed at Missouri.

John Massey was active in FFA and 4-H, and helped with the cropping and livestock system on his father's farm. After graduation from high school Dr. Massey spent four years as a medical supervisor in the Air Force from 1951-54. He obtained the degrees of BS, MS, and PhD at the University of Missouri in 1956, 1957, and 1960 respectively. In March of 1960 he became executive editor of the American Livestock Journal (formerly Breeder Gazette), a national publication and joined the Missouri Extension Division as Area Livestock Specialist in 1961. His expertise was soon recognized and he was appointed as a State Livestock Specialist in February of 1963, where he remained since.



(left to right) John W. and Janet Massey, Bob Dickinson.

Dr. Massey's major responsibility is to provide leadership and coordination in livestock improvement programs with area extension specialists and producers in the area of selection for genetic superiority and reproductive efficiency.

During the past 10 years, he served on several national and regional committees in addition to state committees to improve the genetic merit and reproductive efficiency of beef cattle.

The past 20 years Massey has judged from one to ten different breed shows annually at State Fairs, American Royal, National Beef Expo, or Breed type conferences. He has judged most all of the major breeds of cattle at the various shows.

He and his wife, Janet, reside on a beef cattle and grain farm. They have a purebred Simmental and a commercial beef cow herd and feed out all progeny to slaughter weight.

They have two married children.

1989 BIF AMBASSADOR AWARD

Forrest Bassford

Forrest Bassford, a 59-year veteran of livestock publishing was awarded the 1989 BIF Ambassador Award at the recent Beef Improvement Federation Convention in Nashville, Tennessee.

Probably best known as the long time editor and publisher of the Western Livestock Journal, Bassford joined the publication 1948. He later became part owner of the publication until he retired from the business and sold his interest in 1977 when he was 71 years old.

Bassford and his wife moved into retirement at Encinitas, California, in 1978, soon after Bassford was elected executive director of the Livestock Publications Council, an organization he helped found in 1974, and of which he had served as secretary-treasurer. Under his leadership the council grew from the original 19 members to 100 livestock publications and 36 associate members in Canada and the United States. He produces the organization's monthly newsletter, Actiongram, as well as handles their correspondence and finances.

The Ambassador Award winner has observed and reported on beef cattle performance work, and the people involved from pioneering days until the present. He was an observer at the meeting in Denver, called by Colorado's Ferry Carpenter, that gave birth to the Beef Improvement Federation. That organization later honored him with its Pioneer Award in 1976.

Born in Oklahoma Territory in 1902, near the town of Canton, Bassford grew up on family livestock farms in Oklahoma, Texas and Wyoming. He graduated from Torrington, Wyoming high school a member of that school's first Vo-Ag class. He earned an Animal Husbandry degree in 1929 from Colorado State University. He began his publishing career early as business manager for the college annual and the weekly Rocky Mountain Collegian and was college news and sports reporter for the Fort Collins Express-Courier, Denver Post and the wire services.

Forrest Bassford, on the left, and Bob Dickinson.

After graduation he worked as county agent in Junesburg, Colorado, edited the Brush (Colorado) News, served as field representative for the Denver Daily Record Stockman and then he joined the Hereford Journal in 1934 at the height of the dust bowl and depth of the depression. In 1940 he returned to the Denver Daily Record Stockman to establish their editorial policy and supervise the field staff.

Bassford was married in 1929 to Marian L. Horton, a high school home economics teacher. He turned down a job that year because he and Marian were afraid it would keep him away from home 25 percent of the time. Eventually publication work kept him away from home up to 50 percent of the time, Bassford said.

1989 BIF CONTINUING SERVICE AWARD

Roger McCraw

Dr. Roger McCraw, Associate Professor of Animal Science at North Carolina State University, was honored with a Continuing Service Award presented at the 1989 Beef Improvement Federation Convention in Nashville, Tennessee.

Roger was born and raised on a Carroll County, Virginia farm that consisted of beef, dairy, apple and peach enterprises. He is honored for his service as Executive Director of the Beef Improvement Federation for the past three years. In his own quiet, unassuming style Roger has been the guiding force in making things happen within the BIF organization.

After high school Roger obtained B.S. and M.S.degrees from Virginia Polytechnic Institute and State University. While earning his M.S. degree in Agricultural Education he also taught Vocational Agriculture in Galaz, Virginia. Upon completion of the first M.S. degree he became interested in Animal Breeding and Genetics. With this interest he entered North Carolina State University and received M.S. and PhD degrees in Animal Genetics in 1977 and 1980, respectively. He has remained at North Carolina State University doing beef cattle extension and research work.

(left to right) Bob Dickinson, Phyllis and Roger McCraw.

Roger has served on many BIF committees through the years along with serving as Eastern Regional Secretary for BIF prior to becoming Executive Director. He is dedicated along with being diligent.

He is an active member in many professional organizations; such as, American Society of Animal Science, American Dairy Science Association; Gamma Sigma Delta, Epsilon Sigma Phi, and others.

Roger and his wife Phyllis are proud parents of a son, Jonathan, age 9 and a daughter, Jennifer, age 7.

BIF thanks Roger for splendid past service and looks forward to continued service in the future.

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